Bullion, bills and arbitrage: exchange markets in fourteenth- to seventeenth-century Europe

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Declaration

I certify that the thesis I have presented for examination for the PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I declare that my thesis consists of 68,468 words.

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Abstract

Two drawbacks of current empirical studies on late medieval financial market integration are: the use of low frequency data; and the lack of a benchmark for comparison. As a result, there is a tendency to underestimate the degree of integration and one has no clear idea about whether the estimated degree of integration is high or low by the standards of the time. Consequently, there is not yet a satisfactory answer as to how integrated and efficient financial markets were in the late Middle Ages and early modern era.

In tackling these two problems, this thesis employs monthly and weekly exchange rates to measure the degree of exchange market integration and the results are judged using the speed of communication as a benchmark since the flow of information played a critical role in financial arbitrage.

Therefore, this thesis is able to show that exchange markets were already well integrated in the late fourteenth century. From then to the late seventeenth century, the high speed of adjustment to profitable opportunities was maintained, but the transaction costs associated with arbitrage fell over time. The reduction in transaction cost may be attributed to the financial innovations that took place in the sixteenth century. This thesis also finds that the type of information related to shocks received by economic agents had a decisive impact on the speed of price adjustment. The more explicit the information, the more efficiently the market responded to shocks.

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Introduction

Markets are critical to economic growth. As claimed by Smithian growth theory, markets encourage the division of labour and specialization.[1] Furthermore, markets bridge demand and supply and thus allocate resources to their most desirable use. Compared with other factors, such as investment and technology, markets played an even more important role in economic development in the early modern era, when the economy was dominated by agriculture and manufacture operated on a small scale often under the control of guilds. In markets, surpluses could be sold, demand for various commodities satisfied, and people could obtain signals for their production and consumption decisions. The ability of markets to encourage economic development greatly depended on the degree of their integration and efficiency. An integrated and efficient market fostered competition, provided better signals for production and consumption decisions and improved the security of supply.

While the connection between market integration and economic development is widely acknowledged, research on market integration in the last two decades has become one of the major interests in economic history.[2] Among various commodities, grain has received particular attention. Grain, which was the most important commodity in the early modern era, has always been sold, bought and consumed. Furthermore, the prices for grain, owing to their importance, have been better recorded and preserved than those for other commodities. The availability of price data allows quantitative analyses of grain market integration. However, the analyses of grain prices have not so far led to a generally accepted picture of the way in which integration developed in the early modern period.[3] Although the results

[1] M. Kelly, 'The dynamics of Smithian growth', *Quarterly Journal of Economics* 112 (1997), pp. 939-64.
[2] Federico has provided a thorough survey of the study on market integration and the problems involved with its measurements. G. Federico, 'How much do we know about market integration in Europe?', *Economic History Review*, 65 (2012), pp. 470-97.
[3] Ibid, pp. 473-4.

exhibit, on average, a similar trend over time – markets were well integrated in Europe in the early sixteenth century as in the late eighteenth century, but suffered from disintegration in between these periods – the development of the degree of integration varied cross countries.[4] Furthermore, the degree of integration is susceptible to non-market factors, such as climate change and geographical differences.[5]

The other strand of study in market integration is to look at financial markets. Financial markets bridge credit seekers and those searching for investments and are the means by which capital moves towards the most productive use. In addition, financial markets come close to satisfying the conditions of arbitrage and provide a better ground from which to study market integration and efficiency than does the grain market. The historical data on grain prices, particularly those of the early modern period, do not distinguish between different qualities and strains of this product. The heterogeneous characteristics of grains may bias results: price differentials could have resulted from different qualities as well as arbitrage opportunities. However, financial markets trade in homogeneous goods; for example, every share of the East India Company is identical with every other. Furthermore, transaction costs, which trigger arbitrage, when associated with financial markets are lower than for grain markets. As a result, the degree of market integration and efficiency can be examined more effectively in financial markets, while high transaction costs may prevent price adjustments between grain markets.[6]

In the medieval and early modern eras, grain prices were unlikely to have been market outcomes; instead, they were largely affected and partially decided by regulation, local custom and political elements.[7] In addition, climatic conditions

[4] V. N. Bateman, 'The evolution of markets in early modern Europe, 1350-1800: a study of wheat prices', *Economic History Review*, 64 (2001), pp. 447-74.

[5] R. Studer, 'Does trade explain Europe's rise? Geography, market size and economic development', Working Paper 129/09, London School of Economics, Economic History Department, 2009; U. Pfister, M. Uebele and H. Albers, 'The great moderation of grain price volatility: market integration vs. climatic change, Germany, seventeenth to nineteenth centuries', Working paper, University of Muenster, 2011.

[6] In the case of high transaction cost, one cannot tell whether the failure of the price series to exhibit co-integration and co-movement indicates poor integration and inefficiency or results from the lack of trade between markets.

[7] M. C. Howell, *Commerce before Capitalism in Europe, 1300-1600* (Cambridge University Press, 2010), pp. 8-11; M. A. Aliosio, 'A test case for regional market integration? The grain trade between Malta and Sicily in the late Middle Ages', in L. Armstrong, I. Elbl and M. Elbl, (eds.), *Money, Markets,*

could synchronically affect grain prices in neighbouring markets. Although regulations and interventions over the charging of interest, the movement of bullion and foreign exchange were widely observed in medieval and early modern Europe,[8] the prices of financial goods were, more or less, the outcome of market mechanism.[9]

Perhaps owing to the availability of data, most studies examine market development, both in commodities and finance, only from the eighteenth century onwards.[10] Recently, by analysing the difference between the nominal exchange rates of currencies and their mint parity, scholars have extended the quantitative study of financial market integration back to the late medieval and early modern period.[11] They reveal that though progress in integration was noticed in the early sixteenth century, financial markets in fourteenth-to-sixteenth century Europe took quite a long time (approximately one year) to adjust. However, these findings are based on low-frequency, i.e. annual, data,[12] and do not provide a benchmark for

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and Trade in Late medieval Europe: Essay in Honour of John H. A. Munro (Boston, 2007), pp. 297-309.

[8] P. Einzig, *The History of Foreign Exchange* (London, 1962), pp. 101-10, 155-68; J. H. Munro, 'Bullionism and the bill of exchange in England, 1272-1663: A study in monetary management and popular prejudice', in *The Dawn of Modern Banking*, ed. by the Center for Medieval and Renaissance Studies, (New Haven, 1979), pp.169-240; idem, 'Usury, Calvinism, and credit in Protestant England: from the sixteenth century to the industrial Revolution', Working paper 439, Department of Economics, University of Toronto, 2011; idem, 'The medieval origins of the financial revolution: usury, rentes, and negotiability', *The International History Review*, 25 (2003), pp. 505-62; R. de Roover, *Money, Banking and Credit in Medieval Bruges: Italian Merchant-Bankers, Lombards and Money-Changer– A Study in the Origins of Banking* (Cambridge, 1948), pp. 76-81; F. Edler, 'The effect of the financial measures of Charles V on the commerce of Antwerp, 1539-42', *Revue Belge de Philologie et d'histoire*, 16 (1937), pp. 665-73.

[9] H. Miskimin, 'The enforcement of Gresham's Law', in *Cash, Credit and Crisis in Europe, 1300-1600* (London, 1989), Chapter IX, pp. 147-161; P. Mirowski, 'The rise (and retreat) of a market: English joint stock shares in the eighteenth century', *Journal of Economic History*, 41 (1981), pp. 559-77. However, some research shows that political conflicts and events could have had an impact on the performance of financial markets; see B. G. Carruthers, *City of Capital: Politics and Markets in the English Financial Revolution* (Princeton University Press, 1996); P. Mirowski, 'What do markets do? Efficiency tests of the 18th-century London stock market', *Explorations in Economic History*, 24 (1987), pp. 107-29.

[10] For the literature on commodity market, see Federico, 'Market integration in Europe'; studies on the financial market are discussed in Chapter 1 below.

[11] O. Volckart and N. Wolf, 'Estimating financial integration in the Middle Ages: what can we learn from a TAR model', *Journal of Economic History*, 66 (2006), p. 122-39; P. Bernholz and P. Kugler, 'Financial market integration in the early modern period in Spain: results from a threshold error correction model', Working Paper (2008); P. Kugler, 'Financial market integration in late medieval Europe: results from a threshold error correction model for the Rhinegulden and Basle pound 1365-1426', Working Paper (2009); D. Chilosi and O. Volckart, 'Money, states, and empire: financial integration and institutional change in central Europe, 1400-1520', *Journal of Economic History*, 71 (2011), pp. 762-91.

[12] Volckart and Wolf use quarterly data to estimate the speed of adjustment for Flanders-Lübeck exchange 1403-23, and find a similar result as that on the basis of annual data. Volckart and Wolf, 'Estimating financial integration', pp. 135-6.

judging whether the degree of integration, in terms of the speed of adjustment, was high or low *by the standards of the time*. Therefore, it is difficult to identify whether the great length of adjustment is due to the use of annual data, which probably gives upwardly biased results;[13] or reflects technological determinants of integration in the contemporary conditions, e.g. the speed of transportation and communication; or indicates genuinely poor market integration.

Because of these two problems, research has not yet offered a satisfactory assessment of the integration and efficiency of financial markets in the late Middle Ages and early modern era, nor of what factors determined the degree of integration and efficiency and whether later financial innovations had any impact on them. In order to answer these questions and to show long-term development, this thesis employs foreign exchange rates, which enable us to construct a high-frequency dataset, with, for example, monthly and weekly entries, to estimate the degree of financial market integration and efficiency in late medieval and early modern Europe. Moreover, the thesis takes the contemporary speed of communication as a benchmark by which to judge market performances, since the flow of information was crucial to financial arbitrage. Its approach is to examine market integration by looking at the effectiveness of triangular arbitrage on foreign exchange rates, and market efficiency by analysing how quickly foreign exchange markets reacted to monetary alterations. These issues together help to address the main research theme of this thesis: how financial markets performed in the late medieval and early modern eras in terms of integration and efficiency.

Unlike other trade, the cost of transport represented only a very small part of the total transaction costs associated with foreign exchange dealings which largely occurred through bills of exchange. The results derived from investigating exchange markets provide us with the maximum level of integration that markets could have achieved in such circumstances. This does not mean that exchange markets were invulnerable to the prevailing threats faced by other markets at the time. On the contrary, the study of exchange markets helps us to focus on another equally, if not more, important element in determining the degree of integration: the information

[13] Federico, 'Market integration in Europe', p. 487.

process. The capacity for arbitrage on exchange rates greatly depended on communications and the flow of information. To survive and even profit from the hazardous and volatile business environment of the late medieval and early modern eras, information had to be swiftly exchanged, gathered and analysed, business decisions made carefully, and capital moved promptly according to the state of the market. The degree of exchange market integration reveals crucial insights into the speed at which markets responded to changes/shocks, on the basis of speed of communication and the transmission of information.

This thesis finds that financial markets, as far as the foreign exchange market is concerned, were already fairly well integrated around 1400, in terms of their speed of communication; and their capacity for arbitrage was effective to adjust exchange rates and bring markets back to equilibrium. Looking at long-term developments, the degree of market integration in terms of contemporary communications remained little changed from the late fourteenth century to the late seventeenth century, but the transaction costs associated with arbitrage on foreign exchange declined greatly, possibly due to the financial innovations developed in the sixteenth century: discountability, negotiability and the endorsement of foreign bills, regular publication of exchange rates, and the establishment of public banks in handling bills of exchange.[14] Moreover, the thesis shows that exchange market integration was temporarily hampered by warfare and monetary alterations. Even in the short term, market integration was disturbed by warfare which led to high transaction costs and interrupted trade. The effect of monetary alterations on market integration largely depended on whether information was implicit or explicit. When information about monetary alteration was implicit and required some time to process, exchange markets could not adjust efficiently and a long interval elapsed before the restoration of equilibrium. In contrast, exchange rates adjusted efficiently if information was explicit. The flow and quality of information critically determined the degree of financial market integration and efficiency in the period under survey.

[14] L. Neal, *The Rise of Financial Capitalism: International Capital Markets in the Age of Reason* (Cambridge University Press, 1990), pp. 1-43; S. Quinn and W. Roberds, 'An economic explanation of the early bank of Amsterdam, debasement, bills of exchange and the emergence of the first central bank', Federal Reserve Bank of Atlanta's working paper 2006-13, 2006.

Methods and sources

In order to quantitatively address the research questions, the thesis is divided into three sub-periods: 1395-1410, 1537-68 and 1668-80. The choice of period is, to a great extent, data-driven, but still each period reflects different stages of the development of foreign exchange markets and the political and economic situations of the time. Except for those that appear in the fragmentarily surviving seventeenth-century price currents,[15] mercantile documents such as correspondence and merchants' account books and ledgers are the richest source of information about exchange rates before the eighteenth century. Among those preserved, precious few fulfil the time criterion for the periods studied here: the ability to provide a sufficient number of observations to construct high-frequency (at least monthly) data. As a result, this thesis has had to leave the fifteenth century aside in this regard and hope that the discovery of exchange rates in the future can fill in the lacuna.[16]

The dataset used to study foreign exchange markets contains some published series and some new materials collected from the archives. For the late fourteenth century, the thesis employs the published exchange rates extracted from Datini's commercial documents.[17] In contrast with the exchange rates from around 1400, based entirely on a single source, the sixteenth-century series is a new collection of exchange rates compiled from various mercantile documents. Those recorded in the Marescoe-David letters, with the addition of the other two commercial documents, compose the series of exchange rates for the seventeenth century. The collection of sixteenth-century Anglo-Flemish exchange rates is in itself a contribution to the

[15] N. W. Posthumus, *Inquiry into the History of Prices in Holland* (Leiden, 1964); J. J. McCusker and C. Gravesteijn, *The Beginnings of Commercial and Financial Journalism: The Commodity Price Currents, Exchange Rate Currents, and Money Currents of Early Modern Europe* (Amsterdam, 1991).
[16] The exchange rates recorded in the ledgers of the Borromei Company in London and Bruges allow us to construct monthly exchange rates between Bruges and London and Venice and London in 1436-9. But only 46 observations are available for each series, which is insufficient to undertake quantitative analysis in advanced econometric models. G. Biscaro, 'Il banco Filippo Borromei e compagni di Londra', *Archivio storico Lombardo*, XL (1913), pp. 375-80. One can also find the full content of Borromei Company of Bruges of 1438, in the Borromei Bank Research Project: http://www.queenmaryhistoricalresearch.org/roundhouse/default.aspx (the last visit to the website was on 31 July 2012).
[17] R. C. Mueller, *The Venetian Money Market: Banks, Panics, and the Public Debt, 1200-1500* (Baltimore, 1997). The exchange rates quoted in Venice can be found in the Medieval and Early Modern Data Bank (MEMDB), http://www2.scc.rutgers.edu/memdb/index.html (the last visit to the website was on 31 July 2012). The exchange rates of Bruges and Barcelona are reported in R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968), pp. 105-54.

economic history literature, since the dataset allows further exploration into the Anglo-Flemish financial and commercial relationship. These sources are discussed in more detail in the following chapters.

The principal methodology employed in this thesis is to examine the exchange market's integration and efficiency in regard to the concept of the law of one price. There are, according to Federico, four conventional approaches: (1) using the coefficient of variation to examine price dispersion; (2) using the coefficient of correlation to examine the movement of prices between markets; (3) measuring the volatility of the price series; and (4) running co-integration tests to see whether arbitrage operates to bring price differentials back to the equilibrium level after shocks.[18] Because of the nature of foreign exchange markets and the dataset, the co-integration test seems the best approach to the research questions. Two econometric models are employed below to test the co-integration of exchange rates, namely, threshold error correction (TEC) and threshold autoregressive (TAR) models. The speed of adjustment (the length of time required to restore the equilibrium when the law of one price is violated) and the transaction costs associated with adjustment can be measured within the models.

Owing to transaction costs, the law of one price is held as long as the price differentials between two places remain in the band of transaction costs for arbitrage. The TEC model is applied to measure the speed of adjustment of triangular arbitrage, i.e., the speed with which arbitrage closes the gap if the difference between direct-exchange rates and cross-exchange rates via the third place exceeds the transaction cost of arbitrage. The more integrated markets are, the quicker the adjustment will be and thus the shorter the time that the law of one price is violated. In testing market efficiency, the impact of monetary alterations on foreign exchange rates is assessed in the framework of the TAR model. In the early modern period, the exchange rate between two currencies was largely determined by the metallic content of each currency (the mint parity). Exchange rates would adjust after monetary alterations changed the mint parity. The speed of the ensuing adjustment is the measurement of market efficiency. The degree of market

[18] Federico, 'Market integration in Europe', pp. 478-85.

efficiency is measured against two types of monetary alteration to explore how information affects market performance.

Due to slow communications, the estimated speeds of adjustment are deemed to be slow and will appear inefficient by modern standards. In order to properly interpret the results of the estimations, since arbitrage and price adjustment critically depended on the flow of information, the speed of communication in each period is used as a benchmark showing whether the foreign exchange markets in late medieval and early modern Europe were integrated and efficient.

Outline of the chapters

This thesis is composed of three self-contained research papers. Each represents one sub-period of the late medieval and early modern eras and investigates the development of foreign exchange markets in terms of integration and efficiency (Chapters 2, 3 and 4). A contextual chapter (Chapter 1) is included to address some fundamental issues shared by the three papers and illustrates how they together deal with the main theme of this thesis.

Chapter 1. Foreign exchange and market integration in context

This chapter asks what is known about financial market integration in early modern Europe? Before the emergence of modern capital markets, how did merchants finance their international trade? By laying a contextual base for this thesis, Chapter 1 first summarises recent findings about the integration of the early modern financial market. For those unfamiliar with the financial history of this period, it provides a necessary discussion of the dual function of bills of exchange and the international capital market that operated on the basis of them. Moreover, the conception of the law of one price and the definition of market integration and efficiency are elaborated. The general form of the econometric models employed to measure foreign exchange market performance, in terms of integration and efficiency, is presented to reveal the analytical framework. Overall, the purpose of

Chapter 1 is to address some common elements shared by the other three chapters, but these issues are also further explored in the relevant chapters.

Chapter 2. International exchange market integration at the time of Datini

This chapter considers market integration against the backdrop of the great increase in the cost and risk of conducting business in such a hostile environment as fourteenth-century Europe, when warfare and plague were rampant. However, at the same time, with established agents/branches in major trading cities and consequently the widespread use of bills of exchange, it became cheaper and easier to move capital internationally. The two objectives of Chapter 2 are: (1) to re-examine, from the point of view of literature, the integration of financial markets in the late Middle Ages with the help of monthly and weekly exchange rate data extracted from Francesco Datini's mercantile documents; and (2) to assess whether or not the increasing transaction costs and hostile business environment characterising this period resulted in less integrated exchange markets, or whether exchange markets behaved then as they do now, regardless of the huge social, economic and technological differences.

Chapter 3. London-Antwerp exchange markets during the Great Debasement

By using a new dataset of exchange rates, this chapter estimates the efficiency of the London-Antwerp exchange markets against the backdrop of the Great Debasement, 1544-1551. During the Great Debasement, the bullion content of the pound sterling fell by 25 per cent in gold and 83 per cent in silver. For those engaged in foreign trade, this highly disturbing level of monetary change shook confidence in the pound sterling and altered the prices of English goods in foreign markets. Were exchange rates able to adjust soon enough to compensate for the loss of the bullion content of English money and reduce the rising transaction costs caused by the debasement? Chapter 3 reveals how early modern merchants grasped monetary alterations and how exchange rates reflected their perception and knowledge of the relationship between changes in the bullion content of coins and the exchange rates of coins.

Compared to the adjustment made to the currency revaluation in the Habsburg Netherlands, the analysis of the Anglo-Flemish exchange market also sheds light on the relation between the different types of information that circulated in relation to monetary alterations and the speed of adjustment.

Chapter 4. Northern European exchange market integration during the Franco-Dutch war

The cost associated with financial transactions fell and the participation in financial markets increased in the seventeenth century, owing to several financial innovations. How was the performance of the exchange market affected by these developments? The exchange rates between London, Amsterdam and Hamburg are used to examine the effectiveness of triangular arbitrage in northern Europe. The results reveal that exchange markets adjusted at much the same speed, in relation to communication, as had around 1400, but witnessed a remarkable decline in transaction costs. The claim that Amsterdam was the distribution centre of information at the time is quantitatively verified. Furthermore, the dataset also allows investigation into the impact of warfare (the Franco-Dutch war) on market integration.

Chapter One Foreign exchange and market integration in context

1.1 Introduction

As this thesis is a collection of three self-contained papers which thematically relate to the subject of exchange market integration and efficiency, this chapter provides some necessary background and an outline of the fundamental issues shared by the papers and illustrates how they together address the main theme, the performance of exchange markets in terms of integration and efficiency in the late medieval and early modern eras and what were the principal elements that underlay the development.

This chapter discusses existing studies of financial market integration in the early modern period, the credit instruments used by merchants before the emergence of modern financial institutions, and the theoretical and econometric framework in which the analyses are carried out. Section 1.2 summaries what is known about financial market integration in early modern Europe and data and methods on which the study is based. Section 1.3 discusses the role of bills of exchange in financing international trade and how borrowing and lending can be undertaken by this means. Moreover, it establishes the link between the use of bills of exchange and commercial development. Finally, section 1.4 explores the fundamental concept of market integration and the section 1.5 the econometric model employed to analyse and measure the degree of market integration and efficiency. This chapter concludes with a brief summary of these issues.

1.2 Historiography of financial market integration

Due to the availability of data to perform empirical analyses, most research on financial market integration and the efficiency of international arbitrage has concentrated in the markets of London and Amsterdam from the eighteenth century

onwards. From the late sixteenth century, Amsterdam emerged as the commercial and financial centre in northern Europe where various commodities, bills of exchange and stock shares were traded daily in substantial volume. However, the prices of commodities and financial assets were only consistently and continuously preserved from the very end of the seventeenth century.[19] Meanwhile, as a result of the mounting British government bonds issued to meet the need to finance wars, foreign capital growingly flowed into England.[20] Consequently, London and the continental financial centres were drawn closer by the movement of capital. By consulting share prices listed in both London and Amsterdam (*the Course of the Exchange* and *Amsterdamsche Courant*), scholars are able to (1) estimate the degree of market integration and (2) test the efficient market hypothesis for eighteenth-century financial markets in northern Europe.

To counter the argument that the London stock market did not allocate resources properly in the eighteenth century, Mirowski tested the efficient market hypothesis – that share prices would rapidly adjust to any change in the profitability of the company, by regressing share prices on the current and past profit rates of three companies: the London Assurance Company, the Million Bank and the East India Company. His results clearly reveal that, except for the East India Company, the movement of the share prices in the two other firms is statistically significantly

[19] The printed form of exchange rates appeared in some major trading places as early as the 1580s. Not until the 1660s, however, was similar commercial publication adopted in England. John Castaing, a London stockbroker, started to continuously and consistently publish stock prices and exchange rates twice a week (on Tuesday and Friday) from 1697 onwards. R. J. Lothian, 'The internationalization of money and finance and the globalization of financial markets', *Journal of International Money and Finance*, 21 (2002), p. 705. The exchange rates and share prices recorded in Castaing's, *The Course of the Exchange* (London, 1698-1868), can be found in the European State Finance Database website: http://esfdb.websites.bta.com/Database.aspx (the last visit to the website was on 31 July 2012). J. G. van Dillen, 'Effectenkoersen aan de Amsterdam beurs, 1723-1794', *Economische-Historische Jaarboek*, 17 (1931), pp. 1-46; Posthumus, *Inquiry*; J. J. McCusker, *Money and Exchange in Europe and America, 1600-1775: A Handbook* (The University of North Carolina, 1978). For a detailed discussion of these price lists, see Neal, *The Rise of Financial Capitalism*, pp. 20-43; Neal also provides in the Appendix the end-of-month share prices for the Bank of England, the East India Company, South Sea Company and Three Per Cen Consols in the eighteenth century.

[20] The extensive discussion of the presence of Dutch capital in England can be seen in A. Carter, 'Dutch foreign investment, 1738-1800', *Economica*, 20 (1953), pp. 322-40; C. Wilson, 'Dutch investment in eighteenth-century England: A note on yardsticks', *Economic History Review*, 12 (1960), pp. 434-9; P. G. M. Dickson, *The Financial Revolution in England: A Study in the Development of the Public Credit, 1688-1756* (London, 1967), pp. 311-21, 332; H. V. Bowen, 'Investment and empire in the later eighteenth century: East India stockholdings, 1756-1791', *Economic History Review*, 42 (1989), pp. 186-206; J. F. Wright, 'British government borrowing in wartime, 1750-1815', *Economic History Review*, 52 (1999), pp. 355-61.

related to the profitability of each company and indicate that "although the eighteenth-century share market was not perfectly efficient, it did perform its function [of resource allocation] to a significant degree".[21] However, the financial market of eighteenth-century London failed the tests in terms of two other neo-classical theories buttressing the efficient market hypothesis: those of present-value and rational expectation.[22] Under the lens of the neoclassical model, this financial market seems to have behaved inefficiently. Nevertheless, the explanation of the movement of share prices and interest rates in eighteenth-century England probably lies in historical events and its historical setting, which cannot be captured by neoclassical theory; and the role of institutions and politics had a certain influence on market performance.

In terms of measuring financial market integration during this period, Eagly and Smith's study is regarded as a pioneer work from the quantitative perspective. They applied a cross-spectral analysis to measure the strength of domestic and international association in the London financial market. Domestic market integration is measured by the ratios of interest rates implied in the London exchange rates (bill rates) and the yield of the Bank of England and the East India Company, whereas international integration is measured by the ratios of bill rate, the Amsterdam discount rate, and the yield of the Bank of England and the East India Company. The results in this study indicate that London domestic money markets became more integrated by the end of the eighteenth century than in its early decades, in particular after 1773. Yet the markets in London and Amsterdam were already well integrated with each other in the 1730s and the strength of integration increased over time due to the increasing flows of Dutch capital to England. [23]

Neal introduces a more comprehensive approach to investigating the integration of the capital markets among London, Amsterdam, Paris and New York from the eighteenth to the twentieth centuries. His approach, which is to compare prices of

[21] Mirowski, 'The rise of a market', p. 575.
[22] The present-value theory argues that the current price of a share should be equal to the expected income which it generates in the future; and the rational expectation theory indicates that the long-term interest rate is determined by the future expectation of the short-term rate. Mirowski, 'What do markets do?'; P. Mirowski and K. L. Weiller, 'Rates of interest in 18th century England', *Explorations in Economic History*, 27 (1990), pp. 1-28.
[23] R. V. Eagly and V. K. Smith, 'Domestic and international integration of the London money market, 1731-1789', *Journal of Economic History*, 36 (1976), pp. 198-212.

identical stock shares traded at these places, is based on the law of one price which states that, due to the effect of arbitrage, identical goods must have the same price regardless of where they are traded. Consequently, the price difference of identical shares simultaneously traded in many markets can be regarded as an index to measure the degree of market integration. The larger the difference, the less integrated markets are. Neal's estimates suggest that international capital markets were already well-integrated in the mid-eighteenth century, particularly between London and Amsterdam. However, market integration was disrupted by political factors at the end of the century, e.g. the French Revolution and the Napoleonic Wars. The degree of market integration in the nineteenth century remained roughly at the same level as that which had already been achieved in the eighteenth century.[24] Through a closer examination of the integration of stock markets between London and Amsterdam in the eighteenth century, Neal argues that these two capital markets were efficient except for the Amsterdam prices of the English East Indian Company, in that the share prices of the company were more susceptible to political events, and already well integrated from the 1720s onwards and the degree of integration did not show much improvement over the century.[25]

In the framework of common features (trend and cycle) analysis, Dempster et al show that prices of identical shock shares traded both in London and Amsterdam moved in a parallel fashion in both the short and the long run and changes in the London stock market were soon followed by those in Amsterdam. Their finding further confirms Neal's early argument that the capital market integration between London and Amsterdam had existed since the early eighteenth century.[26]

Instead of focusing on stock markets, Schubert examines market integration in terms of the effectiveness of arbitrage in exchange markets. He identifies the average of the percentage deviations of a cross-exchange rate from its direct rate as an arbitrage opportunity. He then shows that most of the deviations are located within

[24] L. Neal, 'Integration of international capital markets: quantitative evidence from the eighteenth to twentieth centuries', *Journal of Economic History*, 45 (1985), pp. 219-226.
[25] L. Neal, 'The integration and efficiency of the London and Amsterdam stock markets in the eighteenth century', *Journal of Economic History*, 47 (1987), pp. 97-115; idem, *The Rise of Financial Capitalism*, pp. 141-165.
[26] G. Dempster, J. M. Wells and D. T. Wills, 'A common-features analysis of Amsterdam and London financial markets during the eighteenth century', *Economic Inquiry*, 38 (2000), pp. 19-33.

the band of transaction costs, indicating that arbitrage worked effectively to exploit profitable opportunities. The degree of effectiveness of arbitrage in the exchange market in London and other European cities was less significant than in Amsterdam and susceptible to the effect of war. Except for periods of war, exchange markets were integrated and efficient in eighteenth-century Europe.[27]

These studies together conclude that, by the 1720s, London and Amsterdam had already become well-integrated and arbitrage operated effectively to adjust any large price differential. In addition to these empirical results, some qualitative evidence also suggests that a high level of financial market integration was already achieved in the turn of the eighteenth century. Two examples are briefly addressed here: one is the emergence of quotations of the rate of short bills on price currents; the other is the extensive information network within the mercantile community.

The London-Amsterdam bill of exchange was quoted both at usance and double usance in the seventeenth century.[28] Compared to these two types of bill, the sight bill was a better instrument for international flows of capital. Perhaps, in order to respond to the rapid increase in English government debts to meet military expenses at the turn of the eighteenth century, investors resorted to using sight bills to move funds across the Channel. Possibly to meet the rising demand for quickly moving capital, the price current began to quote exchange rates at sight in the 1720s. The change in the form of quotation supports arguments for an existing close financial connection between London and Amsterdam in the early eighteenth century.[29]

On the basis of a series of arbitrages taken by Stephen Evance, a London goldsmith-banker, Quinn shows that an extensive business network between London and other continental markets existed in the late seventeenth century, upon which the success of arbitrage pivoted. The exchange rate for the pound sterling was falling in the 1690s and thus it became profitable to export silver to Europe by drawing bills on Amsterdam. Meanwhile, England was involved in a series of Continental wars and needed money to pay the troops in Europe. In providing credit to the English

[27] E. S. Schubert, 'Arbitrage in the foreign exchange markets of London and Amsterdam during the 18th century', *Explorations in Economic History*, 26 (1989), pp. 1-26.
[28] Posthumus, *Inquiry*, pp. 579-98.
[29] E. S. Schubert, 'Innovations, debts, and bubbles: international integration of financial markets in Western Europe, 1688-1720', *Journal of Economic History*, 48 (1988), pp. 299-306.

Treasury in Europe, Evance was required to remit huge funds to Flanders. Acting as a bullion middleman and creditor to the government at the same time, Evance was fully engaged in arbitrage between bills of exchange and bullion. The success in arbitrage on bills and bullion demonstrated that the English money market was well connected with the Continent and that in the late seventeenth century information on market conditions was exchanged extensively and frequently.[30]

Overall, financial (stock and exchange) markets between London and Amsterdam have been statistically confirmed to be well-integrated and efficient since the 1720s. The degree of integration and efficiency was maintained throughout the century although occasionally disturbed in wartime. Although there is no direct statistical data to support the development of integration and efficiency in late seventeenth-century markets, the qualitative evidence (the established information networks and Evance's successful arbitrage between bills and bullion) indicates that financial markets between London and Amsterdam had already become closely connected by the late seventeenth century.

Most studies on financial market integration and efficiency are limited to the eighteenth century or later because their data rely heavily on *the Course of the Exchange*, where quotations began only in 1698. Recently, scholars have extended their study in inquiries into financial market integration back towards the late medieval and early modern eras by comparing the nominal exchange rates between coins and their mint parity. The contribution and the limitation of this new development are reviewed in later chapters and, on this basis, the present study pursues its exploration of financial market performance before the eighteenth century.

1.3 The bill of exchange

Long before the emergence of modern financial markets, several financial institutions had been established in Europe to provide capital for public and private

[30] S. Quinn, 'Gold, silver, and the Glorious Revolution: arbitrage between bills of exchange and bullion', *Economic History Review*, 49 (1996), pp. 473-90.

uses, such as municipal annuities, state banks and rentes against property.[31] Since these forms of finance were mainly concerned with long- or medium-term investment tied either to property estates or public finance, they bore little connection with commerce. Faced with the prevalent anti-usury doctrine in the Middle Ages, it was impossible to charge interest openly. However, commerce was conducted largely on the basis of credit: hard cash comprised only part of the payment and the rest was made on credit. Credit acted as the lubricator of commerce and the accessibility of credit had a profound effect on economic development.[32] Although necessary, commercial loans had to be disguised and the best device was the bill of exchange, dealings in which were regarded as legal commercial transactions according to canon law. Originally, bills of exchange were devised to transfer money between different places with different currencies. Due to slow communication at the time, they began to function as credit instruments. Consequently, from late mediaeval times merchants not only obtained short-term credit in exchange markets to satisfy the demand for liquidity but also invested spare capital in exchange.[33] The dual function of bills of exchange – as means of payment and instruments of credit – rendered them indispensable in long-distance trade.

After long-distance trade revived in the eleventh century, one of the constant concerns of merchants engaged in commerce was the difficulty of transferring funds from one place to another and from one currency to another. In the first place, merchants made payments and undertook investments by shipping bullion and coins. Bullion and coins are heavy and take a long time to transfer, they are easy to

[31] J. D. Tracy, *A Financial Revolution in the Habsburg Netherlands: Renten and Renteniers in the County of Holland, 1515-65* (Berkeley, 1985); idem, 'On the dual origins of long-term urban debt in medieval Europe', in M. Boone, K. Davids and P. Janssens, (eds.), *Urban Public Debts: Urban Government and the Market for Annuities in Western Europe* (Turnhout, 2003), pp. 13-24; E. B. Fryde and M. M. Fryde, 'Public credit, with special reference to north-western Europe', in M. Postan, E. E. Rich and E. Miller (eds.) *The Cambridge Economic History of Europe: Economic Organization in the Middle Ages* (Vol. III) (Cambridge, 1963), pp. 430-553; Munro,' Origins of the financial revolution'; J. Zuijderduijn, *Medieval Capital Markets: Markets for Renten, State Formation and Private Investment in Holland (1300-1550)* (Leiden, 2009).

[32] P. Nightingale, 'England and the European depression of the mid-fifteenth century', *Journal of European Economic History*, 26 (1997), pp. 631-51; idem, 'Money and credit in the economy of late medieval England', in D. Wood, (ed.) *Medieval Money Matters* (Oxford, 2004), pp. 51-71; M. Postan, 'Credit in medieval trade', *Economic History Review*, 1 (1928), pp. 234-261.

[33] R. de Roover, 'The organization of trade' trade' in M. M. Postan and E. E. Rich (eds.), *Cambridge Economic History of Europe: Economic Organization and Policies in the Middle Ages*, (Vol. 3) (Cambridge, 1963), pp.42-118 ; idem, *Money, Banking and Credit*; idem, 'Le contrat de change depuis la fin du treizième siècle jusqu'au debut du dix-septième', *Revue belge de philologie et d'histoire*, 25 (1946), pp. 111-28.

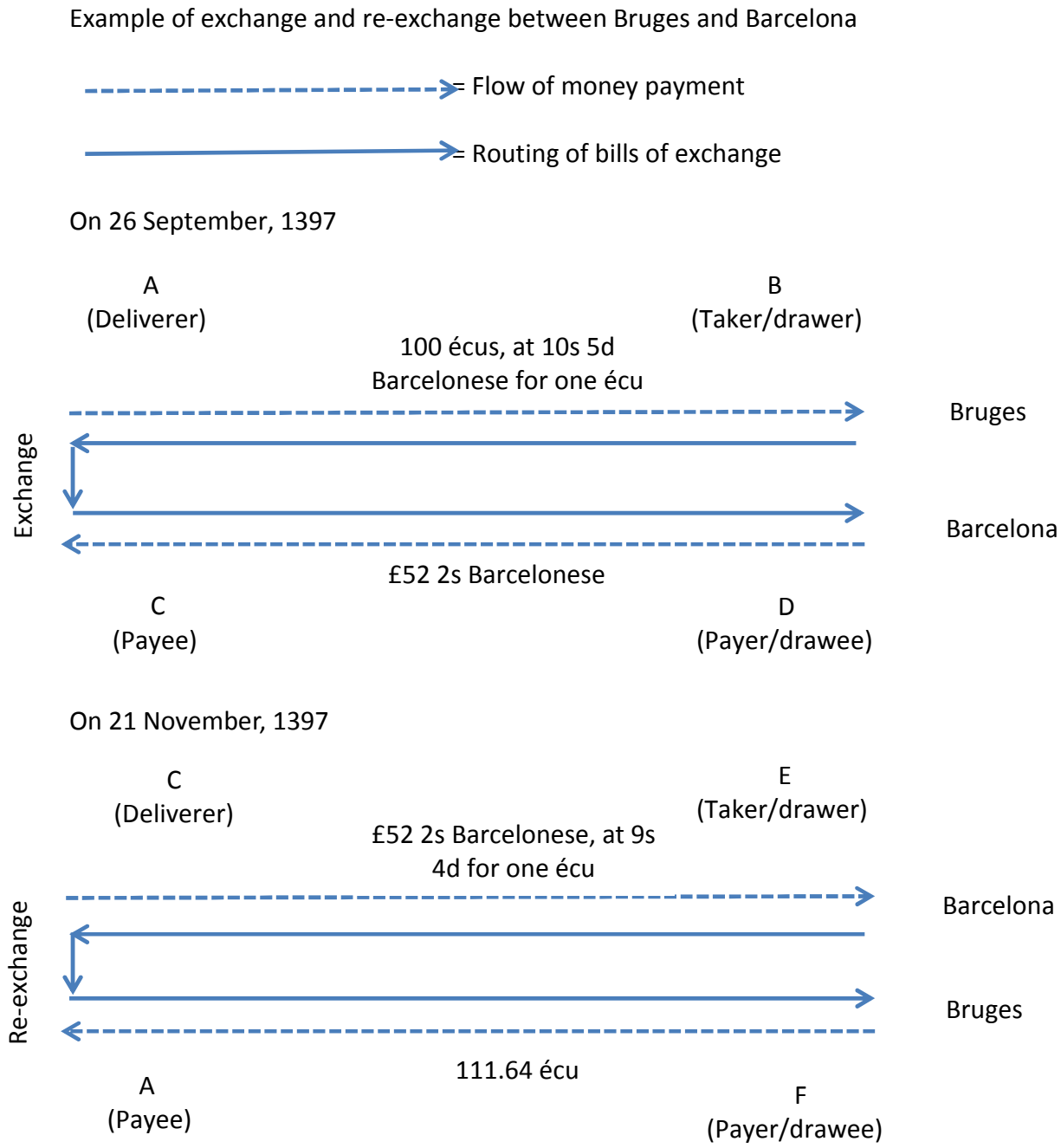
lose and difficult to recover. In addition, roads and bridges were generally in a poor state and brigands, bandits and outlaws were likely to be encountered on the journey. Another cost of shipping bullion and coins was the mint charge. For fiscal reasons, local political entities recognised only local coins as legal tender and consequently merchants had to pay for converting bullion and foreign coins into local currency.[34] As a means of payment in long-distance trade, bullion and coins incurred high risks and costs. With the increase in the volume of trade, the demand for better ways to send money between trading areas rose. The Italians soon developed a method of remittance, the bill of exchange, to lower the risks and costs involved in moving funds between distant places.

The growth in the use of bills of exchange was helped by changes in the organisation of trade. The proliferation of regional fairs from the thirteenth century and growing long-distance trade were the momentum of the development of credit and banking in late medieval Europe. After the decline of the Champagne fairs, the typical periodical travelling trade of the Champagne fairs was replaced by a new type of trade composed of regional fairs and sedentary merchants. In order to meet the needs of this new trading system, Italian merchants and banking houses began to establish branches, or be represented by partners, factors and agents, in major trading cities, such as Bologna, Florence, Genoa, Palermo, Venice, Rome, Paris, Bruges, London and Barcelona. With the help of this spread of banking, it became convenient and beneficial to use bills of exchange to transfer money and soon these became routinely used by merchants associated with long-distance trade. With the establishment of banking in major European cities, bills of exchange became a cheap and safe way for merchants to transfer money from one place to another. Moreover, bills of exchange enabled merchants to circumvent the medieval bullionist policy and pay one another without moving precious metals between two distant places.[35]

[34] Of course, this is the legal situation. In real life, however, foreign money or counterfeiter with foreign origin was in circulation. Even England, which monetary homogeneity was protected by sea, was awash with foreign money. P. Spufford, 'Continental coins in late medieval England', *The British Numismatic Journal*, (1963), pp. 127-39.

[35] Munro, 'Bullionism', pp.173-4. Due partly to ignorance and partly to prejudice and jealousy against the Italians, the English government repeatedly tried to prohibit the use of exchange as part of its bullionist policy. But overall bills of exchange did serve to reduce the use and the movement of bullion in international trade.

Figure 1. The operation of bills of exchange



The bill of exchange is a note in which the author promises to repay a certain amount of local money in another place in the currency of the place. The bill of exchange usually involves four parties and two currencies from two places. The four parties are the taker (drawer), the deliverer, the payee and the payer (drawee). The party wishing to remit funds – the deliverer – gives money to someone who wishes to borrow – the taker – and receives a bill of exchange in return. The bill of exchange

is sent to where money will be received and the agent of the deliverer (the payee) then presents it to the agent of the taker (the payer). Once the bill is accepted, payment is made according to the term of maturity. After receiving the payment, the agent of the original deliverer can remit it by drawing a new bill, but this time the payee becomes a deliverer and the previous deliverer a payee. The operation of bills of exchange is illustrated in Figure 1.

Except for being a means of remittance, bills of exchange also acted as sale credit and a way of raising funds from third parties. Since the era of the Champagne fairs, the Italians had used bills of exchange not only to transfer the proceeds from selling goods in the fairs back home, but also to finance their trade with the expected revenue from trading. For example, the Lucchese manufactured silk cloth, for which the raw silk was acquired from the Genoese, to export to the Champagne fairs. Expecting the revenue from selling silk cloth in the Champagne fairs, the Lucchese could pay the Genoese by selling bills of exchange drawn on Champagne. By purchasing bills of exchange, the Genoese granted sale credit to the Lucchese and the debt would be settled in Champagne when the latter received the proceeds from their silk cloth.[36] Alternatively, the Lucchese could borrow money from the exchange market by selling bills of exchange to a third party to finance their purchases of raw silk. The practice of drawing bills on the expected proceeds of sale to finance trade was also adopted by the English wool/cloth merchants.[37]

Because the monetary return of exchange dealings cannot be decided in advance, the profit generated from exchange was considered as lawful.[38] As noted, bills of exchange were payable in foreign currency. In order to determine the profit of exchange transactions, merchants had to re-exchange the payment for the money into local currency. The profit or loss of exchange transactions was decided by the

[36] T. W. Blomquist, 'Some observations on early foreign exchange banking based upon new evidence from thirteenth-century Lucca in the county of Champagne', *Journal of European Economic History*, vol. 19 (1990), pp. 366-7; idem., 'The dawn of banking in an Italian commune: thirteenth century Lucca', in *The Dawn of Modern Banking*, ed., by the Center for Medieval and Renaissance Studies, (New Haven, 1979), pp. 69-71.

[37] de Roover, 'The organization of trade' pp. 95-96, 117-8; A. Hanham, *The Celys and their World* (Cambridge, 1985).

[38] R. de Roover, 'New interpretations of the history of banking', *Journal of World History*, vol. II (1954), pp. 39-42, 48-51; idem ,'Early banking before 1500 and the development of Capital', *Revue Internationale d'Histoire de la Banque*, vol. IV (1971), pp. 8-11; idem, 'Le contrat de change'; Munro, 'Usury, Calvinism, and credit'.

rate of re-exchange, which was unknown at the initiation of the exchange. Because exchange rates fluctuated from time to time, the profit of exchange dealings was uncertain and bills of exchange were thus regarded as a legal business device. As long as the rate of re-exchange was not predetermined, the bill of exchange would not be condemned as usury by canon law. Hence, borrowing and lending could operate in exchange markets through selling and buying bills of exchange.

Taking the exchange rates shown in Figure 1 as an example, the calculation of profit from exchange dealings is illustrated below. On 26 September 1397, merchant A lent 100 écus of 22 Flemish groots to merchant B in Bruges, who agreed to repay the loan in Barcelona at the rate of 10s 5d Barcelonese for one écu at usance.[39] Based on this exchange rate, merchant C, the agent of merchant A in Barcelona, would receive £52 2s Barcelonese from merchant D, the agent of merchant B, 30 days after presenting the bill. Until the sum of £52 2s Barcelonese was re-exchanged back to Bruges in écus, merchant A would not know whether his loan to merchant B stood at a profit or loss. On 21 November 1397, merchant C remitted £52 2s Barcelonese back to A by drawing a bill on Bruges at the rate of 9s 4d Barcelonese for one écu. As a result, merchant A would receive back 111.64 écu and make a gross profit of 11.64 écu on 100 écu loaned. One needs to know the length of time taken to complete the roundtrip of exchange to calculate the concealed rate of interest.

Before the invention of telegraphy, the speed of communication depended on the distance and travel time separating two places. The maturity of bills of exchange thus varied according to the location of the deliverer and the payer. The further the distance, the longer the time before the bill became due. According to their maturity, there were three types of bill of exchange: sight, *usance* and periodic bills. A sight bill indicates that payment had to be made immediately after the bill was accepted (in practice, no more than one or two days later). Thus, distance alone determines when the payment of sights bills will be received. According to custom, the maturity of bills, based on where money was remitted, was set at a fixed length of time from the

[39] The system of money-of-account in Barcelona and Flanders around 1400 was based on the £/s/d system: one pound equalled 20 shillings and one shilling was subdivided into 12 pence. The groot was the Flemish term for a penny. The écu used as money-of-account in exchange dealings between Bruges and Barcelona was valued at 22 Flemish groots. De Roover, Bruges Money Markets, pp. 21-2.

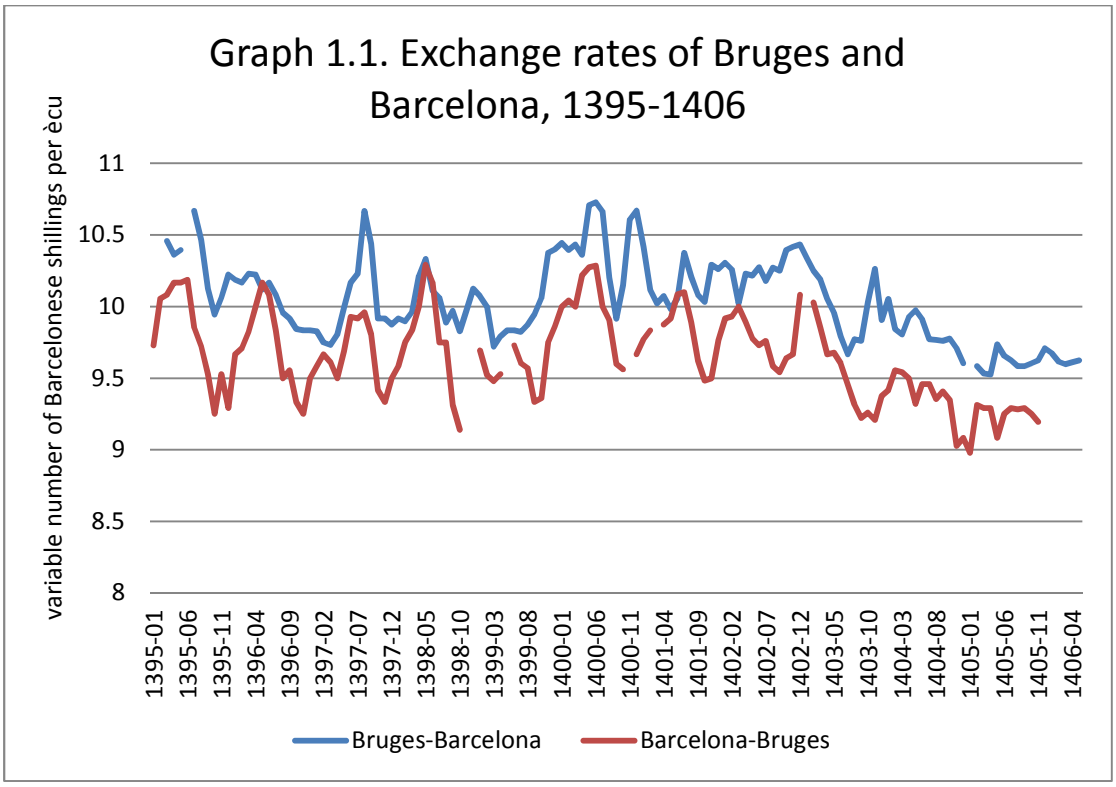
date of issue. This length of time was known as *usance*.[40] Periodic bills were those settled during fairs. At fair-times, merchants from all over Europe gathered to trade with one another. It thus became convenient to settle bills of exchange at fairs.

The usance between Bruges and Barcelona was 30 days from sight, which means 30 days plus the time needed for communication. According to de Roover, around 1400 the time for communication between these two cities was at least 22-23 days.[41] Therefore, the total length of time for a roundtrip of exchange between Bruges and Barcelona was about 3.5 months, if re-exchange was made immediately after the payment of the first bill was received.[42] The profit of 11.64 écus on 100 écus of loan in 3.5 months would be equal to an annual rate of return of 39.9%. It seems that dealing in bills could be very profitable and this probably explains the high proportion of merchant bankers' revenue generated from bills of exchange in the late Middle Ages.[43] Despite being apparently profitable, the size of the profit was actually uncertain and depended on the spread of exchange rates between two markets. The bigger the difference, the more profitable lending money by exchange became.

As long as the exchange rate was higher in the city for which currency was given as certain than in the city giving its currency as uncertain, lending money by purchasing bills of exchange would make a profit.[44] In circumstances when the state of markets suddenly changed, the exchange rate in the city giving its currency as uncertain (e.g. Barcelona) could have been higher than the city giving its currency as certain (e.g. Bruges). In this case, lending money by exchange would turn into loss. For example, if the exchange rate suddenly rose from 9s 4d to 10s 8d Barcelonese for one écu after some Barcelona merchants went bankrupt, at the new rate merchant A received £52 2s Barcelonese for only 97.66 écu in Bruges and ran a loss of 2.34 écu

[40] de Roover, *Money, Banking and Credit*, pp. 57-60.
[41] De Roover, *Bruges Money Market*, pp. 21-2.
[42] It took 52-53 days for the Bruges-Barcelona exchange to be completed (22-23 days of travelling and 30 days of maturity) and the same length of time for the re-exchange. Therefore, the total length of loan was about 3.5 months.
[43] 31% of the gross profit for Datini's Barcelona branch and 44% for Borromei's London branch were associated with bills of exchange. G. G. Booth, 'Foreign-exchange profits in two early renaissance money markets', *Journal of European Economic History*, 38 (2009), p. 124.
[44] In the example of a Bruges-Barcelona exchange, Barcelona gave certainty to Bruges in that the exchange rate was quoted at a variable (uncertain) number of Barcelonese pence for one Flemish écu (certain). R. de Roover, 'What is dry exchange? A contribution to the study of English mercantilism', in J. Kirshner ed., *Business, Baking, and Economic Thought in Late Medieval and Early Modern Europe: Selected Studies of Raymond de Roover*, (The University of Chicago, 1974), pp. 186-90.

on 100 écus in 3.5 months. However, this disequilibrium of exchange rates would not last long because no one likes to lend money at a loss. The supply of available money in Bruges may have declined to adjust exchange rates and thus restored the equilibrium. The movement of monthly exchange rates between Bruges and Barcelona in 1395-1406 is charted in Graph 1.1 showing that most of the time the exchange rates in Bruges were higher than those in Barcelona.



Source: R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968)

Although the profit of exchange dealings was uncertain and unknown until the re-exchange being made, as discussed above, due to the structure of the exchange market a lender (deliverer) normally made a profit on exchange transactions.[45] Because interest, though uncertain ex ante, was concealed in the rate of exchange, except for granting sale credit, merchants could thus circumvent the law against usury and were able to loan money with interest under the disguise of bills of exchange. Combining the functions of means of remittance and credit instruments, bills of exchange played an important role in financing international trade and

[45] An example of Italian bankers losing money in exchange transactions is demonstrated in J. L. Bolton 'How Sir Thomas Rempston paid his ransom: or, the mistakes of an Italian bank', in Linda Clark ed., *Conflict, Consequences and the Crown in the Late Middle Ages* (Woodbridge, 2007), pp. 101-18.

provided a reliable short-term investment opportunity for spare capital.[46] The operation of bills of exchange did not change over time but some innovations occurring in the late sixteenth and early seventeenth centuries boosted the financial function of bills and expanded the use of exchange markets. These developments of bills of exchange are discussed in more detail in Chapter 4.

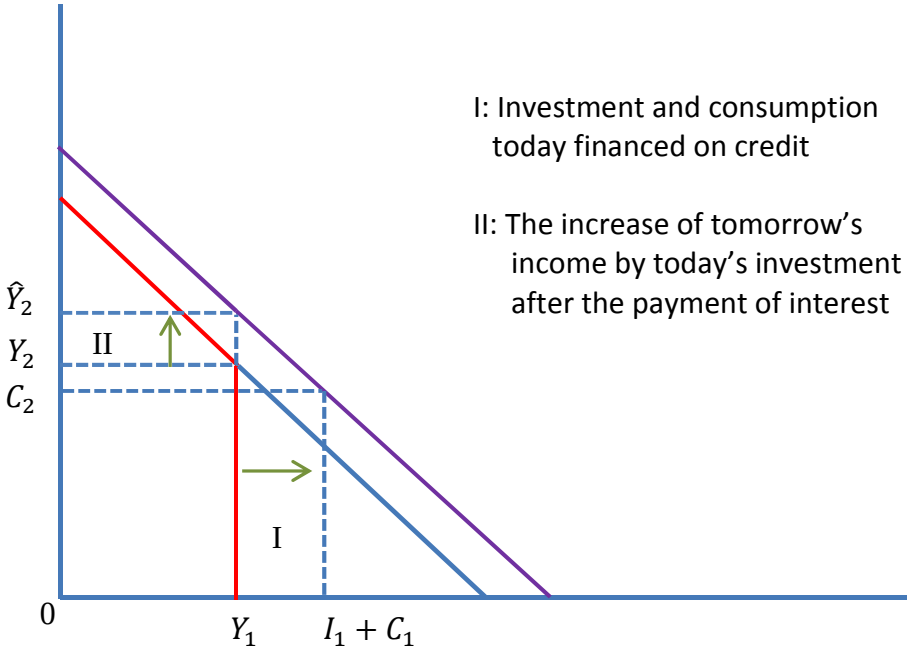
Lending money by exchange was not the only licit form of lending at interest. Other lawful loans at interest included investment in public debts, which was common in most of the Italian city states and *rente* contracts usually seen in Northern Europe to finance municipal and agricultural projects.[47] These loans are considered long-term investments, which could continue for several years, or perpetually. Bills of exchange, by contrast, offered flexible and short-term investment.[48] For a lender, purchasing bills of exchange was a short-term investment for idle capital, allowing the capital to be released within a relatively short time and easily re-assigned to other uses. Meanwhile, by participating in exchange dealings a borrower was able to undertake a larger volume of trade than otherwise. The borrower could obtain funds for an investment by selling bills of exchange on the basis of future income before receiving the proceeds of previous investments and thus the available pool of capital became broader.

The importance of exchange dealings in medieval international trade is demonstrated in the previous case of the Lucchese drawing the proceeds of selling silk cloth in advance to pay for the purchase of the raw silk. In this case, the Lucchese did not need to commit capital to the purchase of the raw silk. With the help of dealing in bills, they could draw on the expected income from future sales to pay for the raw silk. Otherwise, they would have had to reduce the scale of investment in silk cloth to have funds available to pay for the raw silk. Furthermore, capital did not have to be tied up in several places if bills of exchange were used. The Lucchese may have had money at the Champagne fairs but no money in the place where the payment for the raw silk had to be made. Without bills of exchange, not only did the

[46] The length of the maturity of a bill of exchange at the time usually varied between 1 and 3 months. If it was necessary, the maturity could extend further.
[47] Munro, 'Origins of the financial revolution'; de Roover, 'New interpretation'; Zuijderduijn, *Medieval Capital Markets*.
[48] The longest loan on exchange and re-exchange was between London and Venice for six months duration, which offered three months' usance in each direction.

cost of remittance increase, but capital became less movable; and the cost of capital consequently increased. As a result, the scale of commerce and investment would have had to shrink. It is arguable that the use of bills of exchange made a remarkable contribution to European international commerce.

Figure 2. Optimal consumption: the borrower



The effect of the financial function of bills of exchange on trade is illustrated in Figure 2. Without the operation of credit from dealing in bills, the amount of investment and consumption is constrained by the income of today and tomorrow ($\{Y_1, Y_2\}$, within the red lines. When the agent is able to finance a profitable investment by selling bills of exchange drawing on tomorrow's income, he will not only expand his consumption today and tomorrow but also enhance tomorrow's income.[49] Given tomorrow's income at £100, the interest rate of 3 per cent and the rate of return of investment of 5 per cent, from financing investment by bills of exchange, the agent will make a profit of £2 and raise tomorrow's income to £102 after the payment of interest. The agent will continue to finance investment by

[49] Because the investment financed on credit today (I_1) increases tomorrow's income, the budget constraint is moved outwards and the optimal set of investment and consumption of today and tomorrow will lie on the purple line, which cannot be achieved under the original budget constraint (the red line).

borrowing until the interest rate increases to offset the rate of return. Because bills of exchange can quickly and easily raise funds and make payments, those who use them can re-allocate capital to production in a short time could move capital rapidly from place to place in pursuit of the most profitable investment, and capital is not locked into long-term commercial commitments.

Although the interest rate concealed in exchange dealings (12-14 per cent) was high in relation to the average return from trade (15-16 per cent),[50] this does not mean that the bill of exchange was a bad credit instrument for financing commercial ventures. The financial role of exchange dealing in international commerce did not function like the stocks and bonds which provided cheap and long-term capital to enterprises in the seventeenth century and onwards. The function of sale credit was to allow a new investment to be financed by drawing on the expected revenues of an earlier one. Dealing in bills released capital from its long commitment in trade and increased the pool of available capital for investment. It probably also acted as a short-term credit instrument to solve a temporary liquidity problem.

Before the Industrial Revolution, commerce rather than manufacture was an important element of economic growth. In a commercial world, success, to some degree, depends on the efficiency of allocating capital: to place money where it is most needed at lowest cost, to quickly move spare capital to available investments, to obtain funds most cheaply and so on. Integrated exchange markets not only helped to allocate resources to the most productive use, but also to reduce the financial and opportunity costs of trade and indirectly encourage commercial activities. The development of banking around Europe in the fourteenth century allowed merchants to take advantage of using bills of exchange to transfer money, participate in borrowing and lending, enhance the flexibility of available capital and enlarge the capital pool. Hence, the effectiveness of arbitrage on exchange markets can be used to measure how efficiently funds/capital would have been allocated internationally in the late medieval and early modern eras.

[50] de Roover, 'Early banking', p. 11

1.4 The law of one price

The study of market integration is based on the law of one price, which states that due to the operation of arbitrage identical goods must have the same price, regardless of where they are traded. The concept of arbitrage operations rendering the same level of prices can be traced back to A. A. Cournot, a French mathematician in the nineteenth century.[51] In *Researches into the Mathematical Principles of the Theory of Wealth*, he stated that "an article capable of transportation must flow from the market where its value is less to the market where its value is greater, until the difference in value, from one market to the other, represents no more than the cost of transportation".[52] This indicates that prices in different markets will converge to the level of transaction costs if trade takes place between these markets. Arbitrageurs can simply move goods between markets to exploit price differentials as long as the price differentials exceed the transaction costs. In equilibrium, any price difference between markets is attributable to transaction costs. The violation of the law of one price, the existence of price differences exceeding transport and transaction costs, will be transitory if arbitrage is working effectively to bring price differentials back within the band of transport and transaction costs. In other words, in a world where markets are integrated and efficient, the price levels in two markets move up and down together and the law of one price can only be violated for a short period.

Following this concept, the degree of market integration is conventionally measured by two approaches. One is to see if price movements are correlated; the other is to estimate the speed of market adjustment. If markets are integrated, one should expect that price changes in one or more markets move together and prices adjust rapidly to converge to some equilibrium level. The first approach can be simply undertaken by looking at the correlation of prices between markets. If correlations are high, they imply that markets are integrated.[53] However, price correlations

[51] Federico, 'Market integration in Europe', p. 474.
[52] A. A. Cournot, *Researches into the Mathematical Principles of the Theory of Wealth* (New York, 1927), p. 117.
[53] R. W. Unger, 'Thresholds for market integration in the Low Countries and England in the fifteenth century', in L. Armstrong, I. Elbl and M. M. Elbl eds., *Money, Markets and Trade in Late Medieval Europe: Essays in Honour of John H. A. Munro* (Leiden, 2007), pp. 349-80; Neal, 'Integration and

between pairs of markets may not be appropriate indicators of integration, in that prices in two isolated markets could have move synchronically owing to some common external factors, such as warfare, natural disasters and climate. Moreover, price correlations shed little light on the adjustment process, the relationship between transaction cost and market integration and the determinants of the degree of integration.

The process of arbitrage implied in Cournot's dictum can be captured by cointegration models in which the speed of market adjustment is measured. The violation of law of one price will be transitory if arbitrage works effectively. Therefore, the length of time taken to close the gap between the price differential and the transaction cost can be regarded as a proxy with which it is possible to estimate the degree of market integration. The more quickly arbitrage works to close the gap, the more integrated the markets are.

1.5 Econometric models: threshold error correction and threshold autoregressive models

Two cointegration models are employed in this thesis to explore the market adjustment process driven by arbitrage which takes transport and transaction costs into consideration: the threshold error correction (TEC) and threshold autoregressive (TAR) models.[54] In the framework of triangular arbitrage, the law of one price can be tested on the difference between direct-exchange rates and cross-rates via the third place using a TEC model (Chapters 2 and 4). The TAR model is used to measure the speed of adjustment against monetary alterations (Chapter 3). In order to avoid the reiteration, the general form of the TEC model employed is elaborated below, leaving the discussion of the TAR model to Chapter 3.

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efficiency'; A. J. H. Latham and L. Neal, 'The international market in rice and wheat, 1868-1914', *Economic History Review*, 36 (1983), pp. 260-80.

[54] K. G. Persson, *Grain Markets in Europe, 1500-1900: Integration and Deregulation* (Cambridge, 1999); M. Ejrnas and K. G. Persson, 'Market integration and transport costs in France 1825-1903: a threshold error correction approach to the law of one price', *Exploration in Economic History*, 37 (2000), pp. 149-173; E. Canjels, G. Prakash-Canjels and A. M. Taylor, 'Measuring market integration: foreign exchange arbitrage and the gold standard, 1879-1913', *The Review of Economic and Statistics*, 86 (4), (2004), pp. 868-882; Volckart and Wolf, 'Estimating financial integration'.

As mentioned, the more integrated markets are, the shorter the persistence of violation of the law of one price. Hence, the degree of market integration can be estimated by the length of time that arbitrage takes to restore the law of one price. If the price differential between two markets is greater than the transport and transaction costs involved in moving goods between them – the existence of arbitrage gain – the arbitrageur will move goods from where they are abundant to where they are dear. Consequently, one expects to observe the price differential to be driven back within a band set by transaction costs. Within the band, prices are expected to move randomly. The arbitrage concept is described in a general TEC model given by

$$\Delta P_t^1 = \begin{cases} \alpha_1(P_{t-1}^1 - P_{t-1}^2 - \gamma^{12}) + \varepsilon_t^1 \;\; if P_{t-1}^1 - P_{t-1}^2 > \gamma^{12} \\ \varepsilon_t^1 \qquad\qquad\qquad\qquad if -\gamma^{21} \leq P_{t-1}^1 - P_{t-1}^2 \geq \gamma^{12} \\ \alpha_1(P_{t-1}^1 - P_{t-1}^2 + \gamma^{21}) + \varepsilon_t^1 \;\; if P_{t-1}^1 - P_{t-1}^2 < -\gamma^{21} \end{cases} \tag{1.1}$$

$$\Delta P_t^2 = \begin{cases} \alpha_2(P_{t-1}^1 - P_{t-1}^2 - \gamma^{21}) + \varepsilon_t^2 \;\; if P_{t-1}^1 - P_{t-1}^2 > \gamma^{21} \\ \varepsilon_t^2 \qquad\qquad\qquad\qquad if -\gamma^{12} \leq P_{t-1}^1 - P_{t-1}^2 \geq \gamma^{21} \\ \alpha_2(P_{t-1}^1 - P_{t-1}^2 + \gamma^{12}) + \varepsilon_t^2 \;\; if P_{t-1}^1 - P_{t-1}^2 < -\gamma^{12} \end{cases} \tag{1.2}$$

where $(\varepsilon_t^1, \varepsilon_t^2) \sim Nid(0, \Omega)$. P_t^1 and P_t^2 are the prices in market one and two at time t, respectively. The parameters of (α_1, α_2) and $(\gamma^{12}, \gamma^{21})$ are estimators of the speed of adjustment and the trading cost associated with moving goods from market one to two and two to one, respectively. The adjustment process implies that $\alpha_1 < 0$, $\alpha_2 > 0$ and $\gamma^{12}, \gamma^{21} > 0$. The multitude of adjustment parameters indicates the speed of adjustment, therefore, a high value of (α_1, α_2) means a fast adjustment and integrated markets.

In investigating the integration of late medieval exchange markets, the difference between direct- and cross-exchange rates can be regarded as the price differential in the TEC model. When merchants use bills of exchange to transfer funds from one place to another, they can either choose direct exchange or cross exchange via the third place, depending on which offers the more favourable rates. Cross-exchange incurs extra transaction costs: the brokerage and post fee for the second bill, the

interest forgone and increasing risk in a longer transaction.[55] Hence, in the presence of the additional transaction cost it should be cheaper to transfer funds by direct-exchange than cross-exchange; the equilibrium of exchange markets is expressed as follows:

$$E^d \leq E^c + C \tag{1.3}$$

where E^d and E^c are direct- and cross-exchange rates, respectively, and $C > 0$ is the transaction cost associated with drawing the second bill in the third place.

If, for example, a trade dispute occurs between market one and two, the cross-exchange rate between them via the third place, after including the transaction cost, could be below the direct-exchange rate. As a result, merchants would switch to cross-exchange to take advantage of the lower cost of moving funds via the third place. With the operation of arbitrage, the advantage of cross-exchange disappears and markets return to equilibrium. Arbitrage is triggered when the condition below is satisfied

$$E^c + C \leq E^d \tag{1.4}$$

Expression (1.4) implies that the law of one price is violated and arbitrage starts to operate as

$$E^d - E^c \geq C \tag{1.5}$$

The difference between direct- and cross-exchange rates is equivalent to an arbitrage gain. Expression (1.5) indicates that when arbitrage gain exceeds transaction cost, arbitrage will be carried out to adjust exchange rates toward equilibrium (Expression (1.3)). Therefore, the general TEC model (Equations (1.1) and (1.2)) can be adapted to a two-regime TEC model, by which the behaviour of exchange rates reflecting arbitrage operation can be described.

The two-regime threshold error correction model is as follows:

[55] Because cross-exchange rates are calculated ex ante, a sudden change of exchange rates in the third place would mark cross-exchange rates as less favourable than direct-exchange rates. The prospect of changing exchange rates and the possible default of the second transaction make the risk associated with cross-exchange higher than with direct-exchange.

$$\Delta E_t^d = \begin{cases} \alpha_1\left(E_{t-1}^d - E_{t-1}^c - C\right) + \varepsilon_t^1 & if\ E_{t-1}^d - E_{t-1}^c > C \\ \varepsilon_t^1 & if\ E_{t-1}^d - E_{t-1}^c \leq C \end{cases} \quad (1.6.A)$$

$$\Delta E_t^c = \begin{cases} \alpha_2\left(E_{t-1}^d - E_{t-1}^c - C\right) + \varepsilon_t^2 & if\ E_{t-1}^d - E_{t-1}^c > C \\ \varepsilon_t^2 & if\ E_{t-1}^d - E_{t-1}^c \leq C \end{cases} \quad (1.6.B)$$

The parameter of $C > 0$ is the estimated transaction cost (the threshold triggering arbitrage). The parameters (α_1, α_2) measure the speed of adjustment in exchange markets with respect to direct- and cross- exchange. When the differential between direct- and cross- exchange rates (arbitrage gain) exceeds the trading cost associated with cross-exchange, arbitrage will be triggered to bring the difference between the two exchange rates below transaction cost. Therefore, $\alpha_1 < 0$ and $\alpha_2 > 0$. A high value of the adjustment parameters indicates a fast adjustment. Otherwise, the movement of exchange rates follows a random walk.

The trading cost here is unknown and needs to be estimated. Assuming that exchange markets were weakly integrated, the differences between direct- and cross-exchange rates can be used as the possible set of transaction costs. The proxy of transaction cost is calculated on a grid search method, which is to locate the parameters minimising the residual sum of squares, proposed by Balke and Fomby.[56] The procedure is followed:

(1) To select a set of thresholds (transaction costs) from the values of price differentials $(E_{t-1}^d - E_{t-1}^c)$

(2) Given the values of the threshold, one then uses OLS to estimate the parameters (α_1, α_2). The values of the threshold are discarded when the number of observation outside the threshold falls below 20 per cent of the total observation. The procedure repeats until the possible thresholds are exhausted.

(3) The set of parameters (α_1, α_2, C) is chosen on the basis of the minimisation of the sum of the residual sum of squares.

[56] The other approach to estimating the threshold is to maximise a likelihood function suggested by Fanizza and Prakash. These two approaches will have the same result under a simple OLS estimation which is used here. N. S. Balke and T. B. Fomby, 'Threshold cointegration', *International Economic Review*, 38 (1997), pp. 627-45; G. Prakash, 'Pace of market integration', Working paper, Northwestern University, 1996; G. Prakash and A. M. Taylor, 'Measuring market integration: a model of arbitrage with an econometric application to the gold standard, 1880-1913', NBER working paper 6073 (1997), pp. 17, 31-2.

In this way, the adjustment parameters can be estimated and depend on the estimated value of the threshold.

One of the criticisms of the standard TEC model is that the threshold for triggering arbitrage does not change over time and therefore, the estimations cannot measure the true speed of adjustment.[57] However, this does not pose a serious problem in the following analysis. This thesis analyses the degree of market integration only in a relatively short time period (no more than 15 years); it seems reasonable to assume that transaction costs remained unchanged during the period of investigation. Furthermore, the other inherent problem is that this model is sensitive to the data being analysed. As elaborated above, the threshold is chosen from a pool of price differentials by the grid-search procedure, and adjustment parameters are estimated based on the selected threshold. As the result, the threshold and adjustment parameters are likely to change as the pool of price differentials is different, such as with the different frequency data and time period.

1.6 Conclusion

This chapter presents the existing literature on financial market integration, the way in which merchants used bills of exchange to undertake borrowing and lending in business and the framework and econometric models used to illustrate and measure exchange market integration. Due to data constraints, most quantitative studies on financial market integration focus on London and Amsterdam from the eighteenth century and onwards. The consensus is that the degree of integration between the two financial markets had already reached a high level at the first two decades of the eighteenth century. The well integrated financial markets were in part attributed to the fact that many investment opportunities could be found in the London stock market, where the British government borrowed heavily to finance her Continental wars and a great deal of foreign capital (most of it Dutch) flowed in. Some qualitative

[57] Federico, 'Market integration in Europe', p. 484. An advanced model including structure break and time trend is introduced to allow transaction costs to change over time. B. Van Campenhout, 'Modelling trends in food market integration: method and an application to Tanzanian maize markets', Food Policy, 32 (2007), pp. 112-27; Chilosi and Volckart, 'Money, states, and empire'.

evidence supports the view that a certain degree of integration already existed between London and other European markets in the late seventeenth century but no precise measurement was available to corroborate it.

In the world of anti-usury, the dual function of bills of exchange – as means of remittance and credit instruments – allowed merchants to undertake borrowing and lending. Capital for commerce could be raised from foreign exchange markets, which also provided flexible investments for spare capital and sources of short-term liquidity. With the help of bills of exchange, merchants could easily and cheaply transfer money between trading places and capital could be freed from long-term commitment to trading, and then flexibly and rapidly diverted to other uses. The analysis of exchange markets sheds light not only on the efficiency of allocating capital in the late medieval and early modern eras but also on the connection between financial market and economic performance.

The examination of market integration and efficiency is based on the law of one price, which is that the price differentials of identical goods between markets are confined within the band of transaction cost so long as arbitrage works effectively. The length of time required for price adjustment against profitable opportunities can be used as a proxy to measure the degree of market integration. By employing cointegration models, this thesis assesses the effectiveness of triangular arbitrage on exchange markets and the way in which exchange markets responded to monetary alteration. Hence, the performance of the exchange market in the early period can be quantitatively analysed.

Chapter Two International exchange market integration at the time of Datini

2.1 Introduction

As Munro argues, the rampant warfare of the fourteenth century greatly increased transaction costs and shifted the north-south European trade routes from overland to overseas. Because of the frequent political conflicts, when the flow of trade diverged from the overland routes the established regional and local trade network became unfrequented and abandoned. The economic decline of the late Middle Ages was thus partially a result of falling access to the vast hinterland markets, due to the change in trade routes and the disappearance of many interregional trading hubs. The economic revival in the second half of the fifteenth century is viewed as the result of re-establishing overland long-distance trade in relatively stable political conditions.[58]

The contraction of overland commerce in the fourteenth century had a consequent impact on market integration. As hinterland markets became less accessed and the number of interregional fairs dwindled, the volume of trade and consumption would have declined and markets which had been linked by long-distance trade would have become less integrated. de Roover suggests that the change in trade patterns also induced changes in the manner of financing long-distance trade. Along with the decline of the Champaign fairs, correspondents and agents began to establish themselves permanently in several of the trading centres

[58] J. H. Munro, 'The Low Countries' export trade in textiles with the Mediterranean Basin, 1200-1600: a cost-benefit analysis of comparative advantages in overland and maritime trade routes', Working paper No. 7, University of Toronto, July 1999; idem, 'South German silver, European textiles, and Venetian trade with the Levant and Ottoman Empire, c. 1370 to c. 1720: a non-mercantilist approach to the balance of payments problem', in *Relazione economiche tra Europa e mondo islamico, seccoli XIII-XVIII*, ed., Simonetta Cavaciocchi (2006); H. Van der Wee and T. Peeters, 'Un modèle de croissamce interséculaire du commerce mondial', *Annales: Économies, Sociétés, Civilisations* 25 (1970), pp. 100-26. Although transcontinental trade was to some extent replaced by seaborne trade, Epstein maintains that at the same time regional fairs grew and prospered. The later economic revival was probably based on these local fairs. S. R. Epstein, 'Regional fairs, institutional invocation, and economic growth in late medieval Europe', *Economic History Review*, 47 (1994), pp. 459-82.

accessible to maritime trade routes, e.g. Venice, Genoa, Bruges, London and Barcelona. Due to the emergence of sedentary merchants, the use of bills of exchange to transfer funds between places and currencies soon increased and became routinely practised. In addition to being a tool for remittances, the bill was widely employed to circumvent the prohibition on usury by concealing the charge of interest under the cloak of exchange dealings. Merchants were thus able to obtain short-term credit and lend out spare capital by engaging in exchange deals.[59]

Since systematic data about the variety, prices and volume of commodities traded internationally scarcely survive, examining exchange markets (for which data are more abundant) can shed light on financial aspects of late medieval international trade. It is not clear, on the basis of existing literature, whether the rapidly changing and frequently hostile business environment –the frequent outbreaks of war, together with plague, famine and trade embargoes – which characterises the fourteenth century hindered the exchange markets' ability to adjust; whether the change in trade routes led to less integrated exchange markets; or whether the change in business organisation then helped to facilitate exchange dealings; or whether exchange markets behaved as they do now regardless of the huge social, economic and technological differences.

This chapter aims to estimate the degree of exchange market integration in the late Middle Ages and to explore the impact of the change in the north-south trade routes on exchange market integration. The approach is to compare direct- and cross- exchange rates between Venice, Bruges, Barcelona and Paris. According to the law of one price, if exchange markets were well integrated, arbitrage should have constrained the difference between direct- and cross- exchange rates within the bounds of transaction costs associated with arbitrage, which would have quickly eliminated any excessive differentials.[60] The exchange rates employed in the following analysis are extracted from Datini's mercantile documents.[61] Francesco Datini was a Florentine merchant engaging in international trade through several

[59] de Roover, 'The organization of trade'; idem, *Money, Banking and Credit* ; idem, 'Le contrat de change'.
[60] G. Poitras, *The Early History of Financial Economics, 1478-1776: From Commercial Arithmetic to Life Annuities and Joint Stocks* (Edward Elgar, 200), pp. 243-50.
[61] Cf. footnote 17.

branches of his company in the late fourteenth and early fifteenth centuries. His accounts and correspondence are a rich source of exchange rates of major trading places. With the help of Datini's numerous business records, the Venetian and Bruges money market in the late fourteenth and early fifteenth centuries can be systematically reconstructed.

Three advantages stand out from analysing market integration on the basis of exchange rates. First of all, unlike other trading, the cost of transport represented only a small share of the total transaction costs in exchange dealings (i.e. bills of exchange). The results derived from investigating exchange markets provide us with the maximum level of integration that markets could have achieved in similar circumstances. This does not mean that exchange markets were invulnerable to the menaces of the time. On the contrary, the study of exchange markets helps us to focus on another equally, if not more, important element in determining the degree of integration: information processes. The ability to arbitrage on exchange rate differentials greatly depended on communication and the flow of information. To survive and even profit from the hazard and volatility of the hostile business environment of the late Middle Ages, information had to be swiftly exchanged, gathered and analysed, business decisions made carefully and capital moved promptly on the new development of the state of the market. The degree of exchange market integration yields crucial insights into the speed at which markets responded to shocks, and that was profoundly affected by the speed of their communication and information transmission.

Second, compared with other commodities (grain in particular), exchange dealing was, to a large extent, free from government regulation and intervention.[62] Consequently, the exchange market is a better ground than the grain market to study market integration in the late medieval period.[63] Although governments from time to time tried to intervene in exchange dealings, the market mechanism always came to

[62] As part of its bullionist policy, the English government attempted to control exchange dealings. Its failure is demonstrated in the repetition of prohibitions. Furthermore, the government of the Low Countries also tried to impose several unsuccessful interventions on exchange dealings. Munro, 'Bullionism'; de Roover, *Bruges Money Market*, pp. 47-8, 54-62; Edler, 'Financial measures of Charles V', pp. 665-73.

[63] The political influence on the supply and price of grains is clearly demonstrated in Aloisio's research on the Sicilian grain trade. Aloisio, 'Regional market integration'.

prevail. [64] Moreover, high-frequency data can be extracted from mercantile documents (monthly and weekly, in the case of Datini's documents) to produce more precise estimations than the prices of other commodities allow.

This chapter demonstrates that arbitrage was effective in keeping the differences of exchange rates within the band of transaction costs and that around 1400 exchange markets were fairly integrated. Furthermore, exchange rates swiftly adjusted to the intervention in the Bruges exchange market by the Flemish government in 1399-1400. The speed of adjustment and transaction costs imposed on arbitrage were largely determined by the distance separating markets and the speed of communication. Overall, in terms of exchange markets, merchants were able to allocate capital efficiently, adjust quickly to changes in economic and political conditions and safeguard themselves from a hostile business environment. The financial integration among major trading cities was established with the help of continuous communication and extensive correspondence.

The chapter proceeds as follows. Section 2.2 provides a brief review of the literature on financial market integration in the late Middle Ages. Section 2.3 addresses the issue of late medieval trade between northern Europe and the Mediterranean, monetary standards in these two areas and the power struggles between the houses of Burgundy and Armagnac. Section 2.4 sets out a two-regime threshold error correction model to estimate the degree of exchange market integration. Datini's exchange rate data are presented and discussed in section 2.5. Section 2.6 reports the empirical analyses and results, offers an interpretation and discusses the implication of the results before drawing conclusions.

2.2 Some findings on late medieval financial market integration

In recent years, based on the exchange rates of various currencies and cointegration models, work in the quantitative analysis of the integration in late medieval financial

[64] de Roover, *Money, Banking and Credit*, pp. 78-81; idem, *Bruges Money Market*, pp. 47-8; Edler, 'Financial measures of Charles V'; idem, 'The van der Molen, commission merchants of Antwerp: trade with Italy, 1538-44,' in J. L. Cate and E. N. Anderson, eds., *Medieval and Historiographical Essays in Honor of James Westfall Thompson* (Chicago, 1938), pp. 119-24.

markets has advanced considerably, but the results are still debatable. By employing threshold cointegration models, such as the threshold autoregressive (TAR) and threshold error correction (TEC) models, one can estimate the transaction costs which set the threshold for arbitrage and the speed of adjustment which is interpreted as the degree of integration.

With this approach, pioneering work in the quantitative analysis of late medieval financial market integration has been done by Volckart and Wolf.[65] They use a TAR model to estimate the degree of financial market integration in 1385-1450 by looking at differences between the nominal exchange rates of silver coins traded between Flanders, Lübeck and Prussia and the mint parity based on their bullion content. Their results are interpreted in terms of a half-life, which is the length of time required to reduce 50 per cent of the deviation outside the bound of transaction costs. It shows that on average the speed of adjustment between Flanders and Lübeck was 8 months and between Flanders and Prussia, 21 months. The transaction costs (silver points) are estimated at 0.122 and 0.988 grams silver per gram silver shipped (12% and 98% of parity) for Flanders-Lübeck and Flanders-Prussia, respectively. The exceptionally high transaction cost associated with Flanders-Prussia arbitrage reflects the distance separating the two markets and the uncertainty about the movement of exchange rates in distant markets. Based on these results, Volckart and Wolf claim that "adjustment in the silver market was massively slower during the late Middle Ages than adjustment in the gold market in the late nineteenth century."[66]

More recently, Chilosi and Volckart have explored the development of financial market integration in late-medieval central Europe. They find that markets became more integrated, though unevenly, in the late fifteenth century. This progress was due to the fall of transaction costs, which was the result of a combination of the relative peace enjoyed at the time, the establishment of monetary unions, the adoption of printing and the emergence of territorial states. However, the results appear somewhat mixed when the integration between city-pairs is analysed by a

[65] Volckart and Wolf, 'Estimating financial integration'.
[66] Ibid, pp. 136-7. Volckart and Wolf compare their results with those of Canjels et al, which show that the London-New York exchange markets adjusted within 6 days in 1879-1913. Canjels et al, 'Measuring market integration'.

TAR model with a time trend. Threshold autoregressive results show that only Basel-Cologne and Jülich-Koblenz experienced significant reductions in both the speed of adjustment and transaction costs: adjustment was achieved within weeks in the mid-sixteenth century and transaction costs were halved (from 9 per cent to 5 per cent). Meanwhile, the speed of adjustment between Cologne and her neighbouring cities deteriorated considerably. The progressive integration between Basel and Cologne is regarded by the authors as the result of restoring overland trade.[67] Their findings are consistent with Van der Wee and Munro's hypothesis about reviving transcontinental trade in the late fifteenth century.

Kugler studies the relationship between the exchange rates of Rhinegulden gold and the Basel pound (a silver currency) and silver-gold ratios in 1365-1429 in the framework of a threshold error correction model.[68] His result reveals that arbitrage did not begin to operate until the deviation was bigger than 7.4 per cent of parity; and 12 months elapsed before deviations from parity were removed. The speed of adjustment is more or less consistent with Volckart and Wolf's results, but the transaction costs are relatively low. The low transaction cost of arbitrage may be due to the lower transport cost of shipping gold than of shipping silver.[69]

These studies advance our understanding of the late medieval financial market. They broadly agree on the order of magnitude of transaction costs, which ranged around 7-12 per cent. However, these studies suffer from two possible drawbacks. First, they do not offer a benchmark, e.g. the time of communication, with which their results can be compared. Therefore, one cannot tell how integrated the markets under their analysis were *by the standards of the time*. Second, the low-frequency (annual and quarterly) data used make it impossible to estimate the speed of adjustment more precisely. As a result, one cannot be sure that the slow speed of adjustment observed in these studies is produced by the low frequency data or the

[67] Chilosi and Volckart, 'Money, states, and empire'.
[68] Kugler, 'Rhinegulden and Basle pound'.
[69] In my opinion, Volckart and Wolf's results should be interpreted as 0.122 (or 0.344) and 0.988 grams silver per gram silver, as in Chilosi and Volckart (2011), instead of 0.12% (or 0.34%) and 0.98% as in Kugler.

genuinely low level of market integration. Moreover, the low-frequency of data probably causes the speed of adjustment to be underestimated.[70]

The existing literature analyses late medieval market integration in the framework of comparing exchange rates of currencies with their gold-silver ratios (or the silver content). This approach implies that arbitrage operated by moving bullion and, therefore, one has to consider the impact of transport costs on arbitrage decisions. Although transport costs in terms of the weight-unit ratio were lower in moving bullion than any other commodity, the risk premium – one component of transport cost – was likely to be exceptionally high at a time notorious for warfare and banditry.[71] In order to emphasise the role of information, this chapter measures the degree of exchange market integration by investigating the effectiveness of triangular arbitrage, an approach which was employed by Schubert in his study of eighteenth-century exchange markets.[72] Regarding the difference between direct- and cross-exchange rates as a potential arbitrage opportunity, instead of shipping bullion, merchants exploited the arbitrage opportunity by remitting money via different routes. Thereupon, this method further eliminates the effect of transport cost on the effectiveness of arbitrage, and, meanwhile, focuses on information transmission.

2.3 The economic and political context

In the Middle Ages, the value of currency was mainly determined by its metallic content. The exchange rate was affected by changes in monetary standards either at home or abroad. Thus, for example, the Venetian-Bruges exchange rates (quoted at a variable number of Venetian grossi a oro for one Flemish franc) fell when the standard of Flemish money deteriorated or that of Venetian money improved. Conversely, enhancing the standard of Flemish or debasing Venetian currency would result in the rise of exchange rates. Apart from this, the state of trade and government intervention also affected the movement of exchange rates. The political

[70] Federico, 'Market integration in Europe', p. 487.
[71] A. M. Watson, 'Back to gold- and silver', *Economic History Review*, 20 (1967), p. 22.
[72] Schubert, 'Arbitrage'.

situation, which always has a great impact on commerce, and the regulation of 1399-1401 imposed on the Bruges exchange market are addressed here as the historical background against which the analysis of exchange market integration at the turn of the fifteenth century is set.

Monetary standard: Venice

The l./s./d. money-of-account system used in the Middle Ages was inherited from Charlemagne's monetary reform. The basis unit was the denaro. The soldo was equivalent to a dozen denari and the lira to a score of soldi.[73] Until the thirteenth century, the denaro was the only denomination of coins being struck; the soldo and lira remained units of money of account. After repeated currency debasements, however, the denaro gradually lost its value over time. Furthermore, the revival of commerce at the time provided the incentive for striking coins with large denomination and high bullion content. In 1201 Venice began to issue grossi, which represented multiple values of the debased denaro. Afterwards, two concurrent money-account systems came into use. One was based on the old denaro (piccolo), the other on the new issue of grosso.[74] By the time of Datini, the grosso system predominated.

In 1284, Venice, following Florence and Genoa, started to mint its own gold coins, the ducate d'oro. The Venetian ducat was the fineness of 24 carat (pure gold) and weighted at 3.56 grams. The metallic content of the Venetian ducat remained unchanged until the fall of the Republic in 1796. The face value in terms of soldi and denari given to the ducat depended on the price of gold in the market. By the beginning of the fourteenth century the value of 24 grossi to the ducat became fixed. In order to accord with prices set against silver, money-of-account made a distinction between the *lire di grossi in monete* based on silver coins and the *lire di grossi a oro* based on the ducat.[75] The exchange rates in Venice on Bruges and Paris reported in

[73] Not only was Venetian monetary system based on this system, but also many other European currency regimes, including the other three markets (Bruges, Barcelona and Paris) discussed here. P. Spufford, *Handbook of Medieval Exchange* (London, 1986), p. xxii.
[74] P. Spufford, *Money and Its Use in Medieval Europe* (Cambridge 1988), pp. 225-6; F. C. Lane and R. C. Mueller, *Money and Banking in Medieval and Renaissance Venice* (Johns Hopkins University Press), pp. 113-23.
[75] Spufford, *Handbook*, p. 91; Lane and Mueller, *Money and Banking*, pp. 333-6.

Datini's commercial letters were quoted at a variable member of Venetian grossi a oro for one Flemish franc and one French franc, respectively.[76]

Monetary standard: Flanders

Before the House of Burgundy's acquisition of Flanders, the monetary standard there was very unstable and the intrinsic value of Flemish coins changed from time to time. In order to exact profits, the intrinsic and nominal values of Flemish coinage under the Counts Louis de Nevers and Louis de Male were frequently altered: the number of alterations amounting to 32 times in gold and 23 times in silver between 1330 and 1384.[77] The confusing state of Flemish coinage was compounded by the use of foreign currencies. Flanders, being the junction of interregional trade, naturally accepted many foreign coins as legal tender, in particular those issued at the French mints and Rhenish areas. The monetary influence of France over Flanders can be observed from its bookkeeping and debt reckoning. In parallel with Flemish money-of-account, account books were commonly expressed in French money-of-account.[78] For example, the franc, a type of French gold coin, was commonly used as money-of-account in Flemish official documents.[79]

The tumultuous monetary state prevailing in Flanders had been alleviated and the Flemish monetary system grew to predominate in the neighbouring areas during the rule of the House of Burgundy. Through marriage, Philip the Bold, Duke of Burgundy, succeeded Louis de Male as Count of Flanders in 1384. In the same year, he restored the health of the Flemish coinage, strengthening the silver coinage by 21 per cent and the gold by 29 per cent in terms of precious metal content.[80]

[76] Mueller, *Venetian Money Market*., pp. 594-6.
[77] F. Blockmans and W. P. Blockmans, 'Devaluation, coinage and seignorage under Louis de Nevers and Louis de Male, counts of Flanders, 1330-84', in N. Mayhew, ed., *Coinage in the Low Countries, 880-1500, The Third Oxford Symposium on Coinage and Monetary History* (Oxford, 1979), p. 76.
[78] D. Nicholas, 'Commercial credit and central place function in thirteenth-century Ypres', in L. Armstrong, I. Elbl and M. M. Elbl, eds., *Money, Markets and Trade in Late Medieval Europe: Essays in Honour of John H.A. Munro* (Leiden, 2007), pp. 313-4.
[79] The franc was originally a type of French gold coin with a face value of one livre tournois. Soon the franc became synonymous with one livre tournois as money-of-account.
[80] V. Gaillard, ed., *Recherches sur les monnaies des comtes de Flandre, vol. II: Sous les règnes de Louis de Crécy et de Louis de Male* (Ghent, 1856), pp. ; L. Deschamps de Pas, *Essai Sur L'Histoire Monetaire des Comtes de Flandre de la Maison de Bourgogne: Et Description de Leurs Monnaies D'or et D'argent* (Paris, 1863), p.5.

Furthermore, he concluded a monetary agreement with Duchess Joanna of Brabant to strike a common coinage, which would circulate in their two regions. In order to submit Brabant to the Flemish monetary system, Philip the Bold soon reneged on the agreement and debased his own coinage and waged monetary war against the Duchy of Brabant in 1386-8. In these three years, he debased the silver coinage by 51 per cent and the gold by 58 per cent. Faced with this scale of debasement, Brabantine mints could not compete with the Flemish for precious metals and finally had to close down. The Duchess Joanna succumbed to pressure to sign another monetary agreement in 1389, which required her to give up the issue of coinage.[81] Once Brabant yielded to the hegemony of Flemish money, Philip the Bold ceased to debase the coinage and instituted a monetary reform which increased the bullion content of Flemish coinage and re-coined the previous issues.[82] Thereafter, the monetary standard in Flanders remained stable for eighteen years.

The scarcity of bullion was a chronic problem in late medieval Western Europe.[83] The monetary famine began to be felt in Flanders by the late fourteenth century.[84] As early as 1392, the Ghent mint ceased to produce coinage. The Bruges mint closed down later in 1399. The Flemish mints remained inactive until the resumption of minting in 1410.[85] John the Fearless, who had inherited the County of Flanders from his father, Philip the Bold, planned a monetary reform to strengthen Flemish coinage in 1407. However, the operation turned into total chaos and was withdrawn within a few weeks.[86] The monetary failure of 1407, however, did not discourage the Duke at all. Two years later, he embarked on another monetary reform to successfully

[81] Three years later, Joanna broke the agreement and resumed minting in May 1392. However, it did not stop the inflow of Flemish coins and the influence of its monetary system.
[82] The ordinance of December 1389 ordered a strengthening of the silver coinage by 32 % and the gold by 37%. J. H. Munro, *Wool, Cloth, and Gold: The Struggle for Bullion in Anglo-Burgundian Trade, 1340-1478* (University of Toronto, 1972), Table J and K.
[83] The issue of bullion famine in late medieval Europe is still open to dispute. N. Sussman, 'Missing bullion or missing documents: a revision and reappraisal of French minting statistics, 1385-1415', *Journal of European Economic History*, 19 (1990), pp. 147-62; idem, 'The late medieval bullion famine reconsidered', *Journal of Economic History*, 58 (1998), pp. 126-54.
[84] J. Day, 'The great bullion famine of the fifteenth century', Past and Present 79 (1978), pp. 3-54. For the mint output of Flanders, see J. H. Munro, 'Warfare, liquidity crises, and coinage debasements in Burgundian Flanders, 1384-1482: monetary for fiscal remedies?', University of Toronto, Working paper 355 (2009), Table 2.
[85] D. Nicholas, *Medieval Flanders* (Longman, 1992), p. 375; Munro, *Wool, Cloth, and Gold*, Graph II and Table B.
[86] W.P. Blockmans, 'La participation des sujets flamands àla politique monétaire des duc de Bourgogne', in *Revue belge de numismatique*, vol. 119 (1973), pp. 105-6.

enhance the bullion content of the silver coinage by 16 per cent and the gold (in terms of the noble) by 20 per cent.

After this, Flanders retained monetary stability for another seven years until the debasement of 1416.[87] In the face of the English debasement of 1411-2 and the French debasement following the military disaster in Agincourt, John the Fearless resorted to striking new coins containing less precious metal so as to maintain the activities of his mints.

During the period covered by the analysis below, the bullion content of Flemish coins remained unchanged. Moreover, the Venice-Bruges and Bruges-Barcelona exchange rates were based on imaginary currencies: the Flemish franc and Flemish écu, respectively. The Flemish franc was an imitation of the French franc issued by Louis de Male. As mentioned, Flemish money in the time of Louis de Nevers and Louis de Male suffered constant alteration. The public lost faith in Flemish gold coins; therefore, in 1361 the Count of Flanders instructed the mint to strike a franc in imitation of the French franc issued the year before.[88] The Flemish franc was struck at 63 1/3 taille per marc de Troyes (equivalent to 3.867 grams weight per franc) and with a fineness of 24 carats. The issue of the Flemish franc spanning three years, 1361-4, amounted to about 157,757 Flemish pounds and less than one and half millions pieces.[89] By the time of Datini, the Flemish franc may have disappeared from circulation after repeated monetary alterations in Flanders and been used only as money-of-account. Mueller regards Flemish franc referred to in the Venice-Bruges exchange quotations as money-of-account of a fixed value of 33 Flemish groots.[90] Although the Flemish écu was real money, the écu used in quoting Bruges exchange rates was also regarded as money-of-account. The écu used in the Bruges-Barcelona exchange rates was given a value of 22 Flemish groots, but of 24 groots for Bruges-London quotations.[91] Hence, one can safely exclude Flemish monetary alterations as a source of exchange fluctuation.

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[87] Munro, 'Warfare, liquidity, crises', Table 1.A.
[88] H., Van Werveke, 'Currency manipulation in the Middle Ages: the case of Louis de Male, Count of Flanders', *Transactions of the Royal Historical Society*, 31 (1949), p. 121.
[89] Marc de Troyes is the mint-weight unit equivalent to 244.753 grams in Flanders. Blockmans, 'Devaluation', Table 6.
[90] Mueller, *Venetian Money Market*., pp. 594-5.
[91] Blockmans, 'Devaluation', Table 6; de Roover, *Bruges Money Market*, pp. 21-2.

Monetary standard: France

Medieval rulers were expected to live on their own income, e.g. from feudal rents, income generated from royal domains and revenues from some sale taxes (the wool tax in England and the salt tax in France, for instance). These revenues were barely sufficient for the daily expenses of the royal household. Rulers had frequently to ask the parliament or representative assemblies to increase taxes and grant money. Besides, rulers could also borrow from the merchant class. However, taxation took a long time to negotiate and collect, and loans always required valuable pledges. They were not efficient ways to raise money in times of emergency. Hence, the French crown often relied on currency debasement to raise money quickly, during wartime in particular.[92] In the Middle Ages, the most severe and frequent French debasement occurred during the Hundred Years War.[93]

The French monetary disorder – the repeated debasement and reinforcement and constant changes in the face value of coins – continued until the 1360s. In the Battle of Poitiers (1356), John the Good was captured by the English and later a colossal ransom for his freedom of 3 million écus was settled.[94] A reform of the French monetary system came together with the new issue of francs. The first issue of French francs, the franc à cheval, was issued in 1360-4 to celebrate his return to France. The French franc was gold coin of 63 taille per marc de Troyes (equivalent to 3.906 grams weight per franc) and 24 carats fineness; and the face value was given at one livre tournois.[95] From then onwards, the term franc became equivalent to the livre. Unlike the Flemish franc, though used as money-of-account (one livre tournois), the franc à pied was still in production and being used as real coin at the beginning of

[92] Because English wool was the most sought-after material in the medieval textile industry, the English king was better financially equipped than his French counterpart with the help of the customs revenue and large loans from the Italians based on wool exports.
[93] H. A. Miskimin, *Money, Prices and Foreign Exchange in Fourteenth-Century France* (Yale, 1963), pp. 36-52; N. Sussman, 'Debasements, royal revenues, and inflation in France during the Hundred Years' War, 1415-1422', *Journal of Economic History*, 53 (1993), pp. 44-70.
[94] The ransom for John II was colossal, compared with others. The ransom paid for Richard the Lionheart was about 23 tons of silver and 11 tons of silver were paid for the Teutonic Knights captured by the Poles at Tannenberg in 1410. For John's ransom, over 1 million écus were actually paid, which was roughly equivalent to 48 tons of silver. O. Volckart, *Die Münzpolitik im Deutschordensland und Herzogtum Preußen von 1370 bis 1550* (Wiesbaden, 1996), PhD thesis.
[95] Marc de Troyes is the mint-weight unit equivalent to 246.084 grams in France. Taille per marc is the number of deniers (1d) struck from the marc of the given fineness. A. Blanchet and A. Dieudonné, *Manuel de numismatique Française*, vol. 2: *Monnaies royales Françaises depuis Hugues Capet jusqu'a la Révolution* (Paris, 1916), p. 256.

the fifteenth century. In 1407, the Flemish authorities gave official values to several gold coins of domestic and foreign origin circulating in Flanders, of which the French franc was one. A good French franc was given an official value of 32 groots.[96] However, the Flemish franc was not mentioned in the proclamation of 1407 which confirms the statement that the Flemish franc was entirely withdrawn from circulation and functioned only as money-of-account.

In spite of several minor reductions in the bullion content of French coinage later, the reform of 1360 successfully restored France's monetary stability. Still, the country had to face the problem of old issues of coins remaining in circulation and the shortage of small change. Nonetheless, a stable monetary system was maintained until the resumption of English invasions in 1415 and a new burst of currency debasements began in the late 1410s.[97]

Opportunities of arbitrage in the exchange market could derive from changes in market conditions and political situations, monetary alteration and seasonal patterns of trade. As the monetary standard in France and Flanders at the turn of the fifteenth century remained stable, the element of change in monetary standards in arbitrage is largely eliminated. The rest of this section outlines the impact of the Hundred Years War on the transaction cost of international trade, the development of the political situation in France and the Flemish monetary regulations in 1399-1401.

The direct sea-route between Italy and North-western Europe had been established from the early fourteenth century. As the consequence of continuous warfare in the Mediterranean and Western Europe, a sharp increase in the transaction costs of international trade diverted trade from overland to the sea-route. In contrast to the conventional wisdom, Van der Wee and Munro argue that the move to the sea-route may not have been as cost-effective as was long believed and it could have also caused the decline of interregional fairs (and consequently, the decline of commerce).[98] Around 1400, a relatively peaceful atmosphere prevailed in

[96] de Roover, *The Bruges Money Market*, pp. 68-9.
[97] N. J. Mayhew, *Coinage in France from the Dark Ages to Napoleon* (London, 1988), pp. 86-100. For the French currency debasements in the 1420s see Sussman, 'Debasements' and Munro, *Wool, Cloth, and Gold*, Tables I and II.
[98] J. Munro, 'The Low Countries's export trade in textile'; H. van der Wee, 'Structural changes in European long-distance trade, and particularly in the re-export trade from South to North, 1350-1750',

the monarchies of North-western Europe. Due to the exhaustion of financial sources and the rule of minority sovereigns in both England and France, military campaigns temporarily came to a halt and a fragile truce was made and repeatedly prolonged between these hostile nations in the period of 1380-1415.[99] Despite the end of warfare in France, the land routes connecting Italy and Western Europe were not entirely safe from pillaging *routiers,* often unemployed mercenaries and disbanded soldiers, who were terrorising the French countryside. Although the relatively peaceful atmosphere at the time allowed a revival in overland trade between Italy and Northern France and Flanders, merchants had to face a substantial risk to undertake business, which reflected on a much greater transaction cost. With this hostile business environment and volatile markets, the accurate analysis of flows of news and prompt action on it became critical elements in conducting trade.

Despite the peace maintained among the belligerents, France was plunged into political disarray and internal power struggles. Charles V died in 1380 before he could completely expel the English from France and left a financially exhausted and religiously disunited country to his 12-year-old son, Charles VI. As the king was a minor, his uncles ruled on his behalf until 1388. A few years after assuming power, Charles VI became mentally ill and the control of government fell into the hands of Philip the Bold, Duke of Burgundy and his brother the Duke of Berry. Philip the Bold, also Count of Flanders at the time, not only diverted French royal revenue to his own uses but also directed French foreign policy, towards England in particular, to his own benefit. The struggle to control power in the French court escalated as John the Fearless tried to maintain influence and control after the death of his father and clashed with the Duke of Orleans. The rivalry between these two great nobles ended with the public murder of the Duke of Orleans in 1407. [100] The animosity among the French nobles had a far-reaching effect on the later development of Anglo-French conflicts.

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in J. D. Tracy, ed., *The Rise of Merchant Empires: Long-Distance Trade in the Early Modern World, 1350-1750* (Cambridge, 1990), pp. 14-33.

[99] E. Perroy, *The Hundred Years War* (London, 1965), pp. 178-206.

[100] R. Vaughan, *Philip the Bold* (London, 1962); idem, *John the Fearless* (London, 1966)

The shortage of money in north Europe at the time resulted from the discontinuity in its minting and hoarding due to the frequent warfare.[101] By settling debts/bills and transferring money through bank accounts,[102] merchants could, to some degree, circumvent the dwindling supply of money. However, given the shortage of money and the idleness of mints, the Flemish authorities devised a sequence of ill-considered regulations on exchange that aimed to encourage the inflow of bullion, gold most of all, but which entirely ignored the market mechanism. In October 1399, all bills of exchange in Bruges were ordered to be paid in hard coin instead of by transfer in a bank. The next February, to encourage the inflow of gold, an ordinance further demanded that all exchange transactions should be paid in gold.[103] The undervaluing of gold was the underlying reason for the scarcity of gold coins circulating in Flanders.[104] Requiring payments to be made in gold but not raising the price for it only worsened the case. Gold in Flanders stood at a great premium to the mint price and thus merchants found it difficult and expensive to obtain. As a result, trade suffered from stringent money and stressed trading conditions. Meanwhile, foreign exchange was quoted at different rates according to whether payment was made in gold or silver: it was cheaper to pay in silver.[105] By quoting exchange in different rates, merchants, to some extent, circumvented this intrusive policy. After several appeals had been made for these regulations to be withdrawn, the authorities relented and alleviated them in July 1400. Eventually, in October 1401, the attempt to force the use of hard coin and gold to pay bills of exchange was effectively repealed.[106]

[101] Cf. p. 43, above and N. Sussman, 'The late medieval bullion famine reconsidered', *Journal of Economic History*, 58 (1998), pp. 126-54.
[102] de Roover, *Money, Banking and Credit*, p. 57.
[103] Payments had to be paid one third in gold and two-thirds in silver from May 1 to August 31, 1400, two-thirds in gold and one third in silver from September 1 to the end of the year and entirely in gold from January 1 1401 onwards. de Roover, *Money, Banking and Credit*, p. 79.
[104] Munro, *Wool, Cloth and Gold*, Graph I and H. A. Miskimin, *Money and Power in Fifteenth-Century France* (Yale University Press, 1984), Graphs I and II. The gold-silver ratio was lower in Flanders than in neighbouring countries at the time and resulted in the outflow of gold and low mint output in gold coins.
[105] de Roover, *Money, Banking and Credit*, p. 80.
[106] de Roover, *Bruges Money Market*, pp. 47-8, 54-62; idem, *Money, Banking and Credit*, pp. 78-81.

2.4 The econometric model

The dual function of bills of exchange – as means of payment and instruments of credit – rendered them indispensable in providing credit to international commerce.[107] Capital moved around to find the most productive use; consequently, one would expect that arbitrage between exchange markets was routinely practised. The effectiveness of arbitrage and the degree of financial market integration can be measured by analysing the exchange rates of major trading places. According to the law of one price, if markets are integrated, the price differential between markets is confined within the band of the transaction cost of arbitrage. Once the law of one price is violated, arbitrage works quickly to bring the price differential back to equilibrium.

On the basis of this concept, the chapter measures the degree of exchange market integration using two approaches. One is to calculate the coefficient of correlation. If markets are integrated, one should expect that price changes in one or more markets will move together. If the correlations are high, this implies that markets are integrated. The other approach is to explore the process of adjustment driven by arbitrage with the help of cointegration models. As mentioned, the more integrated markets are, the shorter the violation of the law of one price. Hence, the degree of market integration can be estimated by the speed of adjustment, which measures the length of time taken by arbitrage to restore the law of one price. If the price differential between two markets is greater than the band of transaction costs – a gain from arbitrage – an arbitrageur will move goods from where they are abundant to where they are dear. Consequently, one expects to observe the price differential to be driven back within the band.

Exchange market integration is examined by the operation of triangular exchange arbitrage. Triangular arbitrage is one of many methods that merchants used to speculate on the movement of exchange rates, but the principle is the same: buy when buying is cheap, sell when it is dear and move between markets where price differentials render profitable opportunities. According to de Roover, in the Middle Ages merchant bankers were already engaged in triangular arbitrage and thus

[107] Cf. Chapter 1.

disparities of exchange rates were only transitory.[108] According to triangular arbitrage, the difference between direct- and cross-exchange rates via the third place is equivalent to the arbitrage gain. Arbitrage operates only when the gain exceeds the costs associated with arbitrage, which are, in the case of bills of exchange, the brokerage and post fees for the second bill, the interest forgone and the increasing risk in a longer transaction. Because of transaction costs, direct-exchange is used in the state of equilibrium. Therefore, as discussed in more detail in Chapter 1 the process of adjustment can be described by a two-regime threshold error correction model, and the speed of adjustment and the transaction cost of arbitrage can be estimated.[109] The two-regime TEC model is given as follows

$$\Delta E_t^d = \begin{cases} \alpha_1\left(E_{t-1}^d - E_{t-1}^c - C\right) + \varepsilon_t^1 & if\ E_{t-1}^d - E_{t-1}^c > C \\ \varepsilon_t^1 & if\ E_{t-1}^d - E_{t-1}^c \leq C \end{cases} \quad (2.1.A)$$

$$\Delta E_t^c = \begin{cases} \alpha_2\left(E_{t-1}^d - E_{t-1}^c - C\right) + \varepsilon_t^2 & if\ E_{t-1}^d - E_{t-1}^c > C \\ \varepsilon_t^2 & if\ E_{t-1}^d - E_{t-1}^c \leq C \end{cases} \quad (2.1.B)$$

where E^d and E^c are direct- and cross exchange rates, respectively. The parameter $C > 0$ is the estimated transaction cost associated with drawing the second bill in the third place (the threshold triggering arbitrage). The parameters (α_1, α_2) measure the speed of adjustment in exchange markets in respect to direct- and cross-exchange. When the differential between direct- and cross-exchange rates (the arbitrage gain) exceeds the trading cost associated with cross-exchange, arbitrage will be triggered to bring the difference between two exchange rates below the transaction costs. Therefore, $\alpha_1 < 0$ and $\alpha_2 > 0$. A high value of the adjustment parameters indicates a rapid adjustment. Otherwise, the movement of exchange rates would follow a random walk.

With the help of Datini's exchange rates, two triangular exchange arbitrages can be tested on the exchange markets of (1) Venice, Bruges and Paris and (2) Venice, Bruges and Barcelona in the period 1399-1410. Besides estimating the degree of integration between exchange markets in these years, the event of the monetary

[108] R. de Roover, *Gresham on Foreign Exchange: An Essay on early English Mercantilism with the Text of Sir Thomas Gresham's Memorandum* (Cambridge, 1949), p. 137.
[109] Cf. Chapter 1.

regulation imposed on the Bruges exchange market around 1400 is examined to see whether this government intervention had any impact on market integration. The speed of communication between markets is used for comparison with the resulting speed of adjustment, which gives us an idea of the speed at which the exchange markets adjusted in terms of communication.

2.5 Francesco Datini and his exchange rates, 1395-1410

The exchange rate data used in this chapter come from the records of Francesco di Marco da Prato (also called Datini) & Co., a Florentine merchant banker. There are many surviving mercantile documents for the medieval period. However, most of them are either fragmentary or cover a relatively short period, and thus no satisfactory series of exchange rates can be constructed on this basis.[110] The uniqueness and importance of Francesco Datini's account books and commercial letters is that they provide a comprehensive and continuous series of commercial data from 1385 to 1410. In terms of wealth and the scale of business, Datini was one of many modest merchants who traded a wide variety of goods on a small scale and also engaged in retail selling in their own shops. Their success depended on hard work and prudent decisions, not on any monopolistic power. They had to diligently collect information from trading places and pay great attention to any changes in market conditions. One can easily observe these characteristics of market sensitivity in all of Datini's commercial letters to his agents abroad. As a result, Datini's business records preserve precious information about medieval money and commodity markets.[111]

[110] Maghfeld's account book, 1390-9, the ledger of Filippo Borromei & Co. of Bruges, 1436-40 and Medici's account book and correspondence.

[111] The surviving Datini documents are now stored at the State Archives in Prato. Francesco Datini died without legitimate heirs and left most of his wealth, including all his business documents, to a charitable foundation which he had founded. A vast number of these mercantile documents were discovered in 1870 in a disused stairwell. The collection includes some five hundred account books and ledgers, over a hundred thousand letters and many other miscellaneous commercial items. I. Origo, *The Merchant of Prato* (Jonathan Cape, 1957); J. Gies and F. Gies, *Merchant and Moneymen* (London, 1972), pp. 183-97; de Roover, *Bruges Money Market*, pp. 15-20. Some of Datini's documents can be seen online, http://www.istitutodatini.it/schede/archivio/eng/arc-dat1.htm (the last visit to the website 31 was on July 2012).

In 1350, Francesco Datini began his merchant career in Avignon. After nine years of hard work, he, in partnership with another merchant, established a firm to deal chiefly in armour. After success in the armour business, he entered partnerships with other Tuscan merchants and expanded the range of his trade: dealing in cloth, spice, salt and many other miscellaneous items; opening a wine tavern and a draper's shop; and even setting up a money changer's table.

When Datini finally returned to his hometown, Prato, in 1382, he was a wealthy man. He did not retire to a comfortable rural life, but opened several branches in major trading cities to facilitate his international business: Pisa in 1382, Florence and Genoa in 1392 and then Barcelona, Valencia and the Island of Majorca in 1393-4. He also entered the cloth business by setting up a wool shop and a dyeing house in Prato. Besides wool imported from the western Mediterranean, he also purchased wool from England. Instead of setting up a branch in London, he depended upon the already established Tuscan firms to buy up English wool and probably used bills of exchange drawn on Bruges to pay for them.

Although Bruges was the most important trade and exchange centre in North Europe, Datini did not establish a branch in Bruges. However, he maintained close communication with this northern commercial centre through letters to other Florentine firms already established there. He used Florentine firms to facilitate his payments and remittance of funds to Bruges, which is apparent in the collection of exchange rates quoted in Bruges on other trading places: Barcelona, Genoa, London, Paris and Venice.[112] By correspondence with the Florentines in Bruges, he gathered information on the course of the exchange and gave instructions about buying and selling in the exchange market. This network of intensive correspondence enabled Datini to join in speculating on exchange markets. In June 1399, for instance, the Orlandini, among Datini's correspondents in Bruges, suggested that the Barcelona branch should not remit money to Genoa but to Paris or Venice instead, because of the currency debasement in Genoa.[113]

In addition to exploiting the flow of information, the seasonal pattern of trade provided opportunities for speculation in the money markets. During the fairs or

[112] de Roover, ibid, Appendix I.
[113] Ibid., p. 54.

when the Venetian galleys left for the Levant, money markets were tight because of the high demand for money. Therefore, it was favourable for merchants to remit but not to draw money and to act conversely when the money market eased. According to the exchange rates quoted in Datini's letters, the seasonal variance of the money market was reflected in the fluctuation of the exchange rates. Money was tight in Bruges during the fairs after Easter and in late autumn when the Venetian galleys arrived. Money was usually relaxed in winter when the flow of trade was interrupted by the bad weather.[114] In Venice, the high demand for money in June and July preceded the departure of the galleys bound for the Levant, which always carried a huge amount of specie to make up the balance of trade. Money eased and exchange rates fell after the sailing season in September.[115]

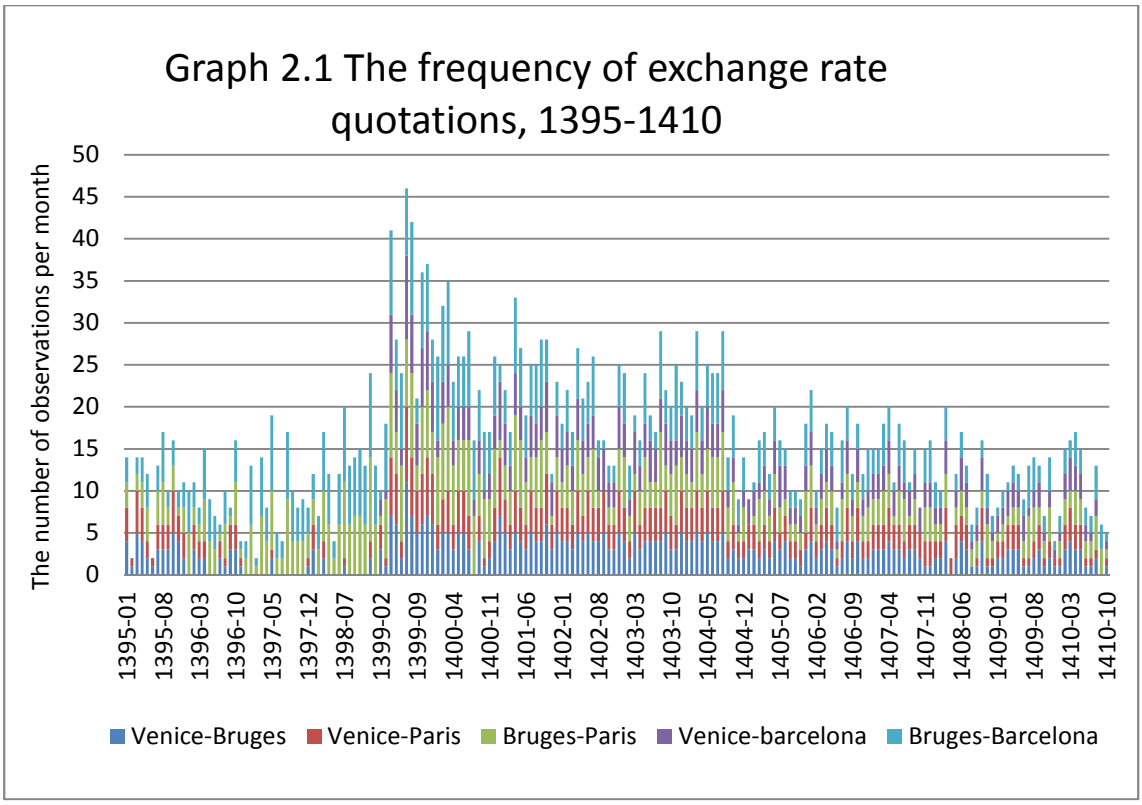
Datini's mercantile records show that medieval merchants were well informed about changes in distant markets and took full advantage of seasonal variance in the money markets. Some degree of integration between money markets had already been in place at the turn of the fifteenth century. Therefore, the integration between exchange markets is not a matter of "either/or", but rather "to what degree". The following sections will use the exchange rates quoted in Datini's documents to answer the question of how far the market was integrated in the late Middle Ages and how large the transaction costs involved in arbitrage were.

The direct- and cross-exchange rates

As pointed out earlier, the approach used here to estimate the degree of exchange market integration is to look at the deviation between direct-exchange rates and cross-exchange rates. Apart from being data-driven, Venice and Bruges, two major exchange centres in Europe, are ideal choices for studying exchange market integration between South and North Europe. At the time, the speed of communication largely depended on the distance between two places. In order to explore the effect of communication on market integration, Paris and Barcelona are thus chosen for comparison.

[114] Ibid., pp. 48-50.
[115] Mueller, *Venetian Money Market*, pp. 303-10.

The exchange rates between Venice, Bruges, Barcelona and Paris quoted in Datini's documents have been compiled by Mueller and de Roover. The exchange rates quoted in Venice were collected by Mueller and de Roover's data are those quoted in Bruges and Barcelona.[116] The Venice-Bruges and Bruges-Paris exchange rates span from 1384 to 1411, the Venice-Paris from 1388 to 1411. Before the year 1395, the exchange rate data are very fragmentary. Hence, the analysis will deal only with the period January 1395-October 1410, in which exchange rates are quoted more regularly. The continuous exchange rates associated with Barcelona are available for a shorter period: Venice-Barcelona from 1399-1411 and Bruges-Barcelona from 1395-1410. Over these years, Datini's documents recorded 525, 522, 474, 761 and 799 quotations of the Venice-Bruges, Venice-Paris, Venice-Barcelona, Bruges-Paris and Bruges-Barcelona exchange rates, respectively. The frequency of quotations each month over the period concerned is presented in Graph 2.1. It can be observed that, from 1399 onwards, the quotation of exchange rates became more abundant: for most months, at least two data points are recorded.



Source: R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968); Medieval and Early Modern Data Bank (MEMDB): Currency exchanges (Mueller) http://www2.scc.rutgers.edu/memdb/index.html

[116] See footnote 17.

The weekly exchange rates are taken from the average of exchange rates available in each week. For those weeks without any quotation, two interpolation methods are applied. In order to avoid distorting the analysis, omitted exchange rates less than or equal to 4 data points in a row are estimated by linear interpolation. Otherwise, the missing data are estimated by cardinal spline interpolation and polynomial extrapolation.[117] In addition to these direct-exchange rates, there are two series of cross-exchanges concerned: (1) the exchange rates on Paris drawn from Venice via Bruges and (2) those drawn from Venice to Barcelona via Bruges. The weekly direct- and cross-exchange rates of Venice-Paris and Venice-Barcelona and the differences between them of 1399-1410 are reported in Appendices 2.A and 2.B.[118]

As discussed, the Flemish franc and écu and the French franc appearing in exchange quotations were used as money-of-account. Hence, the weekly Venice-Bruges-Paris cross-exchange rates (at a variable number of Venetian grossi a oro for one French franc) can be calculated under the following format: $E_t^{vbrup} = \frac{E_{t-4}^{brup}}{33} * E_t^{vbru}$, where E^{vbru}, E^{brup} and E^{vbrup} are the Venice-Bruges, Bruges-Paris direct-exchange rates and Venice-Paris cross-exchange rates via Bruges, respectively.[119] The weekly Venice-Bruges-Barcelona cross-exchange rates (at a variable number of Barcelonese denari per Venetian ducat) are calculated at $E_t^{vbrubar} = \frac{24}{E_t^{vbru}} * 1.5 * E_{t-4}^{brubar}$,where E^{vbru} , E^{brubar} and $E^{vbrubar}$ are the Venice-Bruges, Bruges-Barcelona direct-exchange rates and Venice-Barcelona cross-exchange rates via Bruges, respectively.[120] Because of the time element, the Bruges-Paris and Bruges-Barcelona exchange rates available in Venice to calculate cross-exchange rates are those at time t-4.[121]

[117] For the cardinal spline interpolation, the tension parameter is set at 0.1.
[118] There are 7 out of 11 linear interpolations for the Venice-Bruges exchange rates, 8 out of 12 for Venice-Paris, 2 for Venice-Barcelona, 7 for Bruges-Paris and 3 for Bruges-Barcelona.
[119] The figure of 33 is the fixed face value of one Flemish franc.
[120] The ratio between the Flemish franc and Flemish écu was 1.5 and 24 Venetian grossi a oro were equal to one Venetian ducat.
[121] The speed of communication around 1400 between Venice and Bruges was about one month; thus the current calculation of Venice-Bruges-Paris cross-exchange rates is based on the Bruges exchange rates which prevailed four weeks before.

Take the exchange rates in the first week of 1403 as an example here (see Appendix 2.A). In order to receive a French franc in Paris, Venetian merchants could buy a bill directly drawn on Paris at a rate of 21 Venetian grossi a oro in Venice. Alternatively, Venetian merchants could draw a bill on Bruges and at the same time instruct the agent in Bruges to draw the second bill of one French franc on Paris. In the first week of 1403, the Venice-Bruges exchange rate stood at 19.5 Venetian grossi a oro for one Flemish franc and the latest available information about Bruges-Paris exchange rate (week 49, 1402) showed 35.125 Flemish groots for one French franc. As the Flemish franc was used as money-of-account at a fixed value of 33 Flemish groots, the cross-rate between Venice and Paris via Bruges for one French franc was 20.756 ($\frac{35.125}{33} * 19.5$) Venetian grossi a oro. The cross-rate was 0.244 grossi (1.16%) lower than the direct-rate.

Did this scale of difference justify the use of cross-exchange? The answer depends on two elements: (1) the transaction cost associated with cross-exchange and (2) (arbitrageur's expectation of) the future movement of the Bruges-Paris exchange rates. According to merchants' handbooks published at the time, the brokerage charge in Bruges ranged between 0.033 and 0.091 per cent.[122] Besides the brokerage fee for drawing the second bill in Bruges on Paris, there were also an extra post fee and the opportunity cost of the money involved in the second bill. If not drawing the second bill, the money could have been employed in other productive uses. Hence, the opportunity cost associated with the cross-exchange greatly depended on the interest rate and the length of time which elapsed before receiving money at the destination. The length of time was determined by the usance and speed of communication between the third place and final destination. The usance of a Bruges-Paris bill was 10 days after sight and the speed of communication was about 3-5 days (see Table 2.1). Thus, the opportunity cost of using the Venice-Bruges-Paris cross-exchange was the loss of interest over these two weeks. According to Booth, the annual interest rate concealed in exchange dealings was about 12 -14 per

[122] The brokerage fee of bills drawn on London was higher, amounting to 0.208%. In the case of bills drawn on Barcelona around 1425, the rate was about 0.091%. The rate for Italian bills was lower, only amounting to 0.033%. de Roover, *Bruges Money Market*, p. 29; idem, *Money, Banking and Credit*, p. 55.

cent.[123] The opportunity cost of cross-exchanging between Venice and Paris via Bruges approximated to 0.48 per cent.

Table 2.1 Exchange figures quoted in Venice, Bruges and Barcelona and the speed of communication between these places around 1400

place	Where quoted	Usance	Speed of communication*
	In Venice		
Barcelona	a variable number of Barcelonese denari for one Venetian ducat	2 months	40-45 days[a]
Bruges	a variable number of Venetian grossi a oro of account per Flemish franc (33 Flemish groots)	2 months	30-35 days[b]
Paris	a variable number of Venetian grossi a oro of account per French franc	2 months	28-30 days[b]
	In Bruges		
Barcelona	a variable number of Barcelona denari per Flemish écu (of 22 Flemish groots)	30 days after sight	22-23 days[c]
Paris	a variable number of Flemish groots per French franc	10 days after sight	3-5 days[d]
Venice	a variable number of Flemish groots per Venetian ducat	2 months	30-35 days
	In Barcelona		
Bruges	a variable number of Barcelona denari per Flemish écu (of 22 Flemish groots)	30 days after sight	22-23 days
Venice	a variable number of Barcelonese denari for one Venetian ducat	2 months	40-45 days

Source: R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968), Table I and II; Mueller, R. C., *The Venetian Money Market: Banks, Panics, and the Public Debt, 1200-1500* (Baltimore, 1997), pp. 594-7

Note: * It is here assumed that the speed of communication between two places is reciprocally consistent.

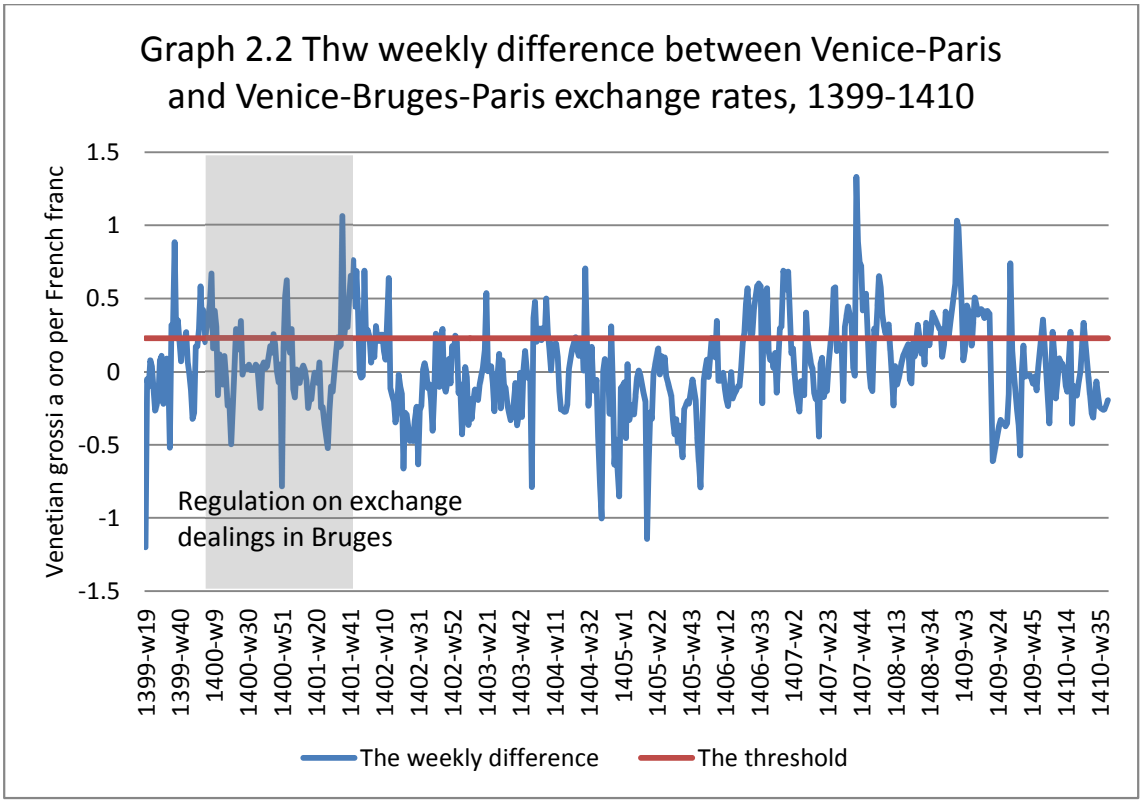
a. Archivio di Stato di Prato: Fondo Datini http://datini.archiviodistato.prato.it/www/indice.html. b. According to Spufford, couriers in the late Middle Ages, on average, covered 30-40 kilometres per day. At this speed, the speed of communication can be approximately estimated. P. Spufford, *Power and Profit: the Merchant in Medieval Europe* (London, 2002), p. 200. c. R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968), p. 22. d. P. Spufford, *Handbook of Medieval Exchange* (London,1986), pp. 320-1.

[123] Booth, 'Foreign-exchange profit', p. 139.

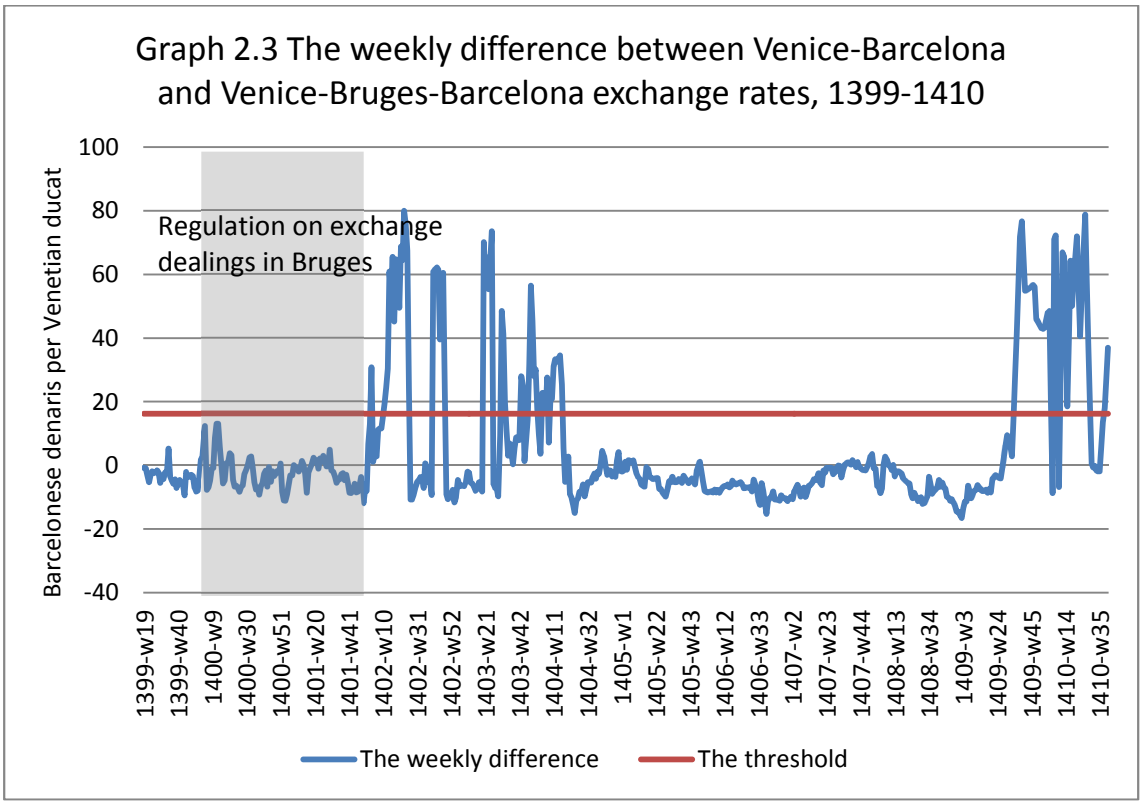
Merchants also had to consider the movement of Bruges-Paris exchange rates between the time when the cross-exchange rates were calculated and the time when the second bill was drawn. Because of slow communication, the ex-ante cross-exchange was not equal to the ex-post. The cross-exchange rate was calculated on the Bruges-Paris exchange rate in the last period (time t-4) and exchange rates in Bruges could have deviated from this when the second bill was actually drawn (time t+4). If during the period of communication the Bruges-Paris exchange rates suddenly increased, the gain from using cross-exchange would fall or even turn into a loss. At the same time, the benefit from a cross-exchange would increase if the Bruges-Paris exchange declined. Whether engaging in arbitrage or not, one had to take the future movement of exchange rates in the third place into consideration, in other words, the speculation on the future movement of exchange rates. Hence, the difference of exchange rates has to be large enough to offset the likelihood of loss caused by sudden changes in exchange rates. The uncertainty associated with the fluctuation of exchange rates in the third place is also part of the transaction cost of cross-exchange.

As shown in Appendix 2.A, the Bruges-Paris exchange rate rose to 35.75 Flemish groots in week 5, 1403 (when the agent in Bruges received instructions to draw the second bill). In this example, the ex-post cross-exchange rate was 21.125 grossi, which was 0.125 grossi higher than the direct-exchange rate, 21 grossi. Instead of making profit, merchants would lose money due to the change in Bruges-Paris exchange rates during the transaction of the first bill. Because of slow communications, exchange arbitrage at the time always involved with speculation on the movement of exchange rates in the third place.

The weekly differences between the Venice-Paris and Venice-Bruges-Paris exchange rates in 1395-1410 are shown in Graph 2.2 and those between Venice-Barcelona and Venice-Bruges-Barcelona in Graph 2.3. The differences between the Venice-Paris direct-rates and cross-rates fluctuate around zero and the size of the difference is banded within the rate of 0.228 Venetian grossi a oro for one French franc (about 1 per cent). The number of positive differences (322) is similar to the number of negative ones (273). By contrast, the fluctuation in the difference



Source: Appendix 2.A



Source: Appendix 2.B

between Venice-Barcelona direct- and cross-exchange rates is huge and over two-thirds of the observations (400 out of 595) are below zero. Two exceptional periods for arbitrage on the Venice-Barcelona cross-exchange occurred in 1402-4 and 1409-10. The sudden surge in Venice-Barcelona exchange rates made it profitable to remit money via Bruges.[124] The different pattern of exchange rate differentials and arbitrage opportunities illustrated in the two graphs largely reflects the flow of trade between these markets, which will be further discussed later.

2.6 Analysis and interpretation of the results

As discussed in Chapter 1, the degree of market integration can be simply measured by looking at whether prices of the two markets are correlated. If the price for the same good moved up and down similarly in the two markets, it indicates that these markets were, to some extent, integrated. Hence, the correlation coefficient for the price of a given currency quoted in the two markets can be used to measure how closely the exchange markets were integrated. Table 2.2 reports the coefficients of correlation for the levels and the first differences of the Venetian ducat, Genoese florin and French franc.[125] The correlation coefficient of the level measures the co-movement of price itself and the first difference shows that of the changes in price between two places.[126] The closer the correlation coefficient is to 1, the more integrated the market is.[127]

The correlation coefficients are consistently high for the level for three types of gold coin, but vary greatly for the first difference. Comparing the results in Table 2.2 with the correlation coefficients of the share prices between London and Amsterdam in the eighteenth century, the exchange markets around 1400, in terms of the level

[124] See Appendix 2.B.
[125] The price of the three coins in Barcelona and Venice are converted to Flemish money-of-account by multiplying exchange rates, and then the coefficients of correlation are calculated.
[126] Let x_1 and x_2 be the price of the Venetian ducat in market 1 and 2, the correlation coefficient for the level is $r_{x_1x_2} = \frac{\sum_{i=1}^{n}(x_{i1}-\bar{x}_1)(x_{i2}-\bar{x}_2)}{\sqrt{\sum_{i=1}^{n}(x_{i1}-\bar{x}_1)^2 \sum_{i=1}^{n}(x_{i2}-\bar{x}_2)^2}}$; for the first difference $\hat{r}_{x_1x_2} = \frac{\sum_{i=1}^{n}(\Delta x_{i1}-\overline{\Delta x}_1)(x_{i2}-\overline{\Delta x}_2)}{\sqrt{\sum_{i=1}^{n}(\Delta x_{i1}-\overline{\Delta x}_1)^2 \sum_{i=1}^{n}(\Delta x_{i2}-\overline{\Delta x}_2)^2}}$, where $\Delta x = x_t - x_{t-1}$
[127] Federico, 'Market integration in Europe', p. 482.

of correlation coefficient, seem not too far away from the level of integration achieved in eighteenth-century stock markets. The coefficients of correlation for the first difference are much lower but are close as those of the South Sea Company.[128] The co-movement test shows that exchange markets around 1400 were fairly well integrated by eighteenth-century standards. However, the coefficients of correlation shed little light on the processes of price adjustment and convergence and the level of transaction cost associated with arbitrage.

Table 2.2 The coefficients of correlation for prices of three gold coins around 1400

	Venetian ducat	Genoese florin	French franc
Bruges-Barcelona			
Levels	0.884	0.782	-
First differences	0.282	0.351	-
Bruges-Venice			
Levels	-	-	0.891
First differences	-	-	0.086

Source: R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968); Medieval and Early Modern Data Bank (MEMDB): Currency exchanges (Mueller) http://www2.scc.rutgers.edu/memdb/index.html

In what follows, attention turns to estimating the degree of integration and level of transaction costs in the framework of the TEC model described above. The model given in Equations (2.1.A) and (2.1.B) is based on the assumption of price differences ($E^d - E^c$,ΔE_t^d ,ΔE_t^c) in a stationary process. When arbitrage operates, shocks will not have a long-term effect on exchange rates and differences between two exchange rates will eventually return to the band of transaction costs. The hypotheses of unit root and stationarity are tested to see whether a long-term effect of shocks on the exchange series exists, which invalidates the ideal of arbitrage underlying the TEC model.

The results are reported in Tables 2.3 and 2.4. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests examine the series of exchange rates for the unit root and the Kwiatkowski-Phillips-Schmid-Shin (KPSS) test for the stationarity hypothesis. Tables 2.3 and 2.4 clearly demonstrate that the hypothesis of unit root

[128] Neal, 'Integration and efficiency', p. 101.

can be rejected at 1% significance level by the ADF and PP tests. The stationary hypothesis is rejected at the 5% and 10% levels by the KPSS test in some level series, however, for the first differences the hypothesis cannot be rejected. The exchange rate series can be regarded as integrated of order one. Hence, the tests support the use of the TEC model to estimate the speed of adjustment in the exchange markets.

Table 2.3 The result of the unit root and stationarity tests for the Venice-Paris and Venice-Bruges-Paris exchange rates

	ADF test	PP test	KPSS test
		1399-1410	
Δ Venice-Paris (ΔE^{vp})	-13.9876***	-14.0319***	0.1385
Δ Venice-Bruges-Paris (ΔE^{vbrup})	-16.8908***	-17.7632***	0.1367
The difference between the Venice-Paris and the Venice-Bruges-Paris exchange rates ($E^{vp} - E^{vbrup}$)	-8.8636***	-9.4434***	0.1532
		1399-1402	
Δ Venice-Paris (ΔE^{vp})	-12.4307***	-16.6372***	0.3971* (0.1559)
Δ Venice-Bruges-Paris (ΔE^{vbrup})	-14.9711***	-15.9702***	0.2203
The difference between the Venice-Paris and the Venice-Bruges-Paris exchange rates ($E^{vp} - E^{vbrup}$)	-7.758***	-8.1219***	0.1175
		1403-1410	
Δ Venice-Paris (ΔE^{vp})	-15.3231***	-16.5597***	0.4117* (0.1764)
Δ Venice-Bruges-Paris (ΔE^{vbrup})	-21.9051***	-23.7884***	0.4821** (0.1219)
The difference between the Venice-Paris and the Venice-Bruges-Paris exchange rates ($E^{vp} - E^{vbrup}$)	-8.0243***	-7.8677***	0.4954** (0.1187)

Note. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. The statistics for the first difference is stated in parentheses.

Table 2.4 The result of the unit root and stationarity tests for the Venice-Barcelona and Venice-Bruges-Barcelona exchange rates

	ADF test	PP test	KPSS test
		1399-1410	
Δ Venice-Barcelona (ΔE^{vbar})	-9.7162***	-16.4701***	0.2304
Δ Venice-Bruges-Barcelona ($\Delta E^{vbrubar}$)	-12.6287***	-12.7206***	0.1038
The difference between the Venice-Barcelona and the Venice-Bruges-Barcelona exchange rates ($E^{vbar} - E^{vbrubar}$)	-4.8892***	-4.9684***	0.1768
		1399-1402	
Δ Venice-Barcelona (ΔE^{vbar})	-13.7204***	-13.7625***	0.0322
Δ Venice-Bruges-Barcelona ($\Delta E^{vbrubar}$)	-15.2758***	-15.6445***	0.1603
The difference between the Venice-Barcelona and the Venice-Bruges-Barcelona exchange rates ($E^{vbar} - E^{vbrubar}$)	-3.3147**	-3.5783***	0.5233** (0.036)
		1403-1410	
Δ Venice-Barcelona (ΔE^{vbar})	-10.4969***	-19.4441***	0.0673
Δ Venice-Bruges-Barcelona ($\Delta E^{vbrubar}$)	-21.0686***	-21.2114***	0.4059* (0.0966)
The difference between the Venice-Barcelona and the Venice-Bruges-Barcelona exchange rates ($E^{vbar} - E^{vbrubar}$)	-3.7681***	-4.2893***	0.5056** (0.0244)

Note. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. The statistics for the first difference is stated in parentheses.

The results of the estimation of the TEC model for Venice-Paris and Venice-Barcelona exchange are reported in Table 2.5. The threshold for arbitrage (the transaction cost shown in the second column) is estimated at 0.228 Venetian grossi a oro for one French franc (1 per cent)[129] remitted from Venice to Paris via Bruges. It indicates that when the difference between direct- and cross-exchange rates ($E^d - E^c$) was larger than 0.228 grossi a oro, it became cost-effective to remit money by cross-exchange. Merchants thus switched to using cross-exchange instead of direct-exchange. Such arbitrage would reduce the difference and bring exchange rates back to equilibrium where direct-exchange was cost-effective. In the case of a Venice-Bruges-Barcelona exchange, the transaction cost was much higher (8%). This

[129] The transaction cost in terms of percentage is given as the share of average cross-exchange rates.

high cost is probably due to the bigger opportunity cost involved in the cross-exchange. Compared with two weeks' loss of interest in a Venice-Bruges-Paris cross-exchange, taking advantage of a difference between direct and cross rates in this case would involve 30 days after sight for usance and 22-23 days (at least) for communication between Bruges and Barcelona, it no doubt resulted in a greater transaction cost in the Venice-Bruges-Barcelona cross-exchange.

The implicit speed of adjustment can be calculated from the adjustment parameters α_1 and α_2 in Equations (2.1.A) and (2.1.B). These can be expressed in terms of half-life time as $Time_{1/2} = \frac{\ln(0.5)}{\ln(\rho_{d,c})}$, where $\rho_d = 1 + \alpha_1$ for direct-exchange and $\rho_c = 1 - \alpha_2$ for a cross-exchange. A half-life indicates the time required to reduce the impact of the shock to half its original size.

Table 2.5. The result of the estimation of the TEC model

	The estimated transaction costs	α_1	α_2
		<u>The whole series, 1399-1410</u>	
Venice-Bruges-Paris	0.228 grossi a oro (1%)	-0.165 (3.9 weeks)	**0.323 (1.8 weeks)**
Venice-Bruges-Barcelona	16.18 Barcelonese denari (8%)	**-0.14 (4.6 weeks)**	0.008 (1.6 years)
		<u>The period of regulation, 1399-1402</u>	
Venice-Bruges-Paris	0.25 grossi a oro (1.1%)	-0.384 (1.4 weeks)	**0.414 (1.3 weeks)**
Venice-Bruges-Barcelona	9.18 Barcelonese denari (4.5%)	**-0.1 (6.6 weeks)**	0.014 (48 weeks)
		<u>The period of non-regulation, 1403-1410</u>	
Venice-Bruges-Paris	0.248 grossi a oro (1.1%)	-0.093 (1.7 weeks)	**0.308 (1.9 weeks)**
Venice-Bruges-Barcelona	13.45 Barcelonese denari (6.7%)	**-0.141 (4.6 weeks)**	0.004 (3.2 years)

Note. The transaction cost in terms of the share of cross-exchange rates is given in brackets. The speed of adjustment in half-life is given in brackets.

The adjustment parameters show that the coefficient α_2 associated with cross-exchanges, in terms of absolute value, is higher than α_1 in the case of the Venice-Bruges-Paris exchange, which implies that arbitrage mainly took place by adjusting

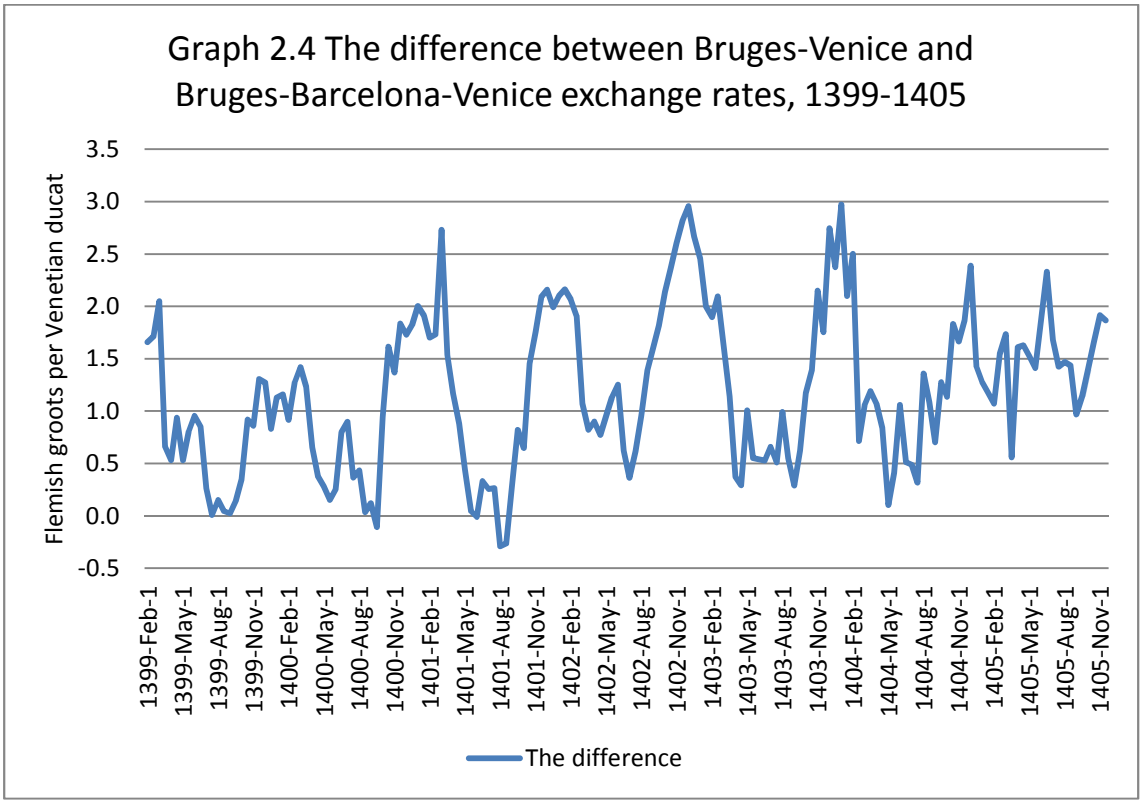
cross-exchange rates and not direct-exchange rates. The adjustment operated at a speed where the difference was reduced to half its size in 1.8 weeks. By contrast, for the Venice-Bruges-Barcelona exchange, the coefficient α_2 is significantly lower than α_1, suggesting that it was a direct-exchange rate adjusting to realise a half of arbitrage opportunity at a speed of 4.6 weeks.

Faced with an arbitrage opportunity, markets adjusted exchange rates through different routes depending on transaction cost and the flow of trade. The direct-exchange adjustment used in Venice-Bruges-Barcelona arbitrage may be attributed to the high transaction cost associated with cross-exchange. On the contrary, the low transaction cost and the fact that Bruges was the major financial and commercial market in north Europe probably resulted in cross-exchange rates for Venice-Bruges-Paris arbitrage being adjusted to restore equilibrium. The estimated speed of adjustment – 1.8 weeks for the Venice-Bruges-Paris cross-exchange and 4.6 weeks for the Venice-Barcelona direct-exchange - more or less accords with the speed of communication at the time (Table 2.1). The slightly quicker adjustment in terms of communication occurring in the Venice-Bruges-Paris exchange may have been due to the element of geography. As a result of being geographic close, the exchange rates between Bruges and Paris were more up to date than those for Bruges-Barcelona. The slightly quicker adjustment of the Venice-Bruges-Paris exchange likely reflects the advantage of accessing more accurate information about the state of the exchange market.

The difference of direct- and cross-exchange rates in Venice-Paris and Venice-Barcelona exchange and estimated arbitrage thresholds are shown visually in Graphs 2.2 and 2.3. One can see that the gap appears in quite different patterns. In the case of the Venice-Paris exchange, the differences of exchange rate fluctuate around zero. Moreover, arbitrage opportunities (the difference exceeding the threshold) occur randomly over the whole period. In contrast, for the Venice-Barcelona exchange the violation of equilibrium mainly concentrates on the years 1402-3 and 1409-10. Over two-thirds of the period, direct-exchange rates were lower than cross-exchange rates. The underlying cause of the violation was the sudden surge of the Venice-Barcelona exchange rates, while the Venice-Bruges and Bruges-Barcelona exchange

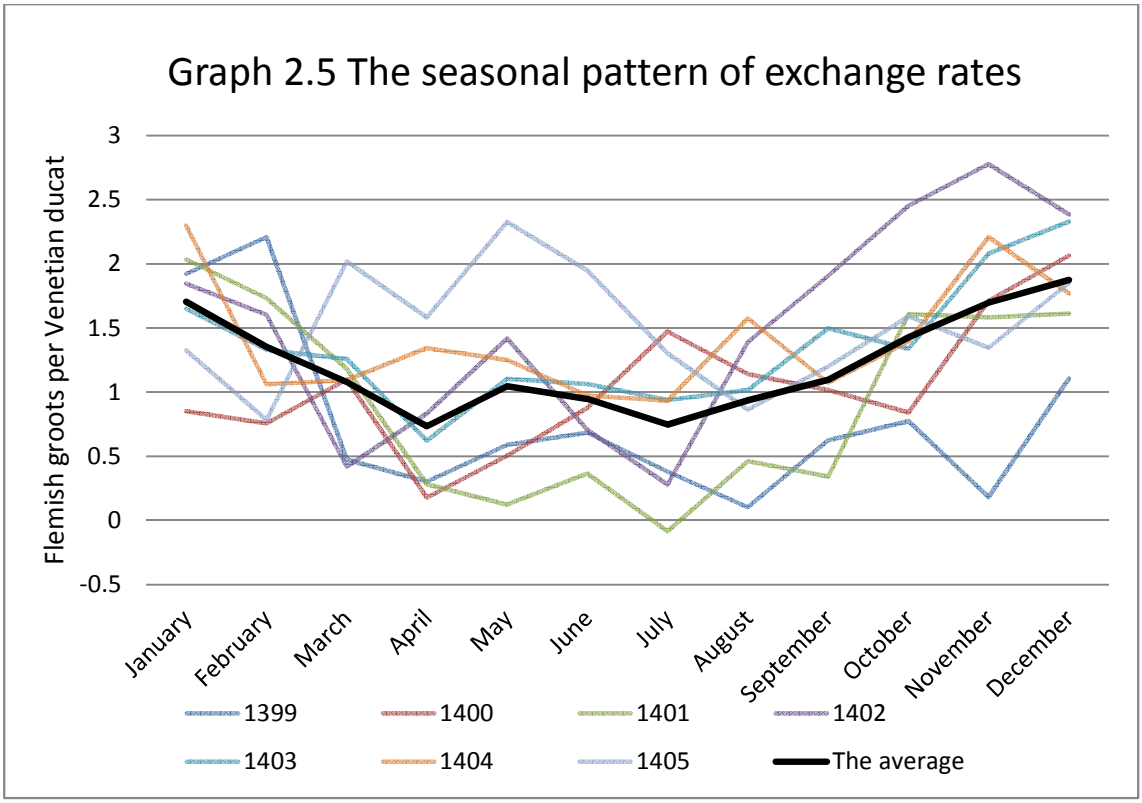
rates remained stable.[130] Though one cannot be sure, the arbitrage opportunities occurring in 1403 and 1409-10 may have been caused by the war in Italy and then affected the flow of trade and money between Venice and Barcelona.[131]

In the Venice-Barcelona exchange, the low direct-exchange rates probably better reflected the pattern of trade at the time than the cross-exchange rates did. As pointed out by de Roover, Flanders had a trade deficit with Italy and simultaneously a favourable trade balance with Catalonia.[132] Considering the balance of trade among these three areas, it is no wonder that it was more costly to remit money indirectly via Bruges to Barcelona than directly. On the contrary, when money was sent from the north to Italy, it 'was less profitable to remit directly to Italy than indirectly by way of Barcelona'[133], because Flanders had accumulated a substantial credit there. This argument is not only supported by Datini's documents but further confirmed by comparing direct- and cross-exchange rates via Barcelona.



Source: Appendix 2.C

[130] See Appendix 2.B.
[131] De Roover, *Bruges Money Market*, pp. 63-4 and 72.
[132] Ibid, pp. 43-5.
[133] Ibid, p. 65.



Source: Appendix 2.C

The semi-monthly differences ($E^d - E^c$) presented in Graph 2.4 show that the direct-exchange rates between Bruges and Venice were persistently higher than the cross-exchange rates via Barcelona. This suggests that it was cost-effective to use the credit building up in Barcelona to send money from Flanders to Italy. A seasonal pattern is presented in Graph 2.5, which exhibits that the size of differentials peaked in winter and fell in summer. Though varying from year to year, the gap usually started to shrink in April, which was in accord with the high demand for money for Venice's trade with the East. Venetian galleys sailing to the Levant were regulated by the Senate and thus the time of their departure was predictable.[134] In order to prepare for merchandise and bullion carried to the East, the Venetians may have recalled funds from the north in spring. Remitting great amounts of money to Venice exerted pressure on the cross-exchange rates; consequently, cross-exchange rates increased and the difference reduced. Since the demand for remittance subsided after the departure, the gap enlarged every autumn.

[134] Mueller, *Venetian Money Market*, pp. 305-9.

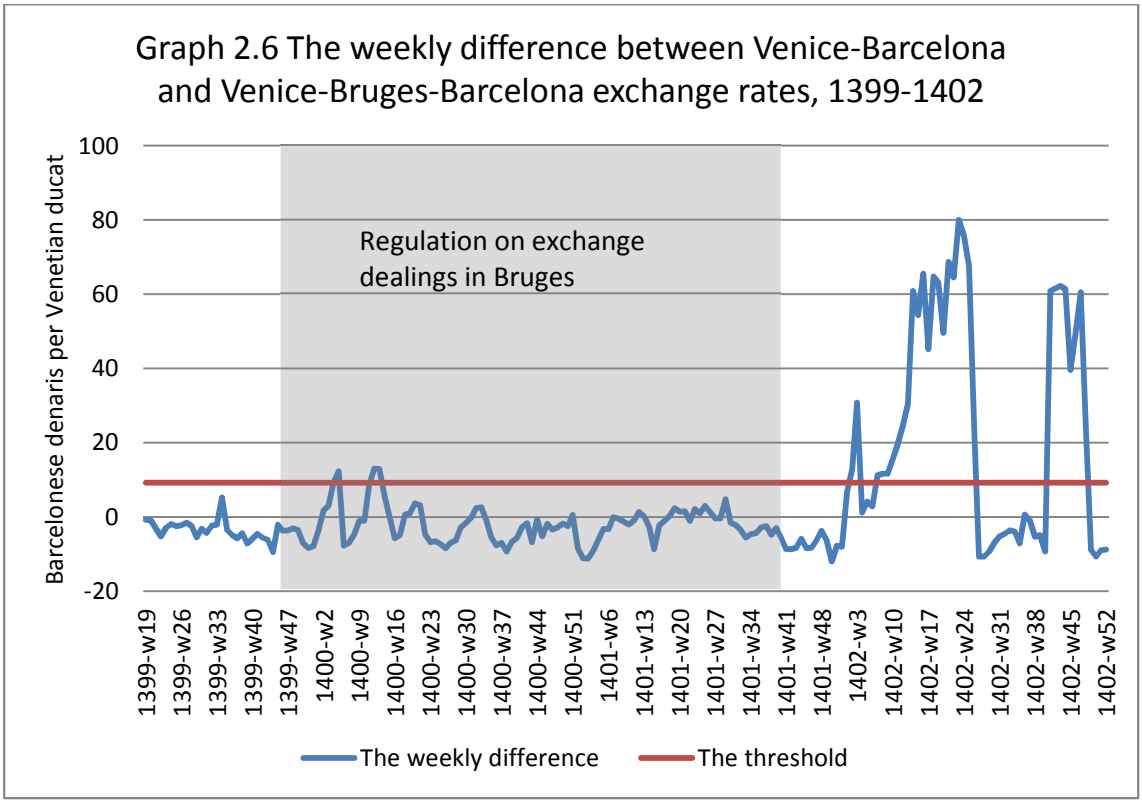
Government intervention was another disturbing factor of the exchange market. Nevertheless, intervention also created opportunities for profitable arbitrage and by exploiting these markets could return back to equilibrium. As addressed above, in order to alleviate the shortage of money, the authorities in Bruges imposed a series of monetary regulations on bills of exchange and thus greatly disturbed the exchange rates of Bruges (f. 48). These regulations (requiring payment in specie and gold coins) greatly increased the transaction costs of exchange dealings in Bruges. Datini's correspondence gives evidence that the price set upon foreign currencies in Bruges adjusted rapidly to reflect the incurred cost and inconvenience of the regulations.[135] To avoid them in Bruges, merchants switched to other exchange markets, such as Venice and Genoa, instead of Bruges.[136] In the end, market forces prevailed to compel the repeal of the regulations in early 1401.

To what extent was the degree of exchange market integration affected by the regulations imposed on the Bruges exchange market? Did merchants became more alert to the movement of exchange rates, or did government intervention impede the operation of arbitrage? In order to answer these questions, the dataset is divided into two parts: one covers the period of regulation (1399-1402), and the other for the period of non-regulation (1403-1410). Like the whole series, the sub-sequence has to be tested for stationarity. The results shown in the lower section of Tables 2.3 and 2.4 suggest that the hypothesis of unit root can be rejected at the two sub-periods.

The estimations of transaction costs and speed of adjustment for the two sub-periods are reported in the lower part of Table 2.5. During the regulation, the transaction cost associated with cross-exchange via Bruges is estimated at 1.1 per cent and 4.5 per cent for the Venice-Paris and Venice-Barcelona exchanges, respectively. Compared with the results for the non-regulation period, the transaction cost for the Venice-Paris exchange remained unchanged, but was decreased by a third for the Venice-Barcelona exchange. This seems to challenge the conventional understanding about regulation that likely results in increasing

[135] According to Datini's correspondence, the Bruges-Barcelona exchange rate fell by 3.23%, the Bruges-Genoa by 4.16%, the Bruges-Venice 2.86%, the Bruges-London 4.81% and the Bruges-Paris 1.23% within one month of the announcement. de Roover, *Money, Banking and Credit*, p. 78.
[136] De Roover, *Bruges Money Market*, p. 56.

transaction costs. Two possible explanations may be offered for this contradiction: (1) the mechanics of estimation and (2) the role of information. As can be observed in Graph 2.6, the regulations imposed on Bruges created few profitable opportunity for Venice-Barcelona arbitrage – the difference increased but for most of time remained below the threshold, which triggered arbitrage. According to the TEC model, the threshold (the transaction cost) is selected from differences of exchange rates which minimises the sum of the residual sum of squares (ff. 31-2). Therefore, the smaller threshold in the period of regulation may be a result of the difference of exchange rates in the two periods.



Source: Appendix 2.E

As discussed, slow communication at the time resulted in the difference between ex-ante and ex-post cross-exchange rates (ff. 56-8). Hence, part of the transaction cost was associated with uncertainty over the future movement of exchange rates in the third place. The regulation of 1399-1401 dictated an upward trend in the Bruges-Barcelona exchange rates and thus reduced the uncertainty premium. However, one may ask why, if this was the case, the transaction cost in the

Venice-Paris cross-exchange remained unchanged instead. Since the Bruges-Paris exchange rates were already less volatile than those of Bruges-Barcelona,[137] and Bruges and Paris are geographically close, the premium of uncertainty was perhaps insignificant in the total transaction cost of the Venice-Paris cross-exchange. If this is the case, as long as the cost of postage and brokerage fee of the second bill did not change, it is not surprising to see the transaction cost in the Venice-Paris cross-exchange was roughly as the same in the period of regulation as the non-regulation.

Like the results from the whole series, in the two sub-periods the adjustment in cross-exchange rates worked to close the gap between the Venice-Paris direct- and cross-exchange rates and for the Venice-Barcelona exchange, arbitrage operated on the direct-exchange rates. Compared with the period without regulation, the adjustment, in terms of half-life time, speeded up to 1.3 weeks for the Venice-Paris exchange, but slowed down to 6.6 weeks for the Venice-Barcelona exchange. The decline in the speed of adjustment of the Venice-Paris exchange could imply that, although transaction costs were not affected by the government's intervention, merchants became more aware of the arbitrage opportunity and quickly acted upon it. According to Datini's correspondence, letters conveying exchange rates were exchanged between Venice, Paris and Bruges at least once a week.[138] The estimated speed of adjustment indicates that exchange rates were accelerated by government intervention to adjust as soon as new information arrived.

However, while transaction costs declined, it appears odd that the speed of the Venice-Barcelona direct-exchange adjustment increased in from 4.6 to 6.6 weeks. As mentioned, the regulations imposed in Bruges did not create but few arbitrage opportunities (see Graph 2.6). The slowness of adjustment is less likely to be a reaction to the monetary regulation. Instead, it may result from the time period affected, which included few arbitrage opportunities comparing with non-regulation period, as illustrated in Graph 2.3. Except for some occasions probably caused by regional conflicts, it was cheaper to transfer money from Venice to Barcelona through direct-exchange. Considering the balance of north-south trade and the

[137] The volatility can be measured by the coefficient of variance (CV). The CV of Bruges-Paris (0.021) is much lower than that of Bruges-Barcelona (0.084).
[138] See footnote 16.

distance separating Bruges and Barcelona, it could be argued that the elimination of large exchange differentials was the result of the disappearance of shocks, which originally increased exchange differentials, e.g. the cessation of conflicts, rather than being exploited by triangular arbitrage. Therefore, the estimations of Venice-Barcelona adjustment reported in Table 2.5 only tell us how large exchange differentials would have to be to trigger arbitrage and at what speed exchange rates would have adjusted if arbitrage was the main driver behind the movement of exchange rates. Along with applying modern econometric models to analyse exchange markets, one has to aware that the movement of exchange rates in the late Middle Ages was affected by market force (arbitrage) as well as by contemporary events and institutions.

On the other hand, triangular arbitrage was more likely to operate in the Venice-Paris exchange, which is supported by the movement of exchange differentials shown in Graph 2.4. They move up and down around zero and arbitrage opportunities appear randomly over the period. Around 1400, Bruges was the exchange central in west-northern Europe and Paris was a satellite banking place of Bruges. The results presented above are close to reflect the operation of arbitrage and measure the degree of integration of exchange markets.

The transaction costs around 1400 estimated here can be compared with those of the eighteenth century reported by Schubert (0.15 per cent service cost + 0.25 per cent opportunity cost).[139] It is not surprising that after the financial market expansion and innovations which occurred in the late sixteenth and seventeenth centuries, transaction costs associated with arbitrage had reduced greatly (by 60 per cent) over three centuries. It is likely that the fall of the interest rate was the main driving force behind the decline. Although one cannot draw comparisons in the speed of adjustment, the estimations here accord with the contemporary speed of communication, indicating that exchange markets around 1400 had probably achieved a high level of efficiency and integrated well. One can presume that later innovations in financial markets were likely to result in a fall in transaction costs, but not much in the degree of effectiveness of arbitrage and integration.

[139] Schubert, 'Arbitrage', pp. 9-12.

2.7 Conclusion

Financial market integration has attracted increasing research interest in the last thirty years. Recently economic historians have started to extend their study back to the late Middle Ages. The literature on late medieval financial market integration is based on annual data and focuses on the difference between the nominal exchange value of coins and their mint parity and arbitrage worked by moving bullion. Three drawbacks of this common approach are: (1) the low-frequency data are insufficient to precisely estimate the speed of adjustment in financial markets where prices are likely to change daily; (2) the effectiveness of arbitrage operated by moving bullion from one place to another was susceptible to regulation and bans on the flow of bullion; and (3) the recent research does not provide a benchmark for comparison and therefore, it tells us nothing about market performance by contemporary standards.

In this chapter, the examination of late medieval exchange markets is based on high-frequency data (weekly) and presented in the framework of triangular arbitrage by looking at the difference between direct- and cross-exchange rates, which did not require bullion to be moved and thus greatly reduces the impact of non-market forces on the estimation of market integration.[140] It is based on the law of one price, that is, if two markets are integrated, the price difference will be constrained by the transaction costs of moving goods from one market to another to exploit the price difference. Because of the combination of transaction and information costs, as long as the difference between direct-and cross-exchange rates did not exceed the combined costs, merchants tended to use direct-exchange to transfer money between two places. Following this conception, exchange market integration among Venice, Bruges, Barcelona and Paris around 1400 is examined under a two-regime TEC model and on the basis of the exchange rates extracted from Datini's commercial documents.

[140] Volckart and Wolf argue that the main reason that the degree of integration by financial markets can be used as a benchmark for other markets is the lower transport costs involved in financial arbitrage. Compared with the their approach, the estimation based on arbitrage of the difference of exchange rates, which did not require the movement of bullion, accordingly, further reduces the factor of transport costs in determining the degree of market integration. O. Volckart and N. Wolf, 'Estimating medieval market integration: evidence from exchange rates', Working paper, p. 27.

First of all, the correlation coefficients for the prices of three currencies suggest that the similar level of integration was already achieved in exchange markets around 1400 as that in the eighteenth-century stock market between London and Amsterdam. By the TEC model, the analyses show that the speeds of adjustment in Venice-Paris and Venice-Barcelona exchange are consistent with contemporary communications, which is used as a benchmark to judge the effectiveness of arbitrage. The results suggest that arbitrage on exchange markets operated effectively and exchange markets had achieved a high level of integration around 1400. However, transaction costs were high by eighteenth-century standards and this may be attributed to the high interest rates prevailing in the late Middle Ages. Moreover, this chapter investigates how exchange rates responded to the government intervention in exchange dealings in Bruges which regulated the means of paying bills of exchange in 1399-1401. The estimations imply that the regulation did not increase transaction costs but prompted merchants to be more aware of changes in market conditions and reacted rapidly to exploit the arbitrage opportunity. The established integration between exchange places did not greatly affected by this government intervention.

In the fourteenth century which was much subject to constant conflicts, financial markets managed to be integrated and to respond efficiently to monetary intervention. The high level of integration and efficiency was largely attributed to the extensive information network built by the established branches and the use of agents in major trading places. Through this network, information about changes in market conditions, economic and political situations, monetary policy and the occurrence of conflicts and trade blockage could be quickly exchanged and prices therefore rapidly adjusted in response. Compared with previous studies of the same period, this chapter presents the view that in the late Middle Ages exchange markets were well integrated. This positive view derives from the fact that the operation of arbitrage analysed here is based on the flow of information, in contrast to that on moving bullion, which was much likely to have been affected by the flow of trade. Arbitrage that operated by moving bullion was likely to be less effective because of the hostile business environment in the late Middle Ages. The difference between the results presented here and those in the literature shows how the state of

transportation and international trade could affect the speed of adjustment and the transaction costs of arbitrage.

In contrast, the results here and those concerning the eighteenth-century stock markets are all based on arbitrage working on the flow of information. Hence, one can argue that the high degree of integration in terms of the speed of communication around 1400 reflects the similar arbitrage behaviour then and later. In sum, regardless of the hostile and risky business environment, slow communications, and the nascent state of exchange markets in the late Middle Ages, exchange markets, where merchants sought short-term credit to finance international trade, were integrated and effectively adjusted as fast as information flowed in, a process which was dictated by the speed of communication.

Chapter Three London-Antwerp exchange markets during the Great Debasement

3.1 Introduction

In studies on financial market integration before the eighteenth century, the sixteenth century has been a less exploited period. However, it was one of the most dynamic ages in the development of financial markets: (1) in England and the Netherlands, it began to be legal to charge interest, up to a certain rate; and in the areas where usury was still condemned, periodic fairs gave up their commercial function in favour of finance; and (2) it witnessed the emergence of some important financial innovations, such as bills of exchange being negotiable and discountable, endorsement, the publication of prices of merchandise and exchange rates, though these did not, until early the next century, become comprehensive and routine in practice.[141] This chapter uses a new dataset to examine the financial connection between London and Antwerp, where the innovations occurred, in terms of the degree of exchange market integration and efficiency against the backdrop of the Great Debasement, 1544-51.[142]

During the Great Debasement, the bullion content of the pound sterling fell by 25 per cent in gold and 83 per cent in silver. For those engaged in foreign trade, this immense monetary change shook people's confidence in sterling and altered the prices of English goods in foreign markets, which would affect the export trade. Were the exchange rates able to adjust soon enough to compensate for the loss of

[141] Cf. Chapter 4 for the discussion of these innovations.

[142] Along with the fine coin, the first English debased coins were secretly produced in 1542-4, according to an indenture issued in May 1542. However, Challis argues that most the debased coins produced in these two years were not released in circulation and absorbed later in minting debased coins when the whole scheme of debasement was disclosed. Therefore, this chapter chose the June 1544 as the beginning of the Great Debasement instead of May 1542. C. H. Challis, *The Tudor Coinage* (Manchester University Press, 1978), pp. 83, 85, 238, and 240; J. H. Munro, 'The coinages and monetary policies of Henry VIII (r. 1509-1547): contrasts between defensive and aggressive debasements', Department of Economics, University of Toronto, Working paper 417, 2010.

bullion content in English money and reduce the rising transaction costs caused by the debasement? What were the elements determining the speed of adjustment? Since bills of exchange were an alternative to remitting funds by shipping bullion, the speed of adjustment can be estimated by comparing the exchange rates of bills with the mint parity. In order to illustrate the role which information played in determining the speed of adjustment, besides the Great Debasement, the adjustment of exchange rates to the revaluation of gold coins in the Habsburg Netherlands in 1539 is also assessed. Overall, this chapter aims to reveal how early modern merchants grasped monetary alterations, how exchange rates reflected their perceptions and knowledge of the relation between changes in the bullion content of coins and exchange rates of coins, to what extent coinage debasement could disrupt market integration, and how important information was in determining the degree of integration.

The chapter is organised as follows: in section 3.2, a brief summary of studies of sixteenth-century financial market integration precedes some remarks on the relationship between the Great Debasement and the movement of exchange rates. Section 3.3 addresses the issue of coinage debasement in late medieval and early-modern times; the Great Debasement of 1544-51; the monetary situation of the sixteenth-century in the Netherlands; and the operation of bills of exchange. Section 3.4 discusses the exchange rate dataset, which is collected from various mercantile documents. The mint parity is calculated in section 3.5. Section 3.6 addresses the methods employed to estimate the degree of integration. The results of the analysis are presented in section 3.7 and the chapter concludes with section 3.8.

3.2 Review of the literature

Few quantitative studies of financial market integration are concerned with the sixteenth century. Three research works provide an ambiguous delineation of the development of financial market integration at the time. Chilosi and Volckart, drawing on the local gold-silver ratios, show that central European financial markets became integrated at the turn of the sixteenth century due to the relative peace

enjoyed at the time, the establishment of monetary unions, the adoption of printing, and the emergence of territorial states. However, their results from a threshold autoregressive model with a time trend suggest that in the Rhineland (7 city pairs) only Basel-Cologne and Jülich-Koblenz showed signs of improvement; meanwhile the degree of integration between Cologne and its neighbouring cities deteriorated considerably. Chilosi and Volckart argue that the increase of international trade at the time contributed to the integration between Basel and Cologne, and the absorption of local trade into international trade may have caused the decline in market adjustment.[143]

Using a threshold error correction model, Bernholz and Kugler examine arbitrage operating on the exchange rates of the Spanish ducado and Dutch groat quoted between Medina del Campo and Seville in the late sixteenth century. Their findings indicate that the adjustment was complete within a year and the transaction cost associated with arbitrage was 6 per cent of the mint parity for late sixteenth-century Spanish exchange markets, which is similar to the level achieved in the late Middle Ages.[144] Without an adequate benchmark, however, one cannot judge whether financial markets became better or less integrated in the sixteenth century.

Apart from studying price differences, the degree of integration can be understood by examining the movement of prices in two places. If markets are integrated, then one should observe a strong correlation between the movements of prices in two of them. With this approach, Pezzolo and Tattara explore the integration of north Italian financial markets at the turn of the seventeenth century. In the second half of the sixteenth century, the Besançon fairs became pure exchange centres independent of commodity trade and acted as an important financial market in Mediterranean Europe.[145] The Besançon fairs were held quarterly to settle bills of exchange and were a convenient venue for the Genoese to raise money for their loans to the Spanish crown.

[143] Chilosi and Volckart, 'Money, states, and empire'.
[144] Bernholz and Kugler, 'Financial market integration'; Kugler, 'Rhinegulden and Basle pound'; Volckart and Wolf, 'Estimating financial integration'.
[145] Boyer-Xamneu, Maire-Thérèse, G. Deleplace and L. Gillard, *Private Money and Public Currencies* (New York, 1994).

Pezzolo and Tattara calculate the correlation between the interest rates which were implicit in the exchange rates quoted in Besançon and show that the interest rates between Genoa and Milan and Genoa and Florence were closely correlated, but that there was no noticeable correlation between Genoa and Venice. The integration between Italian markets is further verified by a cointegration analysis which confirms that arbitrage operated well between Genoa, Florence and Milan. By contrast, Venice was less integrated into the Besançon exchange fairs. This failure of integration can be explained by the fact that Venetian financial market was more affected by its trade than by a concern with Genoese loans to the Spanish crown. The integration of the north Italian financial market was severely disrupted by the default of the Spanish King in 1607.[146]

Considering the geography, clientele and then the dynamic changes in financial institutions, the lack of consensus between different scholars' results are hardly surprising. By examining the London-Antwerp exchange markets, the following analysis enriches our understanding about the sixteenth-century financial market integration and efficiency and sheds new on the effect of monetary and commercial elements on market performance.

The impact of debasement on exchange rates

Since the impact of the Great Debasement of 1544-51 on the London-Antwerp exchange is one of the issues addressed in this paper, it may be helpful first to look at contemporary opinions and existing studies of the connection between the Great Debasement and the subsequent movement of Anglo-Flemish exchange rates. In a letter to Queen Elizabeth, Sir Thomas Gresham attributed the falling Anglo-Flemish exchange rate in the 1540s to the deteriorating metallic content of English silver coins in the earlier regimes of Henry VIII and Edward VI: "[t]he first occasion off the fall of the exchainge did grow by the Kings majesty, your latte ffather, in abasinge his quoyne ffrome vi ounces fine too iii ounces fine. Wheruppon the exchainge fell

[146] L. Pezzolo and G. Tattara, '"Una fiera senza luogo": was Bisenzone an international capital market in sixteenth-century Italy?', *Journal of Economic History*, 68 (2008), pp. 1098-122.

ffrome xxvi*s*. viii*d*. to xiii*s*. iv*d*.*"*[147] Gresham blamed the loss of the bullion content of the English coinage for the depreciation of exchange rates and identified this relationship as a proportionate one. The causality between the declining metallic content of the English coinage and its falling exchange rates was widely recognised by contemporaries.[148]

However, the obvious connection between debasement and falling exchange rates turns out on closer inspection not to be straightforward. In a proclamation issued on 16 May 1544, the scheme of coinage debasement was made public.[149] Within a few months, the value of the English angel and groat circulating in the Habsburg Netherlands was heavily discounted.[150] However, except for the first two months after announcing the debasement (June and July 1544), the London-Antwerp exchange rates remained at the pre-debasement level for almost a year, until early 1545.[151] This illustrates that the correlation between the bullion content of coins and exchange rates was never unequivocal and change in the former did not immediately result in proportionate change in the latter.

The common discount in the face value of English coins abroad indicates that the depletion of the metallic content of English coinage was known among merchants from an early date. In contrast, the Anglo-Flemish exchange rates did not adjust to this public knowledge of English debasement, although merchants were acutely aware of the connection between exchange rates and mint parity. Furthermore, Elizabeth's re-coinage of 1560 did not improve exchange rates to any

[147] J. W. Burgon, *The Life and Times of Sir Thomas Gresham* (London, 1839), Vol. I, p. 484. The degree of Henry VIII's debasement of silver revealed in Gresham's letter is incorrect. If Gresham referred to the deterioration of fineness, the fineness of silver coins, in fact, was reduced from 11 ounces and 2 pennyweights (92.5%) to 4 ounces (33.33%) late in Henry VIII's reign and not from 6 ounces to 3 ounces. It was under Edward VI that silver coins were further debased to the fineness of 3 ounces (25%).

[148] R. H. Tawney and E. Power (eds.), *Tudor Economic Documents* (London, 1924), Vol. II, pp. 182-7.

[149] *Letters and Papers, Foreign and Domestic, Henry VIII, 1509-47* (abb. *L&P*), XIX, part I, No. 513*; and P. L. Hughes and J. F. Larkin eds., Tudor Royal Proclamations (Yale University, 1964)* (abb. *Proclamations*), II, No. 228.

[150] The angel and groat were the most common English gold and silver coins circulating on the Continent at the time. Their face value on the eve of their debasement was given at 7s 6d st and 4d st, respectively. *L&P* XIX, part I, no. 654, 763, 766, 836, 869.

[151] The London-Antwerp exchange rates fell below 26s Fl for one pound sterling in June and July, and afterwards the exchange rate soon recovered to 26s 5d-26s 9d Fl., the pre-debasement level. See Appendix 3.E for the movement of the London-Antwerp exchange rates.

discernible degree.[152] Do these facts imply that the Anglo-Netherlands exchange markets were inefficient in adjusting to shocks? Or can the changes in exchange rates not be entirely explained by changes in mint parity, as contemporary merchants and some scholars argue?[153]

Gould bluntly points out that if changes in the bullion content of coin were the prime factor behind the depreciation of the pound sterling, then the London-Antwerp exchange rates in mid-1551 should have been no more than 4s 10d Fl for one pound sterling, instead of 12s 9d Fl, the lowest rate ever recorded.[154] Without denying the influence of the debasement on the course of exchange rates, Gould advocates an alternative explanation for the movement of the London-Antwerp exchange rates during this period: although exchange rates were persistently much higher than those derived from debased silver coins, they remained within the bounds of the specie import and export points.[155] As an alternative to shipping bullion for the transfer of funds between places, the rate of bills of exchange had to be confined within specie points. He then concludes that "the London-Antwerp exchange in the mid sixteenth century was at least as smooth and well-integrated a mechanism as characterized those between London and New York in the early nineteenth century."[156]

Even though Gould recognises that the specie points imposed an effective limitation on the movement of exchange rates, his calculations of import and export points are flawed: he bases them on fine gold and fine silver, instead of the bullion contained in the circulating Flemish coins. Shipping bullion became preferable only when exchange rates were outside the specie points. Foreign coins, in this case Flemish, but fine gold and silver, are preferable for calculating specie points. It was

[152] During 1560-1, the government recalled the debased silver coins and reminted them into fine silver coins (with the pre-debasement fineness of 92.5%). *Proclamations*, II, No. 471, 478, 480, 487. The Anglo-Flemish exchange rates moved between 21s and 22s under Mary Tudor and began to rise in Elizabeth's reign to stand between 22s and 23s until the downward trend started in 1563. However, there was no noticeable change in the exchange rates before and after the coinage reform in 1560-1. See Appendix 3.E for the movement of exchange rates.

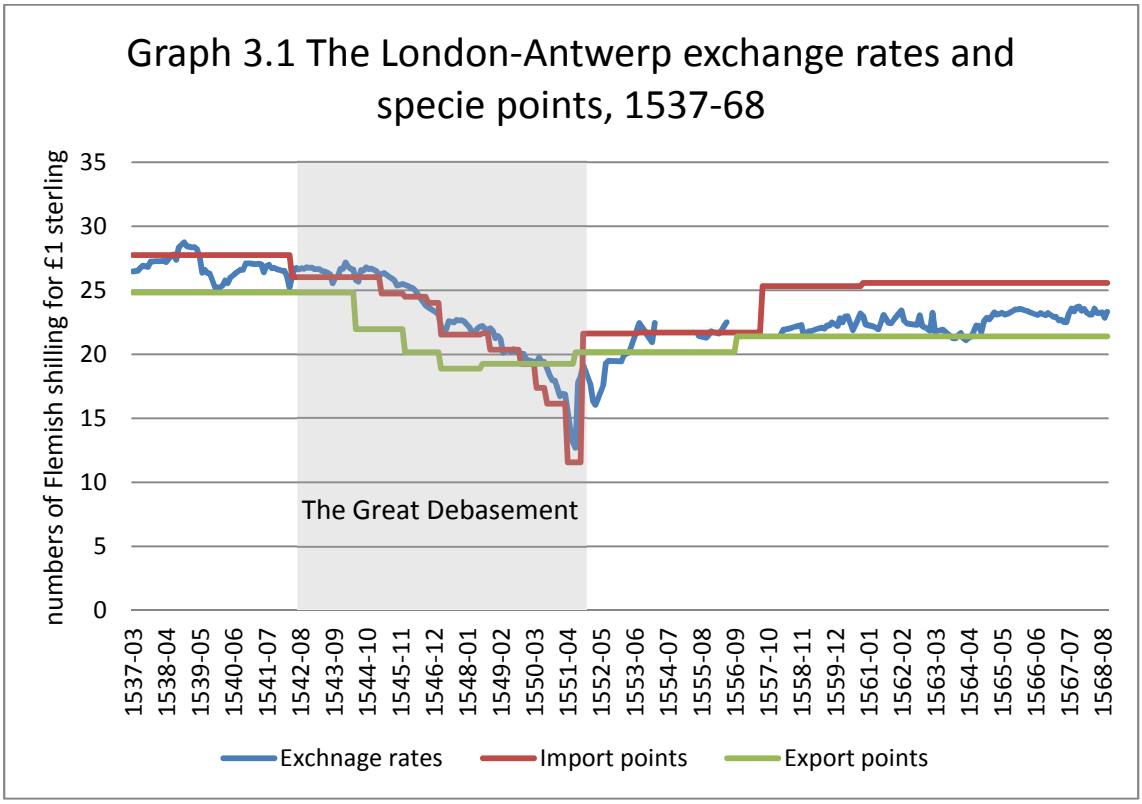
[153] G. Unwin, 'The merchant adventurers' company in the reign of Elizabeth', in R. H. Tawney ed., *Studies in Economic History* (Macmillan, 1927), pp. 154-5.

[154] J. D. Gould, *The Great Debasement: Currency and the Economy in Mid-Tudor England* (Oxford, 1970), pp. 89, 93-4.

[155] The import specie point is the amount of local money received after subtracting transport costs and the mint charge from the imported specie. The export point is the amount of foreign money that can be obtained by exporting specie after the deduction of transport costs and the mint charge.

[156] Gould, *Great Debasement*, p. 112.

convenient for a merchant to use whatever bullion he had, namely, foreign coins, to make payment rather than using fine gold and silver, which had first to be refined from coins. Gould calculates the import and export points directly from the English mint price and mint equivalent and thus his results imply that fine gold and silver, not the coins which were held by merchants, were shipped to make payment. As a result, he overestimates the import points and underestimates the export points. If these points are re-calculated on the basis of the circulating Flemish coins, it becomes evident, as shown in Graph 3.1,[157] that most London-Antwerp exchange rates during the debasement were in fact outside the bounds of the specie points but fluctuated close to the import point. According to the new calculation, Gould's hypothesis that the London-Antwerp exchange markets were well-integrated is no longer tenable. But does this mean that the Anglo-Flemish exchange rate adjusted poorly to the Great Debasement?



Sources: see Appendices 3.E and 3.I

[157] The figures of re-estimated specie points are reported in Appendix 3.I.

This chapter addresses the following questions: how well integrated were the London-Antwerp exchange markets in the sixteenth century? How effectively and efficiently did exchange rates respond to the Great Debasement? And which elements determined the speed of exchange market adjustment? The answers given below are based on a quantitative analysis which employs a threshold autoregressive model similar to the one advanced by Volckart and Wolf. However, in contrast to their analysis, the one presented here includes the factors of time and information transmission. Thus, the degree of market integration and speed of adjustment are discussed to take account of the contemporary speed of communication.

3.3 The historical context

Because the pound sterling had traditionally been one of the most stable currencies of the medieval West, the Great Debasement was a shocking experience to the English. On the Continent, however, coinage debasements were a familiar phenomenon. It may be useful to briefly discuss monetary systems and the methods, motives and effects of coinage debasements in general, before examining the Great Debasement. For comparison, it may also be helpful to address the monetary system in the Habsburg Netherlands and the revaluation of 1539, where the motives and methods of monetary manipulations were quite different from those in England. Finally, the operation of bills of exchange and Anglo-Netherlands exchange are discussed.

3.3.1 Coinage debasements

The issue of coinage was controlled by the political authorities. As a result of political fragmentation, medieval Europe was sprinkled with a huge number of local mints. Usually only local coins were recognised as legal tender and foreign coins were regarded as bullion, except for eminent gold coins, such as the Venetian ducat and Florentine florin. Individuals came to mints to convert metal (in the form of bullion, old and foreign coins) into local coin. They always received in return coins containing less precious metal than they delivered. Part of the difference went to cover

production costs, which were called *brassage*. The rest was sent to the sovereign as a tax levied on minting, called *seignorage*. In numismatics, the face value of the total coins struck from one unit weight (e.g. a pound or mark such as the marc de Troyes) of pure silver or gold is called the *mint equivalent*. After brassage and seignorage had been paid, the residue gives the *mint price*, which is the total face value of the coins that an individual received from the mint for one unit weight of pure silver or gold. In other words, the mint price is the price that the mint would pay for one unit weight of precious metals. The sum of brassage and seignorage is the total mint charge, which is the difference between the mint price and the mint equivalent.

Minting coins was a prerogative of the sovereign. Though councils and local assemblies often exerted some measure of supervision and control,[158] the sovereign could collect seignorage from minting and had much leeway to decide the fineness, weight and face value of his coinage. When princes were under fiscal pressure, coinage debasement provided a quick and easy way to increase revenues without having to ask for money from a council Therefore, coinage debasements were a recurrent phenomenon throughout the Middle Ages.[159]

Coinage debasements usually appeared in four ways: (1) a reduction in the quantity of precious metals contained in coins by changing their fineness; (2) a reduction in the quantity of precious metals contained in coins by changing their weight; (3) an increase in the official value of coins; and (4) any combination of the above three methods. Under the first two methods, the same quantity of pure gold or silver was used to produce more coins, either by alloying with more base metals (usually copper) or reducing the weight of new coins. The third method of debasement could increase the total face value of coins struck from a given amount of precious metals without altering the fineness and weight of the coinage. For a

[158] In most European polities the councils and representative of provinces were able to exert pressure on the sovereign and to reject changes in coinage without their consent. P. Spufford, *Monetary Problems and Policies in the Burgundian Netherlands, 1433-1497* (Leiden, 1970), pp. 147-63; Munro, 'Bullionism', p.191; Volckart, *Die Münzpolitik im Deutschordensland*, pp. 41, 75 and 188.

[159] For general discussions see Spufford, *Money and Its use*, pp. 289-318; for France: see Miskimin, *Money, Prices and Foreign Exchange*, pp. 36-40 and Appendix D; idem, *Money and Power*, pp. 55-61, Sussman, 'Debasements'; for the Burgundian Low Countries: see Spufford, *Monetary Problems*; Munro, 'Warfare, liquidity, crises'. At the same time, however, England was remarkably restrained in the matter of manipulating coinage. A. Feavearyear, *The Pound Sterling* (Oxford, 1963), pp. 16-50; D. Chilosi and O. Volckart, 'Good or bad money? Debasement, society and the state in the late Middle Ages', working paper 140/10, London School of Economics, Economic History Department, 2010.

successful debasement, coins were to pass on face value to guarantee that the debased coins commanded (1) the same value when the intrinsic value was reduced; and (2) a higher face value when the intrinsic value remained unchanged.[160] Furthermore, to make it profitable to bring old coins to the mint, the mint price of debased coins had to be higher than the mint equivalent of old coins.

Although coinage debasement increased princely seignorage revenues, princes did not necessarily benefit from debasement in the long term. Most princely incomes came from rents and other fixed revenues, which were difficult to adjust. Being unable to increase rents quickly to reflect the fall in precious metals contained in debased coins, princes, like landowners and wage-earners living off fixed nominal incomes, suffered from a loss of real income in terms of precious metals. Yet debtors and employers, who were protected by their contracts, stood to benefit from debasement.[161] For merchants, the effects of coinage debasement depended entirely on their financial position: the creditor would suffer and the debtor benefit. Merchants were usually both creditors and debtors simultaneously; therefore the effects of debasement were frequently ambiguous. Nevertheless, merchants probably did not take much delight in monetary instability because it increased the uncertainty and the costs of conducting business.

Faced with changes in the bullion content of coinage, prices ought to have adjusted to eliminate the effects of coinage debasement. In the Middle Ages, rents, wages and grain prices tended to be relatively rigid, due to local customs and regulations. Any gain or loss brought about by coinage debasement was, to some degree, the result of this institutional price stickiness. Exchange, like other trading in the Middle Ages, could not have been free from government intervention and

[160] The denomination was not inscribed on coins until recently, but for a long time given by political authorities through ordinances or proclamations.

[161] The income effect of coinage debasement also depends on whether price levels were able to adjust to the intrinsic value of debased coins. The price adjustment seems to have been more difficult for those under long-term contract and bound by established custom. However, retail prices were likely to have adjusted according to the intrinsic value of coins. Miskimin demonstrates that a close relationship links debasements and the changes in grain prices in late medieval France. Miskimin, *Money, Prices and Foreign Exchange*, pp. 53-82; idem, *Money and Power*, pp. 54-72. However, prices did not start to adjust until a great number of the public realised that the decline of the intrinsic value of coins resulted from debasement. Before this, people could have stood to profit by passing debased coins.

regulation. However, exchange rates adjusted to regulation and intervention more flexibly and market force usually prevailed.[162]

Market mechanisms thus prevailed in exchange dealings. Those engaged in long-distance trade could screen themselves from coinage debasement by adjusting the exchange rate of the currency undergoing debasement. In the sixteenth century, England and the Habsburg Netherlands had a long-established interdependent commercial relationship. Exchange dealings were an indispensable part of the prosperous Anglo-Netherlands trade. In response to the dramatic changes in the bullion content of English coins caused by the Great Debasement, not only the course of exchange rates, but also the scale of the cloth trade was brought to an unprecedented level.[163]

3.3.2 The Great Debasement, 1544-51

In monetary history, England is always regarded as an exceptional case due to the stable standard of its coinage and its centralised organization of mints. During the two centuries before the Great Debasement, only four coinage debasements occurred in England: Edward III's debasements of 1344-51, the debasement of 1412, Edward IV's debasement of 1464-5 and the debasement of 1526. Over these coinage debasements, the government reduced the weight of English coinage but never tampered with the fineness. Not only did coinage debasement occur only roughly every fifty years, but the scale of debasement was modest (10-20 per cent in silver, 10-25 per cent in gold). There was an undeniable fiscal incentive behind the debasements of Edward III and Edward IV. However, the modest reduction in the weight of coins overall can also be seen as an expedient to counter the problem of the inevitable physical deterioration of circulating coins. With daily use, coins in circulation gradually became lighter through wear and tear. Over time the difference in weight between old coins and the new increased and it became profitable to

[162] For the restrictions on using bills of exchange in England, see Munro, 'Bullionism', pp. 198-215; and for government regulation of the payment of bills of exchange in Bruges and Antwerp, see de Roover, *Money, Banking and Credit*, pp.78-81; Edler, 'Financial measures of Charles V'; idem, 'Van der Molen,' pp. 119-23.

[163] F. J. Fisher, 'Commercial trends and policy in sixteenth-century England', *Economic History Review*, 10 (1940), pp. 95-117; Gould, *Great Debasement*, pp. 114-60.

distinguish heavy coins from light ones. Consequently heavy new coins would be hoarded or exported abroad. This illustrates Gresham's Law: bad money drives good money out of circulation. The modest debasement occurring every fifty years in England was sufficient to counteract the effect of Gresham's Law – new coins were produced at a similar weight to the stock of circulating coins.[164]

The government may have increased taxes, levied subsidies and enforced loans when fiscal pressure was high, but English coinage was only tampered with very rarely. For a long time Englishmen perceived coinage debasement as an abnormal monetary phenomenon. As a result, the English monetary system and the confidence in its stability were thrust into total chaos by Henry VIII's manipulations. In 1544, the Crown was in urgent need of immediate funds when England was preparing to invade France. The cost of the war for the first three months was estimated at £250,000, which soon turned out to be insufficient. Nearly half of this amount had to be found from the sources then available.[165] Coinage debasement became unavoidable in the circumstances of extreme financial anxiety in the second half of the 1540s.[166] In the face of colossal military expenses and the accumulation of huge debts abroad, coinage debasement continued into Edward VI's reign. Being unable to further enhance the mint price to attract bullion, Edward VI ordered the re-coinage of testoons issued by Henry VIII, most of which still consisted of a high proportion of fine silver (75 per cent purity) and replaced them with coins of 33 per cent purity in 1548-9.[167] In total, the intrinsic value of English coinage lost 83 per cent in silver and 25 per cent in gold between June 1544 and October 1551. The progress of the Great Debasement is shown in Table 3.1 and Graph 3.2. This scale of debasement shattered confidence in the English coinage and threw Anglo-Flemish exchange rates into disarray.

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[164] Numismatists estimate that every decade English silver lost roughly 2 per cent of its weight through wear. The scale of English debasement more or less corresponded to this estimation, which was about 10 per cent over 50 years. N. J. Mayhew, 'Numismatic evidence and falling prices in the fourteenth century', *Economic History Review*, 27(1974), pp.3- 4. This kind of debasement was monetary rather than fiscally oriented.

[165] *L&P*, XIX, Part I, no. 271.

[166] The fiscal exploitation of coinage yielded in total £1,270,684 between 1544 and 1551. C. H. Challis, 'The debasement of the coinage, 1542-1551', *Economic History Review*, 20 (1967), pp. 452-3.

[167] *Proclamations*, I, no. 302, 321, 322. The Testoon or Shilling with the denomination of 12d was first introduced by Henry VII but until the Great Debasement the testoon acted as a token rather than a circulating coin. Challis, *The Tudor Coinage*, pp. 61 and 211; idem, 'The conversion of testoons: a restatement,' *British Numismatic Journal*, 50 (1980), pp. 67-80.

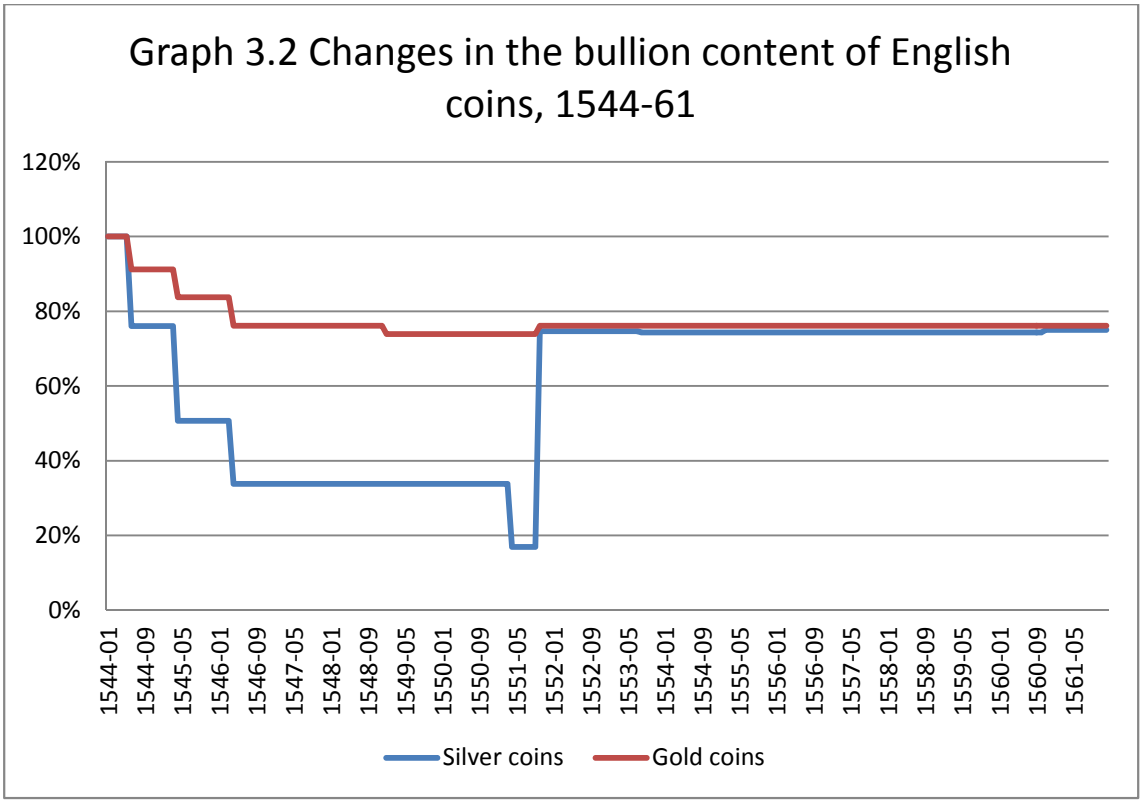
Table 3.1. The English coinage, 1526-60

Date	Fineness	Grams of pure metal per £ Sterling	Mint equivalent (£) for one Troy pound	Mint price (£) for one Troy pound	% mint charges for one Troy pound
Silver					
1526 Nov.	0.925	153.446	2.432	2.378	2.22
1542 May	0.758	117.931	3.165	2.400	24.17
1544 June	0.750	116.640	3.200	2.600	18.75
1545 Apr.	0.500	77.760	4.800	2.800	41.67
1546 Apr.	0.333	51.840	7.200	2.800	61.11
1547 Apr.	0.333	51.840	7.200	3.200	55.56
1548 Oct.	0.333	51.840	7.200	3.400	52.78
1549 Oct.	0.500	51.840	7.200	3.600	50.00
1550 Apr.	0.500	51.840	7.200	4.300	40.28
1551 Apr.	0.250	25.920	14.400	6.000	58.33
1551 Oct.	0.921	114.562	3.258	3.203	1.69
1553 Aug.	0.917	114.040	3.271	3.193	2.38
1557 Aug.	0.917	114.040	3.271	3.191	2.45
1560 Nov.	0.925	115.085	3.242	3.164	2.41
Gold					
1526 Nov.	0.9948	13.752	27.142	27.003	0.51
	0.9166	13.617	27.408	27.246	0.59
1542 May	0.9583	12.420	30.050	28.800	4.16
1545 Apr.	0.9166	11.404	32.727	30.000	8.33
1546 Jan.	0.9166	11.404	32.727	30.600	6.50
1546 Apr.	0.8333	10.368	36.000	30.600	15.00
1546 Oct.	0.8333	10.368	36.000	31.200	13.33
1547 Mar.	0.8333	10.368	36.000	34.800	3.33
1549 Feb.	0.9166	10.063	37.092	36.000	2.94
1550 Dec.*	0.9948	12.893	28.951	28.813	0.48
1551 Oct.	0.9948	10.314	36.188	36.050	0.38
	0.9166	10.368	36.000	35.836	0.46
1553 Aug.	0.9948	10.314	36.188	35.987	0.56
1560 Nov.	0.9948	10.314	36.188	35.987	0.56
	0.9166	10.368	36.000	35.782	0.61

Source: C. H. Challis, *The Tudor Coinage* (Manchester University, 1978), p. 171 and Appendix II.

Note: One Troy pound was equivalent to 373.248 grams

*The plan to restore the quality of gold coins was premature and short-lived and the output of gold coins at this standard was small, only £2,500.



Source: see Table 3.1

The end of the Great Debasement was marked by a 50 per cent devaluation of the debased silver coins in the summer of 1551 and the re-issue of fine silver coins later the same year. However, the governments of Edward VI and Mary I did not recall debased silver coins from circulation. Not until the first year of Elizabeth's reign was the government, by further devaluing the face value of debased silver coins, able to re-coin debased silver coins into fine silver coins. The re-coinage and the restoration of the fineness of silver coins back to 92.5 per cent purity in 1560-1 finally cleared up the monetary confusion left by Henry VIII. The fineness had been restored, but the bullion contained in Elizabeth's silver coins was still 25 per cent less than in those issued before the debasement (Table 3.1).

The timing of the end of the Great Debasement, October 1551, cannot be applied to gold coins as properly as to silver coins, whose bullion content was largely increased from this time. Although gold coins were a little further debased in February 1549, it is arguable that the debasement of gold coins stopped in practice as early as 1547. It can be observed in Table 3.1 that the gold coins issued after October 1551 contained very much the same bullion as those issued in 1546-9,

though the fineness was higher. The plan of December 1550 to increase the bullion content of gold coins, which resulted in a small value of mint output (£2,500), was premature and soon aborted.[168] The most debased gold coins issued between February 1549 and July 1551 amounted only to a value of £77,000 in total (Table 3.2). Not only was the output modest, but it was likely to have been consumed by military expenses paid abroad. Furthermore, the mint price of the coins minted in the years 1549-51 was not sufficient to put the coins issued in 1546-9 at risk of being re-minted. Hence, it was highly possible that most of the gold coins in circulation after March 1547, when the mint price was sufficiently high to remove the issue before April 1546, were those issued in and from April 1546.

Nowadays our understanding of the development of the Great Debasement – the quantity of money produced and changes in the intrinsic value of coins – is heavily indebted to Challis' comprehensive work. By thoroughly sifting through numerous mint accounts and indentures, Challis was able to draw a detailed picture of the mint output, the mint equivalent, the mint price and the estimated amount of circulating money during the debasement.[169] The following review of data on the English mint is essentially based on Challis' research. The breakdown of the scale of the debasement and the known output of English silver and gold at this period are shown in Table 3.1 and 3.2.

[168] Challis, *Tudor Coinage*, p. 105.
[169] C. H. Challis, ed., *A New history of The Royal Mint* (Cambridge, 1991)*;* idem, 'The debasement of the coinage, 1542-1551'; idem, *Tudor Coinage*; idem, 'The circulating medium and the movement of prices in mid-Tudor England', in P. H. Ramsey, ed., *The Price Revolution in Sixteenth-Century England* (Richard Clay, 1971), pp. 115-46; C. H. Challis and C. J. Harrison, 'A contemporary estimate of the production of silver and gold coinage in England, 1542-1556', *Economic History Review*, 88 (1973), pp.821-35.

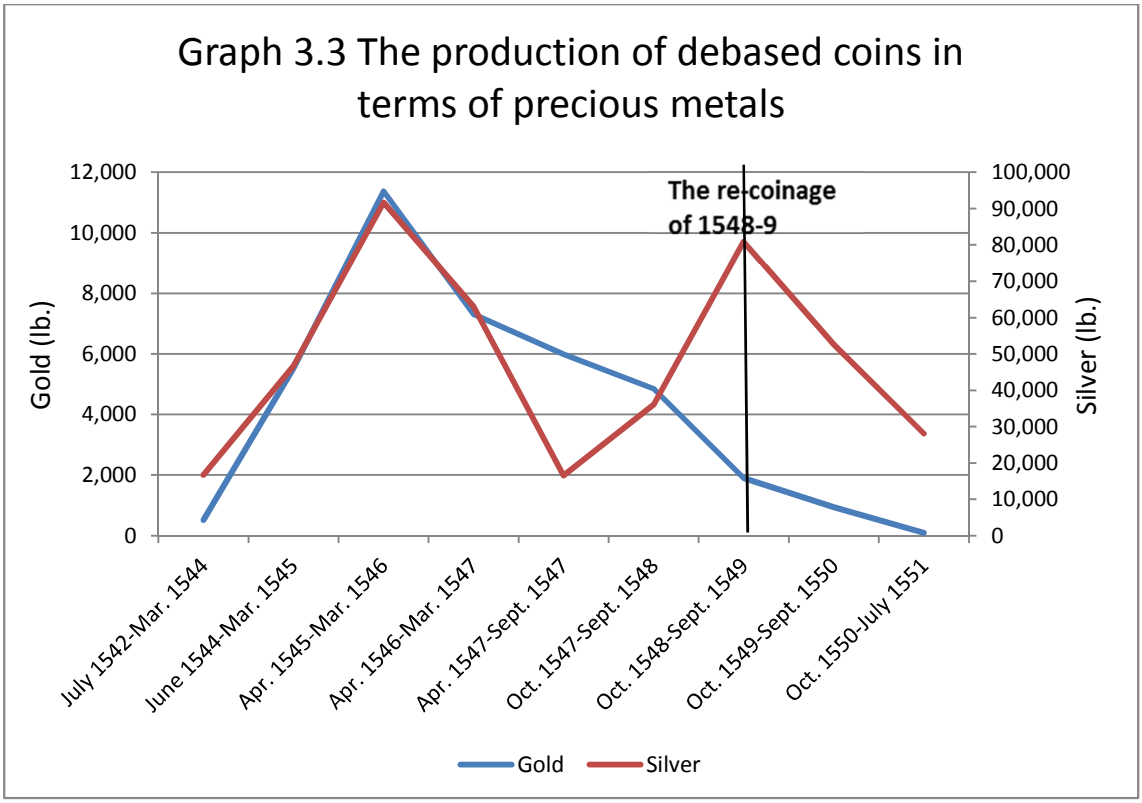
Table 3.2. The Known output of debased English coins, 1542-51*

Date	Gold coin		Silver coin		Gold as a percentage of total value
	Total for the period	Monthly average	Total for the period	Monthly average	
1 July 1542-31 Mar. 1544[1]	£15,595 (519 lb)	-	£52,927 (16,723 lb)	-	22.76
1 June 1544-31 Mar. 1545	£165,931 (5,521 lb)	£16,593 (552 lb)	£149,287 (46,652 lb)	£14,929 (4,665 lb)	52.64
1 Apr. 1545-31 Mar. 1546	£372,180 (11,373 lb)	£31,015 (948 lb)	£440,213 (91,711 lb)	£36,684 (7,643 lb)	45.81
1 Apr. 1546-31 Mar.1547	£263,165 (7,310 lb)	£21,930 (609 lb)	£453,616 (63,002 lb)	£37,801 (5,250 lb)	36.71
1 Apr. 1547-30 Sept. 1547	£215,725 (5,992 lb)	£35,954 (999 lb)	£119,114 (16,543 lb)	£19,852 (2,757 lb)	64.43
1 Oct. 1547-30 Sept. 1548	£174,375 (4,844 lb)	£14,531 (404 lb)	£259,906 (36,098 lb)	£21,659 (3,008 lb)	40.15
1 Oct. 1548-30 Sept. 1549	£69,678[2] (1,901 lb)	£5,807 (158 lb)	£582,779[4] (80,941 lb)	£48,565 (6,745 lb)	10.68
1 Oct. 1549-30 Sept. 1550	£34,762 (937 lb)	£2,897 (78 lb)	378,338[5] (52,547 lb)	£31,528 (4,379 lb)	8.41
1 Oct. 1550-31 July 1551	£2,778[3] (96 lb)	£278 (9.6 lb)	£288,299[6] (28,031 lb)	£28,830 (2,803 lb)	0.95

Source: C. E. Challis, 'The circulating medium and the movement of prices in mid-Tudor England', in P. H. Ramsey, ed., *The Price Revolution in Sixteenth-Century England* (Richard Clay, 1971), p. 118; idem., *The Tudor Coinage* (Manchester University, 1978),Appendix II.

Note: * The figures in the bracket are the output in terms of precious metals contained (in the Troy pound).

1. The secret of the production of debased coin in 1542-44 was not released until the debasement became public in June 1544.
2. The output of gold coins recorded during this period consisted of £27,600 worth of coins with a 20c fine at £30 per lb and £42,077 16s 8d worth of coins with a 22c fine at £34 per lb.
3. The gold coins produced between October 1550 and July 1551 consisted of £277 14s worth of coins of 22c fineness at £34 per lb and £2,500 6s worth of 23c 3 ½ gr at £28 16s per lb.
4. The output of silver coins recorded during this period consisted of £322,561 worth of coins of 4oz at 48s per lb, £210,017 worth of 6oz at 72s per lb and £50,201 worth of 8oz at 96s per lb.
5. The output of silver coins recorded during this period consisted of £8,325 worth of coins of 4oz at 48s per lb, £370,013 worth of 6oz at 72s per lb,
6. The output of silver coins recorded during this period consisted of £115,340 worth of 6oz at 72s per lb and £172,959 worth of 3oz at 72s per lb



Source: see Table 3.2

The sixteenth-century English mint accounts are remarkably complete compared to those of other European countries, though some years are missing: September 1523-September 1526, September 1531-Febuary 1533, June-September 1540, November 1534-September 1536, September 1541-September 1542, April 1552-December 1553 and December 1555-December 1558. There are also accounts of ecclesiastical mints, though often fragmentary.[170] The total quantity of hard money circulating in a given year can be approximated as the total mint output of the preceding 30 years.[171] Based on the surviving accounts and the estimated production, 1.64 million pound sterling is thought to have been in circulation in 1544. However, because of the outflow of bullion for international payments and diplomatic uses, Challis gives a lower figure (£1.23 million).[172] The known total mint output during the debasement was £3.97 million (including the two-year secret

[170] Before the debasement, some English coins were produced in ecclesiastical mints, i.e. Canterbury, Durham and York, run by the religious houses. After the Henrician reformation, the right of the church to issue coinage was abolished. During the debasement, owing to the large scale of production these mints remained in operation but were run by the Crown.
[171] N. J. Mayhew, 'Population, money supply and the velocity of circulation in England, 1300-1700', *Economic History Review*, 28 (1995), p. 245; Challis, *Tudor Coinage*, p. 237.
[172] Challis, *Tudor Coinage*, pp. 237-8.

production of debased coins, which were not released until 1544 and consisted of £15,595 in gold and £52,927 in silver), the breakdown can be found in Table 3.2 and Graph 3.3. On the basis of the official estimation made in the mid-1550s, the unrecorded production of debased coins between June 1544 and July 1551 was estimated at £344,343 for silver, £24,688 for gold, and £80,000 minted at the ecclesiastical mint at Durham House.[173]

As discussed earlier, due to the mint charges (seignorage and brassage) the public received back from the mint less than they had brought. The increasing difference between the mint equivalent and the mint price during the debasement (45 per cent in silver and 8 per cent in gold, on average) is shown in Table 3.1, indicating that the government reaped a healthy profit from the monetary alteration and confirming the fiscal motivation behind the debasement. The much lower proportion of the mint charge imposed on gold coins was in accordance with the small scale and early ending of the debasement of gold.

The figure for fineness which appears in Table 3.1 is precise at 1 point in 1000, but the coins manufactured in the sixteenth century were less accurate than the fineness and weight documented in the indentures owing to the crude technology used by mints. That the weight and fineness of actual coins allowed differs slightly from the standard stipulated is demonstrated in the 'remedy' specified in the indentures.[174] Even if the coinage was produced to a standard close to that prescribed in the indentures, the effects of wear and tear through daily transactions made the weight of circulating coins not only lighter than had been officially agreed, but also different from each other. Keeping these caveats in mind, one can still learn a great deal about the progress of the Great Debasement from information provided in Table 3.1 and 3.2.

[173] The unrecorded production of gold coins was broken down into £21,767 worth of coins issued between April 1546 and 1549 (20c fine at £30 per lb.) and £5,678 worth of coins issued in the years 1549-51 (22c fine at £34 per lb.). For silver, it consisted of £299,942 worth of coins which contained 51.84 grams of pure silver in £1 and £44,399 worth of coins issued in April-July 1551 (3oz fine at 72s per lb.). Among the amount of £299,942 of silver coins were £57,132 worth of coins of 4 oz at 48s per lb and £242,810 worth of coins of 6 oz at 72s per lb. Challis and Harrison, 'Contemporary estimate of production', pp. 830-1, 833-5.

[174] Challis, *Tudor Coinage*, Appendix III.

Table 3.3. The official gold-silver ratios in England, 1526-60

Date	Mint price		Gold-silver ratio	The market gold-silver ratio in Antwerp
	Gold	Silver		
1526 Nov.	27.244	2.378	11.457	11.411
1544 June	28.800	2.600	11.077	11.411
1545 Apr.	30.000	2.800	10.714	11.411
1546 Jan.	30.600	2.800	10.929	11.411
1546 Oct.	31.200	2.800	10.929	11.411
1547 Apr.	34.800	3.200	10.875	11.577
1548 July	34.800	3.200	10.875	11.749
1548 Oct.	34.800	3.400	10.235	11.749
1549 Feb.	36.000	3.400	10.588	12.101
1549 Oct.	36.000	3.600	10.000	12.101
1550 Apr.	36.000	4.000	9.000	12.895
1550 Aug.	36.000	4.300	8.372	12.895
1551 Apr.	36.000	6.000	6.000	12.295
1551 Oct.	36.050	3.204	11.253	12.295
1552 Jan.	36.050	3.204	11.253	12.343
1553 Aug.	35.987	3.193	11.270	12.489
1557 Aug.	35.987	3.191	11.278	13.001
1560 Nov.	35.937	3.162	11.365	13.218

Source: C. H. Challis, *The Tudor Coinage* (Manchester University, 1978), p. 171; H. Van der Wee, *The Growth of the Antwerp market and the European Economy*, Vol. 1, Table XVI, p.130

Note: In England, mints were the only places exchanging bullion for money. Generally speaking, the price of gold and silver was decided by the mint price. Therefore, the official gold-silver ratio in England can be calculated as $\frac{the\ mint\ price\ of\ gold}{the\ mint\ price\ of\ silver}$, which is, at a given amount of money-of-account, the quantity of silver equivalent to one gram of gold. The gold-silver ratio of 1526 is calculated on the crown gold, which was the most produced gold coin in 1526-44 and better represented English gold coins at the time.

Though with different degrees of fineness, the silver coins produced in 1546-51 remained at the same intrinsic value until the final reduction in April 1551. Graph 3.3 demonstrates that the output of debased coins in terms of bullion began to decline in 1546-7. In the early stage of debasement, the bullion supplied to the mint for the production of debased coins came mainly from old coins, with some probably coming from dishoarding. They were attracted by the increasing mint prices. The fall of mint output in silver in early 1547 was due to the exhaustion of old coins and the insufficiency of the mint price to attract early issues of debased coins. The resurgence of the production of silver coins in 1548-50 was the result of the re-

coinage of testoons, which may have absorbed most of pre-1546 issues, and the threefold rise in the mint price. After being temporarily boosted by the increase in the mint price in March 1547, the production of gold coins dropped to a small proportion of the total production by the end of 1548, as the English government adopted a bimetallic policy and deliberately overvalued silver. As shown in Table 3.3, the gold-silver ratios in England were clearly lower than those in Antwerp.[175] As a result, a large quantity of gold flowed out to Europe and silver became the dominating currency in England.

3.3.3 The mint data of the Habsburg Netherlands

In terms of the operation of minting and coinage, there were some differences between England and the Netherlands in the sixteenth century. First, in the Netherlands, minting was decentralised to the major cities of the provinces, Antwerp in Brabant, Bruges in Flanders and Dordrecht in Holland.[176] The poor quality of the mint accounts may be a result of this decentralisation. Second, unlike English coins, the bullion content of Flemish coins was not proportionate to their denominations: coins with large denominations usually contained a higher percentage of precious metals than did smaller denominations. Furthermore, as the commercial centre of north Europe, Antwerp imported and circulated foreign money, together with commodities from the Baltic, the Rhine area, France and the Mediterranean. A great number of foreign currencies were legally recognised and circulated side by side with local coins.[177]

Due to these factors, the calculation of Anglo-Flemish mint parity is affected by the type of coins used as the reference currency. Here, parity is estimated on the

[175] Gould, *Great Debasement*, Table IV, p. 46, 49; Challis, 'Circulating medium', p.129.; idem., *Tudor Coinage*, pp. 176-9. In his Tables II and IV, Gould miscalculated the mint equivalent of gold coins at £27 16s 5d instead of the actual value of £27 2s 10d. Therefore, the gold-silver ratios based on this incorrect mint equivalent are overestimated in his Table IV.

[176] H. Enno van Gelder and M. Hoc, *Les Monnaies des Pays-Bas Bourguignons et Espagnols, 1434-1713* (Amsterdam, 1960), pp. 76-7.

[177] The recognised foreign currencies were given at official values and legally circulated in the Low Countries. However, whether these currencies circulated at official values or not is still open to dispute. J. H. Munro, 'Money and coinage of the age of Erasmus: an historical and analytical glossary with particular reference to France, the Low Countries, England, the Rhineland and Italy', in R. Mynors, D. Thomson, and W. Ferguson eds., *The Collected Works of Erasmus: The Correspondence of Erasmus, Vol. 1: Letters 1 to 151, A.D. 1484-1500* (University of Toronto Press, 1974), pp. 311-48.

basis of Flemish coins with large denominations. Coins with large denominations were likely to be used in large payments, such as payments of bills of exchange, because lower transaction costs were involved in counting and examining them. In view of the availability, Flemish coins rather than the prestigious ducats and florins are suited to estimating parity.[178] Therefore, the Flemish réal of gold and the florin carolus of silver (40 groots) have been chosen to calculate the Anglo-Flemish mint parities.[179] After 1557, the florin carolus was replaced by the écu Philippe in calculation.[180] The bullion content and face value of these Flemish coins are given in Table 3.4.

Also unlike England, the Netherlands in the first half of the sixteenth century enjoyed a calm and stable period in its monetary history. For most of the time, the bullion content of silver coins remained unchanged.[181] Despite the unaltered weight and fineness of gold coins, the official value of the gold coins in circulation was adjusted (reduced) a few times: 10 per cent in 1527, 10 per cent in 1539, 5 per cent in 1548, 5 per cent in 1551 and another 5 per cent in 1567.[182] The Flemish monetary policies give us a chance to test how exchange markets reacted to monetary alteration which information of changes was well-public, and to compare this adjustment to the one following the Great Debasement, where the information about changes in the bullion content was difficult to grasp. The gold-silver ratios in the first half of the sixteenth-century in the Netherlands were affected by the inflow of German silver and precious metals from Spanish America, the monetary policy

[178] Being produced locally, Flemish coins definitively outnumbered foreign coins. Moreover, the state of trade had a strong impact on the number of foreign coins available in the Low Countries.
[179] In 1521, two new gold coins, the réal and the gulden, replaced the Florin Philippus to become the principal gold coins issued in the Habsburg Netherlands. The face value of the gulden was given at 20 stuivers and the value of the réal was 3 times that of the gulden. Due to the high bullion content, the réal is used in calculating the mint parity. H. Enno van Gelder, *De Nederlandse Munten: Het Complete Overzicht tot en Met de Komst van de Euro* (Utrecht, 2002), p. 69.
[180] After Philip II became the lord of the Low Countries, the florin carolus ceased to be produced and meanwhile several new types of silver coin were introduced, the écu Philippe and its fractions, from July 1557 onwards. Enno van Gelder and Hoc, *Les Monnaies*, pp. 97-122.
[181] H. Van der Wee, *The Growth of the Antwerp market and the European Economy Fourteenth-Sixteenth Centuries* (The Hague, 1963), vol. 3, Graph 33; J. H. Munro, 'Money, wages, and real incomes in the ages of Erasmus: the purchasing power of coins and of building craftmen's wages in England and the Low Countries, 1500-1540', Working Paper, No. 1, 2001, Table 2.A.
[182] Van der Wee, *Antwerp Market*, vol. 2, pp. 200, 203; Edler, 'Financial measures of Charles V'; Pusch, *Staatliche Münz-und Geldpolitik in den Niederlanden unter den burgundischen und h1absburgischen Herrschern, besonders unter Ksiser Karl V* (München, 1932), pp. 84-6.

pursued by neighbouring rulers and by the commercial and political situation.[183] Thus, the ratios moved up and down to reflect any change. The fluctuation prompted the Habsburg government to disregard market mechanisms and to arbitrarily change the face value of gold coins so as to fix the gold-silver ratio at the most desirable level. The intervention resulted in tightening up the Antwerp money market, driving up interest rates and bringing commerce to a standstill.[184]

Table 3.4 The bullion content of Flemish money used in calculating the Anglo-Flemish mint parity, 1537-68

Date	Fineness	Face value (Flemish groots)	Grams of pure metal per £ Flemish
Réal d'or (gold)			
1537-48	0.9913	120	10.55
1548-51	0.9913	126	10.05
1551-56	0.9913	132	9.59
1556-68*	0.9913	120 140	10.55 9.05
silver			
Florin Carolus (1537-56)	0.833	40	114.20
Écu Philippe (1557-68)	0.833	70	97.88

Source: H. Enno van Gelder and M. Hoc, *Les Monnaies des Pays-Bas Bourguignons et Espagnols*, 1434-1713 (Amsterdam, 1960), pp. 75-122; H. Enno van Gelder, *De Nederlandse Munten: Het Complete Overzicht tot en Met de Komst van de Euro*, (Utrecht, 2002), pp. 80, 290-2; G. Pusch, *Staatliche Münz-und Geldpolitik in den Niederlanden unter den burgundischen und habsburgischen Herrschern, besonders unter Kaiser Karl V*, (München, 1932), pp. 85-6; P. O. van der Chijs, 1852, *De munten van de voormalige graven en hertogen van Gelderland: van de vroegste tijden tot aan die pacificatie van Gend* (Haarlem, 1852), pp. 343, 350

Note: *The face value of réal d'or in the early reign of Philip II is given at 70 sols (140 groots) by Enno van Gelder & Hoc. However, in another book by Enno van Gelder, *De Nederlandse,* the value is given at 3 pieces of gulden (120 groots). Furthermore, the face value of réal d'or produced in Gelderland was given at 60 stuivers (120 groots) by van der Chijs. Thanks to Oliver Volckart for providing me with van der Chijs's figure.

[183] Van der Wee, *Antwerp Market*., pp. 128-133; I. Blanchard, *The International Economy in the "Age of the Discoveries", 1470-1570* (Franz Steiner Verlag, 2009), pp. 20-3; Idem, 'English Royal Borrowing at Antwerp, 1544-1574', in M. Boone and W. Prevenier eds., *Finances publiques et finances privées au bas moyen âge* (Garant, 1996), p. 59; Idem, 'International capital markets and their users, 1540-1750', in M. Prak ed., *Early Modern Capitalism Economic and Social Change in Europe, 1400-1800* (London, 2001), pp. 107-24; J. H. Munro, 'The monetary original of the 'Price Revolution': south German silver mining, merchant-banking and Venetian commerce, 1470-1540', Working Paper, no. 8, 2003, pp. 11-7.

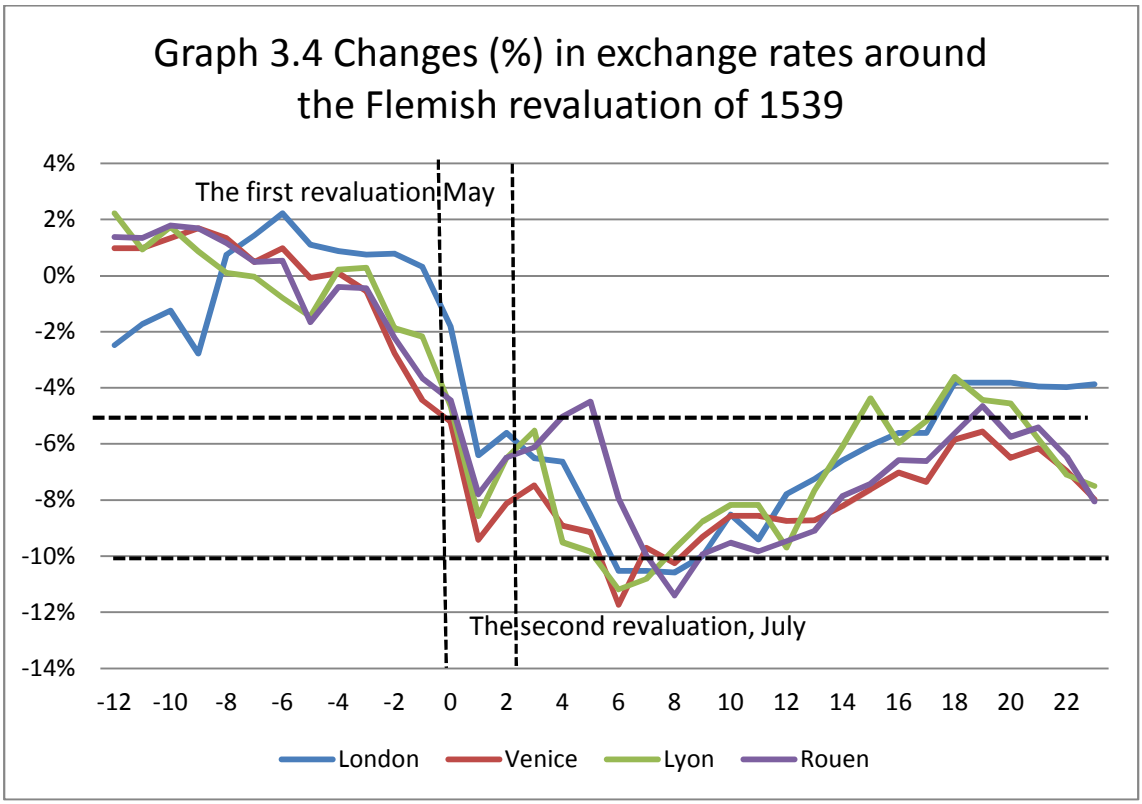
[184] Edler, 'Financial measures of Charles V'; idem, 'Van der Molen,' pp. 119-23; H. Van der Wee, 'Economic activity and international trade in the southern Netherlands, 1538-44', in H. Van der Wee ed. and L. Fackelman tarns., *The Low Countries in the Early Modern World* (Variorum, 1993), pp. 115-25.

Owing to the surviving correspondence of van der Molen, a Flemish merchant,[185] we know much about the development and the effect of the revaluation of 1539 on Flemish exchange and commerce. The market price of gold coins, being reported in money-of-account based on silver, was affected by various factors and changed accordingly. As a result, the market price of gold coins and gold as bullion was not always as the same as the official value dictated by mint indentures, but most of the time the difference remained modest.[186] However, in some instances the difference between the market price and the official value became wider. For example, in 1538 one florin carolus was priced at 44 Flemish groots in the market, meanwhile, the face value was given at 40 Flemish groots; the French écu was priced at 80 groots but officially valued at 72 groots.[187]

Faced with gold coins commanding high prices in the market, the Habsburg Netherlands government set out a plan to reduce the face value of gold coins in circulation by 10 per cent: a first devaluation of 5 per cent was proclaimed in May and another 5 per cent in July 1539. Under the new tariff in the Netherlands, gold coins were undervalued and the result was an outflow of gold, falling prices and rising interest rates.[188] The government's ignorance of market mechanisms was again demonstrated in the policy of 1541, adopted to counter the outflow of gold after the revaluation: all bills of exchange in Antwerp were ordered to be paid two-thirds in gold.[189] Instead of solving the problem, the scheme brought exchange transactions to a stop because no one wanted to make payment in devalued gold coins (which means to give up more coins in any given value of money-of-account) and the scheme cut off access to credit from the exchange markets that merchants had grown used to relying upon. Essentially, the regulation was unenforceable. A few

[185] See cf. 103below
[186] Van der Wee, *Antwerp Market.*, vol. 1, Table XV and XVI; Munro, 'Money, wages, and real incomes', Table 4.
[187] Edler, 'Financial measures of Charles V', pp. 667-8, Pusch, *Staatliche Münz-und Geldpolitik*, pp. 84-5.
[188] Edler, 'Financial measures of Charles V', pp. 668-9; Van der Wee, *Antwerp Market*., vol. 3, Graph 35; idem, 'International trade in the southern Netherlands'.
[189] This was not the first time government attempted to regulate the payment of bills of exchange in the Low Countries. At least two other interventions occurred in the early period, the year 1399 and 1410. de Roover, *Money, Banking and Credit*, pp. 78-81.

months later, payments of bills of exchange were once more made freely, although this regulation was not repealed until 1551.[190]



Source: Appendix 3.B

Note: a. The horizontal axis is the number of months before and after the first revaluation (Time 0) was announced. The second revaluation was proclaimed in the second month after the first (Time 2).

b. The benchmark is the average exchange rate of the previous year. The Antwerp-London exchange rate was quoted as a variable number of Flemish groots for one English noble (6s 8d st.); the Antwerp-Venice exchange rate is a variable number of Flemish groots for one Venetian ducat; the Antwerp-Lyon, a variable number of Flemish groots for one ècu de marc; the Antwerp-Rouen, a variable number of Flemish groots for one French crown.

Based on the exchange rates recorded in van der Molen's correspondence, we can examine closely how exchange rates adjusted to the revaluation of 1539. Because the bullion content of gold coins remained the same, the Flemish pound was worth more gold coins after the devaluation. Given that other conditions remained unchanged, after the revaluation Flemish money should have appreciated against other European money. The simply evaluation of how exchange rates adjusted to this

[190] Edler, 'Financial measures of Charles V', p. 672-3.

policy can be shown as follows. First, the average exchange rates are taken over the 12 months before the revaluation. Then, monthly changes, in terms of the percentage of this average rate after the revaluation, are calculated and plotted in Graph 3.4. Because the exchange rates were quoted in Flemish money, the falling exchange rates are interpreted as the appreciation of Flemish money.

Graph 3.4 shows that, except for Antwerp-London exchange rates, the other three exchange rates (Venice, Lyon and Rouen) anticipated the revaluation 2 to 3 months before it was made public, and rates had already appreciated by 8-10 per cent before the second revaluation announced in July. The rebound in July (Time 2 in Graph 3.4) and August (Time 3) can be regarded as an adjustment to the earlier over-shoot, which may have been a response to the plan made in April (Time -1). Soon after the second devaluation, the rates fluctuated around 90 per cent of the average of the previous year, as the impact of the second devaluation began to be felt. Considering the commercial ties and short distance between London and Antwerp, it is surprising that the Antwerp-London exchange markets did not foresee the scheme, but rather adjusted immediately to two devaluations. Once began, the Anglo-Netherlands exchange market adjusted to the devaluation as quickly as other markets. Overall, the exchange rates of Flemish money in Antwerp quickly adjusted in proportion to the degree of revaluation of gold coins.

3.3.4 The operation of bills of exchange

After long-distance trade had revived in the eleventh century, one of the constant concerns of merchants engaged in commerce was the difficulty of transferring funds from one place to another and from one currency to another. The Italians soon developed a method of remittance, the bill of exchange, to deal with the risks and costs involved in moving funds between distant places. As well as being a means of remittance, the uncertainty of the return exempted dealing in bills from the charge of usury and thus merchants used it as a credit instrument.[191]

Before the invention of telegraphy, the speed of communication depended on the distance and travel time separating two places. The maturity of bills of exchange

[191] See Chapter 1.

thus varied according to where the deliverer and the payer were located. According to custom, the maturity of bills, based on where money was remitted, was set at a fixed length of time. This length of time was known as *usance.* In the fifteenth and sixteenth centuries, the usance between London and the Low Countries was one month. At fairs, merchants gathered to trade with one another and it thus became convenient to settle bills of exchange in this setting. It was observed in early sixteenth-century English merchants' accounts that the Brabant fairs were usually chosen to settle Anglo-Flemish bills.[192] However with the expansion of trade, buying and selling became continuous and permanent activities and hence the seasonal fair gradually lost its importance. Permanent markets, both commodity and finance, started to emerge. In the Antwerp exchange market, for example, merchants could buy and sell bills of exchange at any time and at any length of term all through the year. In Lyon and later Besançon, however, where exchange was controlled by several great Italian houses, bills of exchange and debts under the clearing system were still settled periodically.[193]

The sixteenth-century Anglo-Flemish flow of bills of exchange was rooted in the rhythm of medieval practices. As early as the end of the thirteenth century, bills of exchange in connection with the English wool-export business have been found.[194] Owing to technological advantages and business organization, exchange dealings in England were conducted mostly by Italians, Florentines in particular, who paid for their purchases of English wool with credit accumulated in the Low Countries by using bills of exchange.[195] With the growing trade and the increasing number of English merchants involved, the English learnt the art of exchange dealing and bills of

[192] According to the accounts of Mucklowe and Kitson, English merchants tended to settle their bills of exchange in the Brabant fairs. The four three-month long Brabant fairs were the Easter or Pascha mart (begun in the third week of April) in Bergen-op-Zoom, the Sinxon mart (the second week of June) in Antwerp, the Bamas mart (the third week of September) in Bergen-op-Zoom and the cold mart (early November) in Antwerp. Blanchard, *International Economy*, p. 82. See Table 3.5 for the location of the accounts by Mucklowe and Kitson.

[193] Boyer-Xamneu, et al., *Private Money and Public Currencies*, pp. 91-4; J. I. M. Ruiz, 'The credit market and profits from letters of exchange: Ricorsa exchange operations between Seville and the "Besançon" international fairs (1589-1621)', *Journal of European Economic History*, 33 (2004), pp. 331-55.

[194] de Roover, 'The organization of trade', p. 73.

[195] W. B. Watson, 'The structure of the Florentine galley trade with Flanders and England in the fifteenth century', *Revue belge de philologie et d'histoire*, 39 (1961), pp. 317-47. Watson argues that with a negative trade balance with England, the Florentines used the revenue accumulating in the Low Countries, where they had a favourable trade balance, to finance their wool exports from England.

exchange came hand in hand with the English export trade.[196] English exported wool and unfinished cloth to Europe and the proceeds of the sales were repatriated by bills of exchange. Although Calais remained the staple of English wool trade on the Continent for two centuries (1363-1558), exchange dealings proceeded in Bruges and later in Antwerp.[197]

According to the Celys' Papers, when English merchants sold wool in Calais, they usually received part of the payment in ready money and the rest of the payment (usually two-thirds) as sale credit, the loans being repaid (usually three to six months later) in Flemish money in Bruges. The loans would be collected in Bruges when English merchants (or their agents) attended Flemish and Brabantine fairs. The funds would be remitted to England by buying bills drawn on London.[198] Those who were occupied in the import business and needed Flemish money for their purchasing were the deliverers in the Low Countries – they were usually mercers and grocers. When bills became due in London, merchants engaged in the wool-exporting business would receive their money in pound sterling and use it to repay their debts to the wool producers. Exchange dealings operating in the sixteenth century were almost the same as those in the time of the Celys. However, with the growth of Anglo-Flemish commerce, employed agents, replacing the junior members of families who in the past were usually sent abroad to look after the business, were kept permanently in Antwerp to handle the business and financial transactions and represent interests in the Low Countries.[199]

In Anglo-Netherlands trade, the bill of exchange was used not only as a means of remittance but a credit instrument.[200] The indispensability of exchange dealings in cross-channel trade was demonstrated in Richard Gresham's protest to the government's intervention in exchange: "merchants can no more be without

[196] Calendar of Select Pleas and Memoranda of the City of London, 1381-1412; Hanham, *Celys and their World* ; H. E. Malden, *The Cely Papers: Selection from the Correspondence and Memoranda o the Cely Family, Merchants o the Staples, A.D. 1475-1488* (London, 1900).
[197] From the sixteenth century onwards, cloth had already overtaken wool to become the most important exported commodity. Moreover, cloth could be directly sold in the Brabant fairs, therefore, the commodity market and the financial market for English overseas trade became concentrated in Antwerp. However, the practice of selling English wool did not change: wool was traded in Calais but exchange was settled in Antwerp. After Calais was recaptured by the French in 1558, the hub of the English wool trade moved to Bruges.
[198] Hanham, *Celys and Their World*; Malden, *Cely Papers*.
[199] B. Winchester, *The Johnson Letters, 1542-1552*, Unpublished Thesis (University of London, 1953).
[200] de Roover, 'The organization of trade', pp. 117-8.

exchanges and re-exchanges than the shippers in the sea to be without water".[201] Without bills of exchange, merchants would have needed more capital to conduct their business. The scale of trade would have been smaller because of the lack of capital.

3.4 The data of Anglo-Flemish exchange rates

de Roover once claimed that, in contrast to the seventeenth century, few quotations of sixteenth-century Anglo-Flemish exchange rates survive in Belgian sources.[202] English mercantile documents are in contrast a rich source of Anglo-Flemish exchange rates. Since his statement, at least three collections of Anglo-Flemish exchange rates recorded in English documents have been published: (1) Ramsey lists quotations extracted from Kitson's account and Gresham's daybook in his PhD thesis; (2) Gould presents a table of the monthly London-Antwerp rate of exchange from 1544-63, which is mainly based on the actual figures of Van der Wee's graph and other miscellaneous sources; (3) Lloyd gives us quotations spanning the period 1558 to 1568.[203] In addition to the published quotations, Anglo-Flemish exchange rates can also be traced in other mercantile account books and correspondence. John Johnson and John Isham were both English merchants trading with the Netherlands in the mid-sixteenth century. Their business documents, which have been studied and transcribed, provide valuable information on Anglo-Flemish exchange rates.[204]

The English mercantile documents, on which our knowledge about Anglo-Flemish exchange rates is based are associated with the wool/cloth-exporting business and the destination of their trade was the Habsburg Netherlands. In most cases, these English merchants were occupied with an export business which paid for their

[201] *Proclamations*, I, no. 173, 181 and 182. The full protest of Richard Gresham is printed in G. Schanz, *Englische Handelspolitik Gegen Ende des Mittelalters: mit Besonderer Burücksichtigung des Zeitalters der Beiden Ersten Tudors Heinrich VII und Heinrich VIII* (Leipzig, 18881), II, pp. 632-3.
[202] de Roover, *Gresham on Foreign Exchange*, p. 114.
[203] P. H. Ramsey, *The Merchant Adventurers in the First Half of the Sixteenth Century*, unpublished PhD Thesis (University of Oxford, 1958), Appendix D; Gould, *Great Debasement*, Table IX; Van der Wee, *op. cit*, vol.3, Graph 33; H. Lloyd, 'Early Elizabethan investigations into exchange and the value of sterling, 1558-1568', *Economic History Review*, 53 (2000), Table 2.
[204] G. D. Ramsay, *John Isham, Mercer and Merchant Adventurer* (Northamptonshire Record Office, 1962); Winchester, *Johnson Letters*.

purchase of wool and cloth in English money and sold their goods for Flemish money. By using exchange, they obtained and granted credit over a short period of time and transferred the proceeds of their trade from the Netherlands to London. These merchants paid much attention to the daily movement of Anglo-Flemish exchange rates which, to some degree, affected the margin of profit of trade and the cost of credit obtained from the exchange market. The record of exchange rates and concern over the movement of exchange rates are recurrent features of these English mercantile documents.

Apart from these English sources, Anglo-Flemish exchange rates can be found in one Flemish source, van der Molen's letters (1538-44). Pieter van der Molen and his brothers were Flemish merchants. Besides running their own business, they also acted as agents for Italian merchants in Antwerp. Their trade was very diverse, involving the purchase of English cloths, Flemish linen and spices imported by the Portuguese to Antwerp and the sale of silks and precious stones sent by their Italian customers. Their correspondence with their customers not only documented current events, such as political news and the state of the markets, but also the current exchange rates between Antwerp and other major trading cities, e.g. Lyon, Venice, Rouen and London.[205] The exchange rates extracted from English mercantile sources are supplemented by those quoted in van der Molen's letters. The data upon which the following analysis of the mid-sixteenth-century Anglo-Netherlands exchange market is based were culled from these mercantile documents. The names, the periods covered and the locations of mercantile documents are reported in Table 3.5 and the data on exchange rates in full, such as the exchange rate, the place where the exchange took place, the type of quotation and the terms of payment are presented in Appendix 3.A.

Before this new dataset can be employed to examine the efficiency and integration of the Anglo-Antwerp exchange market, two questions concerning the quality of the exchange rates collected from various sources must be answered. With

[205] The van der Molen letter book is held in Insolvente Boedelskamer, No. 2030, Stadsarchief, Antwerp. Several of F. Edler's works are based on this material: 'Van der Molen', pp. 78-145; idem, 'Financial measures of Charles V'; idem, 'The market for spices in Antwerp, 1538-1544', *Revue belge de philologie et d'histoire*, 17 (1938), pp. 212-21. But the quotation of exchange rates remains unpublished. This chapter lists the monthly averages of the exchange rates recorded in van der Molen's letters between Antwerp and London, Lyon, Rouen and Venice (see Appendix 3.B).

what degree of confidence can these exchange rates be accepted as the outcome of market forces? How can exchange rates of bills with various maturities be converted to a comparable basis?

Table 3.5 Mercantile accounts and letters

Name of document	Location	Date
Mucklowe's Account	Birmingham Public Library	1511
Kitson's Accounts	Cambridge University Library	1514-1539
van der Molen's Letters	Insolvente Boedelskamer, Stadsarchief, Antwerpen	1538-1544
Gresham's Daybook	The Mercers' Company	1542-1550
Johnson's Letters	TNA	1542-1551
Gresham's Letters	TNA	1553-1567
Isham's Accounts	Northamptonshire Record Office	1558-1564
Stoddard's Papers	TNA	1561-1562
Journal of Lawrence	TNA	1565-1568

3.4.1 Representativeness

How representative are these exchange rates collected from various sources? Can the exchange rates recorded in mercantile documents be regarded as market prices or unique prices at a given time and place, which reflected the individual merchants' bargaining power? According to de Roover, after the use of bills of exchange became common, it was customary to cite the current exchange rates between major trading cities at the end of commercial letters.[206] This can be observed in van der Molen's correspondence, at the end of which the exchange rates between Antwerp and other trading cities are quoted (Illustration 1). This habit and business courtesy was adopted by English merchants and is evident in Johnson's letters and Stoddard's papers.

Merchants obtained information on the course of exchange rates from Lombard Street in London and the bourse in Antwerp. Lombard Street, which had been the residence of Italian merchants since the late Middle Ages, was the counterpart in London of the Antwerp bourse. Before the opening of the Royal Exchange in 1571, merchants both native and alien gathered in Lombard Street to hear and exchange

[206] de Roover, *Money, Banking and Credit*, p. 55.

information, to negotiate the price of commodities and exchange, and to settle credit transactions. Several letters written by Otwell Johnson, who was in charge of his family firm's exchange dealings in London, to his brother John Johnson in Antwerp, illustrate his assiduous visits to Lombard Street in order to keep a close and constant watch on the course of exchange rates. He also occasionally uses the term- 'exchange in the street'- to refer to the current exchange rates.[207] As merchants visited the bourse and Lombard Street daily to learn about the latest movement of exchange rates, there seems to be no reason to doubt that the exchange rates agreed on in bills and those quoted in letters conformed substantially to the current market price of exchange.

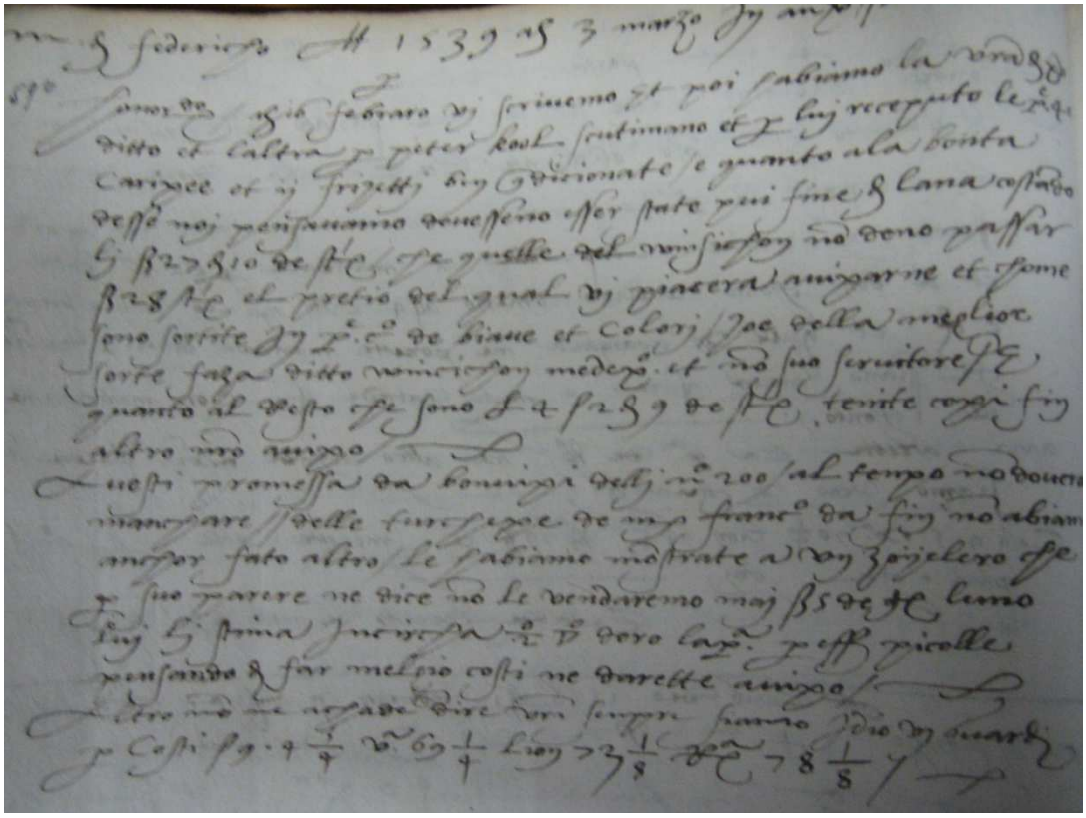
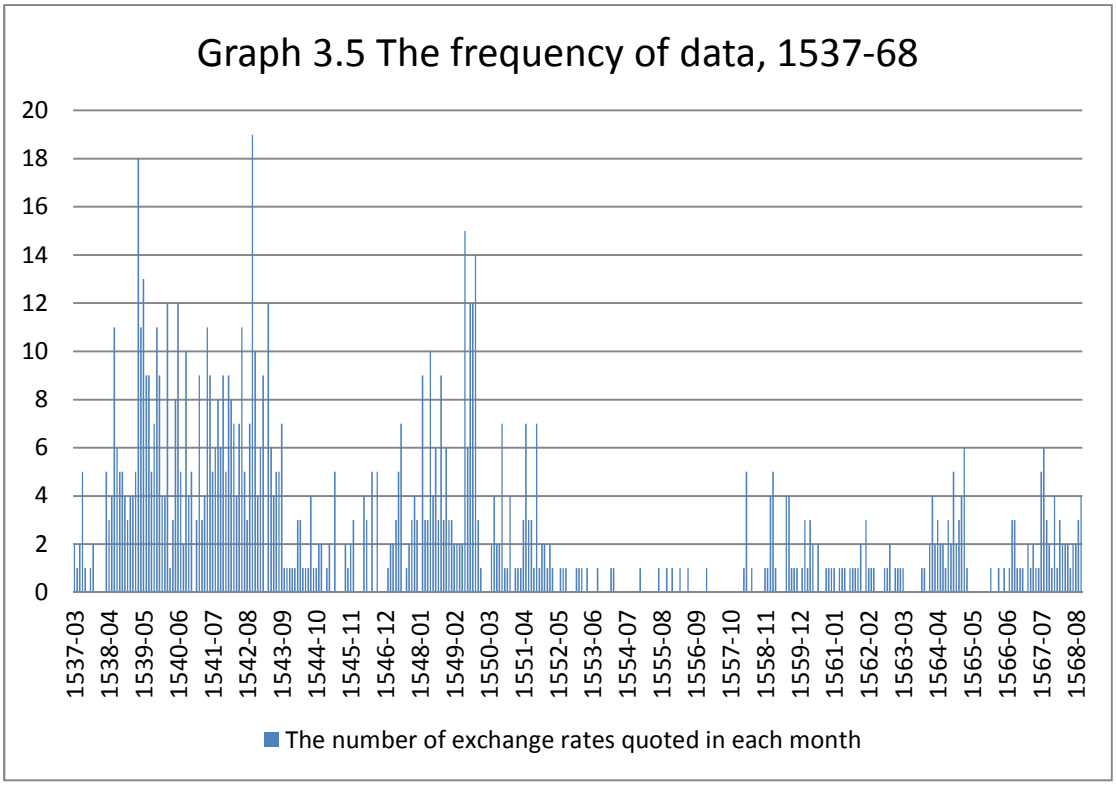


Illustration 1: A van der Molen's letter, 3 March 1539. In the finial line of this letter, it quoted the exchange rate on London at 9 [s] 4 ¾ [d] [Flemish for one English noble], Venice at 67 1/4 [Flemish groots for one Venetian ducat], Lyon at 73 1/8 [Flemish groots for one ècu de marc] and Rouen at 78 1/8 [Flemish groots for one French crown].

[207] SP46/6/111r and Winchester, *The Johnson Letters*.

However, there is evidence in the dataset (Appendix 3.A) that more than one rate of exchange was sometimes quoted on the same date. Does this contradict the idea that the exchange rates appearing in letters and account books were the outcome of market forces? The different exchange rates could be that they represented buying and selling prices. As long as the 'market price' is understood to mean a *set of similar prices* agreed within the market, rather than *a single price*, these rates of exchange payable at the same terms and quoted on the same date can still be seen as market prices. Therefore to a large degree, the quotations of Anglo-Flemish exchange rates appearing in mercantile documents can be regarded as market prices rather than a group of rates peculiar to any given firm or agent.



Source: Appendix 3.A

The number of exchange rates quoted each month- after omitting those payable at an unknown date and/or contracted in places other than London and Antwerp- is shown in Graph 3.5. The average number of quotations available to represent the course of exchange rates within each month is modest: 5.4 observations per month in the years 1537-44, 2.9 in 1544-51, dropping to 1.4 in 1558-68. For these months having few or even a single quotation, no substantial

deviation from the exchange rates of neighbouring months was found. This indicates that the number of quotations in any month, even if modest, suffices to represent the course of exchange rates for the month. The average number of quotations in each month for the period of the Great Debasement is fairly sufficient to catch the dramatic changes in exchange rates due to the monetary alteration. Overall, the collection of Anglo-Flemish exchange rates is representative of the market price and suffices to chart the course of exchange in the mid-sixteenth century.

3.4.2 The quoting systems

The Anglo-Flemish exchange rates given in the sixteenth-century mercantile documents were quoted in two different styles: exchange rates quoted in English sources at a variable number of Flemish groots for one pound sterling; and, in van der Molen's correspondence, at a variable number of Flemish groots for one English noble of 6s 8d (one-third of a pound sterling).[208] The noble had been the most important and popular English gold coin in the late Middle Ages, ever since Edward III started to issue gold coins in 1344.[209] Anglo-Flemish exchange rates were commonly quoted at a variable number of Flemish groots per English noble in fifteenth-century mercantile documents, such as Borromei's ledgers and the Celys' papers.[210] In addition to quoting at noble, the Celys' correspondence also records quotations based on the pound sterling. Probably by the turn of the sixteenth century, the noble may have been replaced by the pound sterling in quoting Anglo-Flemish exchange rates among the English business community. Three Anglo-Flemish exchange rates recorded in Mucklowe's account of 1511 are all quoted at a variable number of Flemish groots for one pound sterling.[211] The quoting system based on the English

[208] The Flemish currency system was similar to the English. One Flemish pound was equal to 20 Flemish shillings and one Flemish shilling was equivalent to 12 Flemish groots.
[209] English gold coins were first produced under the instructions of Henry III in 1257 but this introduction of gold coinage to England was not a success. Not until Edward III were gold coins produced in any significant quantity.
[210] The Borromei Bank Research Project (see footnote 16); A. Hanham ed., *The Cely Letters, 1472-1488* (Oxford, 1975).
[211] See Appendix 3.A.

noble, a remnant of the fifteenth century, was discarded by sixteenth-century English merchants but still used within Italian circles.[212]

As long as the English noble was used as a unit of account in quoting exchange rates between English and Flemish money, the exchange rates based on the noble can be easily converted into a variable number of Flemish groots per pound sterling by multiplying the former by a factor of three.

The English noble, which had been minted since the reign of Edward III, was discontinued and raised from a face value of 6s 8d to 8s 4d when Edward IV debased the English coinage in 1464-5. However, as English consumers had had more than a century to get used to a denomination of 6s 8d, which, being exactly one third of a pound, was convenient for all sorts of transactions, a new gold coin was introduced soon after the debasement: the angel, which received the familiar face value of 6s 8d. The debasement of 1526 again demonstrates the importance of coins with a denomination of 6s 8d. After the face value of the angel was raised to 7s 4d in the course of the debasement, the government once again produced a new coin, called the George noble, to fill in the denomination of 6s 8d, which had been vacant. It is clear that the noble, with its eternal face value and fineness (always given at 6s 8d and 99.48 per cent purity), continued in use as a unit of account after ceasing to be a real coin as a unit of account, like the pound sterling and the mark.

At the time of the Celys and van der Molen, the circulating gold coin with the conventional face value of 6s 8d was actually the angel, which featured the Archangel Michael slaying a dragon and the George noble, on which the royal arms were supported by a lion and a dragon, rather than the original English noble, on which the King holding a sword and shield is shown on board ship. Unlike the angel, which was produced in large numbers, the George noble was never produced on a significant scale. Therefore, the English noble used to quote exchange rates in van

[212] Edler, 'Van der Molen', pp. 78-145; W. Brulez, 'Letters commerciales de Daniel et Antoine van Bombergen à Antonio Grimani (1532-1543)', *Bulletin de l'Institute Historique Belge de Rome*, XXXI (1958), pp. 169-205. Van der Molen and Bombergen both acted as commission agent for the Italians in Antwerp.

der Molen's letters must be treated as a money of account, at a value of a third of a pound sterling.[213]

It is thus adequate to convert the exchange rates quoted in van der Molen's letters into a variable number of Flemish groots for one pound sterling by multiplying the former by three. There was no indication in van der Molen's letters about what terms of payment for the exchange rates were applied. However, it is reasonable to believe that these exchange rates were payable at usance. As mentioned, borrowing from the Italian practice, current exchange rates were quoted at the end of commercial letters. Because usance was the generally recognised length of time of the maturity of bills, the exchange rates quoted in letters were likely to be those payable at usance.[214] Any exchange rate quoted in mercantile documents without specifying its term is assumed to be the rate payable at usance.

3.4.3 The shadow rate of interest and the structural difference

The exchange rates collected from mercantile documents were payable at various terms. In order to adjust them to the same basis, one has to know the interest rate. However, at the time the levying of interest largely remained forbidden and interest rates on commercial credit were rarely recorded. Because of slow of communication at the time, there was always a considerable length of time elapsing before the payment of bills was made. Therefore, the difference between the exchange rates of bills payable at different terms can be used as a proxy of interest rates. Once accepted, bills of exchange payable at sight had to be paid immediately. An Anglo-Netherlands bill payable at usance would have had to be paid within a month. The deliverer of usance bills would demand a higher exchange rate in relation to sight bills, to compensate for losing one month's mobility of capital. The difference between exchange rates of sight and usance bills can, therefore, be regarded as the interest rate for one month's credit. The monthly shadow rate of interest can be

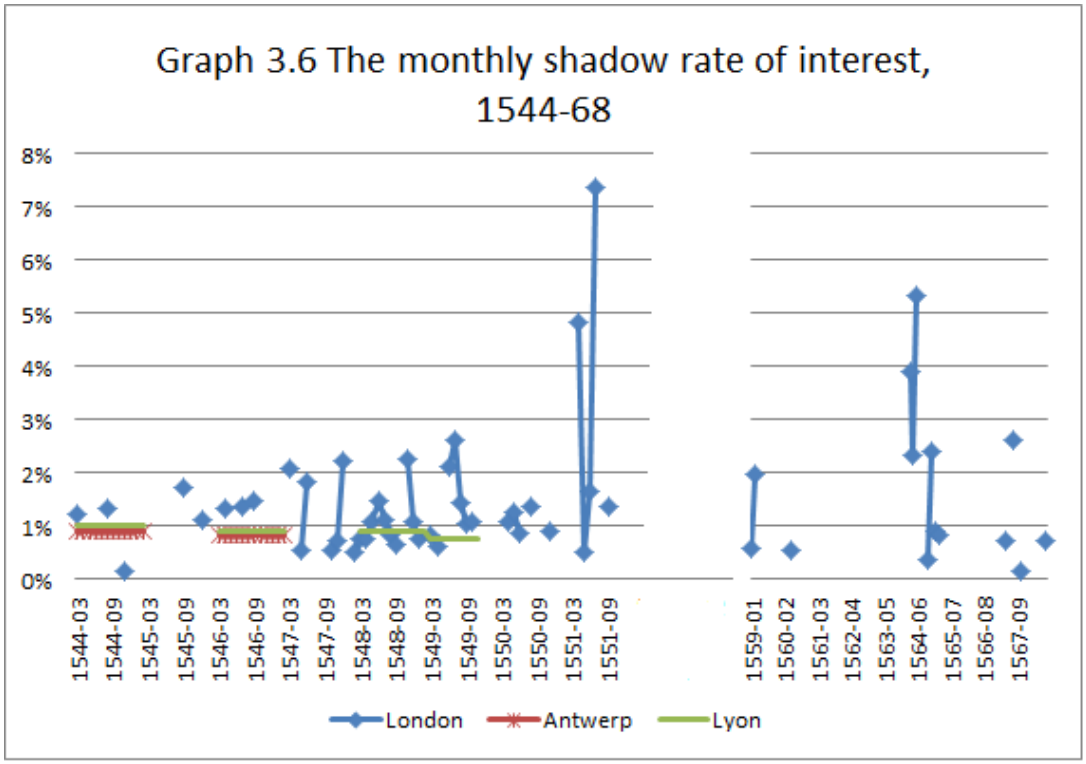
[213] I would like to thank Professor Nicholas Mayhew for pointing this out to me. Based on the surviving mint data, the total production of gold coins of 99.48% purity between 1526 and the Great Debasement amounted to 6.3% of total output of gold coins. The George noble was only one of several types of gold coin of 99.48% purity, which also included the sovereign, ryal and angel. Therefore, the production of the George noble was indeed very small. Challis, *Tudor coinage*, Appendix II.

[214] It was usually the case that without specification bills of exchange were payable at usance. Brulez, 'Letters commerciales', p. 188; de Roover, 'The organization of trade', p. 95.

calculated by comparing exchange rates of different maturities and then used to adjust the exchange rates of bills written on another rate than usance to the usance basis. For example, in May 1547 the London exchange rate at usance was 22s 3d and double usance 22s 6d.[215] The monthly shadow rate of interest in this case is calculated at 1.12 per cent ($\frac{(22s6d - 22s3d)}{22s3d}$). More than half of the dataset are exchange rates quoted at usance (67 per cent), and therefore the analysis here is based on unadjusted usance rates to reduce the risk of distorting the data by adjustments. The robustness of using usance rates will be checked later against sight rates.

Sometimes bills of exchange were payable on a specific date or number of days after sight. In these cases, if the number of days, or the difference between the time of purchase and the payment, was less than 8, the bill would be catalogued as a sight bill, 8-22 days as half usance and more than 22 days as usance. For example a bill, delivered on 20 September 1548 at 22s 3d Flemish for one pound sterling and payable on 31 October, one month and 10 days later, would have been regarded as a one and a half usance bill. On this day, another bill payable at double usance was settled at 22s 4d Flemish for one pound sterling. The monthly shadow rate of interest can thus be calculated at 0.75 per cent ($\frac{(22s4d - 22s3d)}{22s3d} * 2$).[216] Periodic bills, those settled at the time of fairs, are ignored here because no specific time for payment was indicated in the bills.

[215] SP 46/5/207.
[216] Appendix 2.A (SP46/5/295).



Source: Appendix 3.C

Based on the procedure specified above, the monthly shadow interest rate in London is calculated from the London-Antwerp exchange rates with different maturities. The resulting figures are presented in Appendix 3.C and in Graph 3.6, which also includes the annual interest rate on short-term commercial credit in Antwerp and Lyon extracted from written sources. Compared to the interest rates prevailing in Antwerp and Lyon, the London interest rates calculated here appear relatively high. Except for the extreme situation in the years of 1551 and 1564, the estimated monthly shadow interest rate for London is an average of 1.14 per cent (13.68 per cent annually), higher than those in Antwerp and Lyon, which were just under 1 per cent in the 1540s.[217]

Shadow rates of interest clearly appear to be relatively high in the summer of 1549, April and July of 1551 and the first half of 1564. The rising interest rates may reflect the social unrest, monetary chaos and trade dislocation at the time. The high interest rate observed in the summer of 1549 may have been the result of the re-coinage of testoons in 1548-9,[218] social turbulence and armed revolts in England. The

[217] S. Homer and R. E. Sylla, *A History of Interest Rates* (Hoboken, 2005), p. 116.
[218] Cf. p. 86 above.

extremely high interest rates which appear in 1551 could have reflected monetary chaos and a trade crisis. The further adulteration of silver coins concurrent with the devaluation of existing debased silver coins created monetary uncertainty and confusion among merchants. Meanwhile, the free exchange and re-exchange of money were forbidden.[219] In the city rumours about the scale of devaluation grew, to the extent that the government was forced in July to advance the schedule of devaluation and to punish those spreading rumours.[220] Furthermore, the sudden devaluation of English coinage damaged the profits made from cloth exports and arrested the boom in the cloth trade to which the debasement had very likely contributed.[221] The amount of capital available on the market consequently declined. In the face of the uncertainty about the further value of English silver, the reduction of available capital and the constraints on exchange dealings, it is not surprising that the interest rate implied in exchange rose sharply in mid-1551.

In early 1564 interest rates increased dramatically once more. This time, an Anglo-Netherlands trade dispute was behind the escalation. The Elizabethan government retaliated against the seizure of English ships and commodities in the Low Countries by ceasing trade with the Netherlands and temporarily moving the sale of English cloths to Emden. The rate of interest did not return to normal until the restoration of Anglo-Netherlands trade at the end of 1564. Apart from during these turbulent periods, the shadow rates of interest in London are consistent with (though slightly higher than) those charged in Antwerp and Lyon. The relatively high interest rates charged in London may well imply that the London financial market was less developed than Antwerp and Lyon, which were the financial centres in northern and southern Europe, respectively and thus merchants had to pay a higher interest rate to obtain credit in London.

The average shadow rate of interest, 1.14 per cent monthly, after excluding these extreme values, is used to adjust the non-usance exchange rates quoted in London to the usance basis. Approximately, a quarter of known monthly exchange

[219] *Proclamations*, I, no. 375.
[220] *Ibid*, no. 376, 378 and 379.
[221] The causal relationship between debasement and export booms can be elaborated like this: coinage debasement results in currency depreciation, which makes the goods of the country carrying out debasement relatively cheap in the international market, and thus encourages exports. Gould, *Great Debasement*, pp. 114-60; Munro, 'The Low Countries' export trade in textiles'.

rates are adjusted to usance rates. After all exchange rates with various maturities are converted from the non-usance basis, the exchange rates quoted in Antwerp have to be adjusted to the London-Antwerp rate, in particular for the years 1538-43 where only the Antwerp-London exchange rates are available.

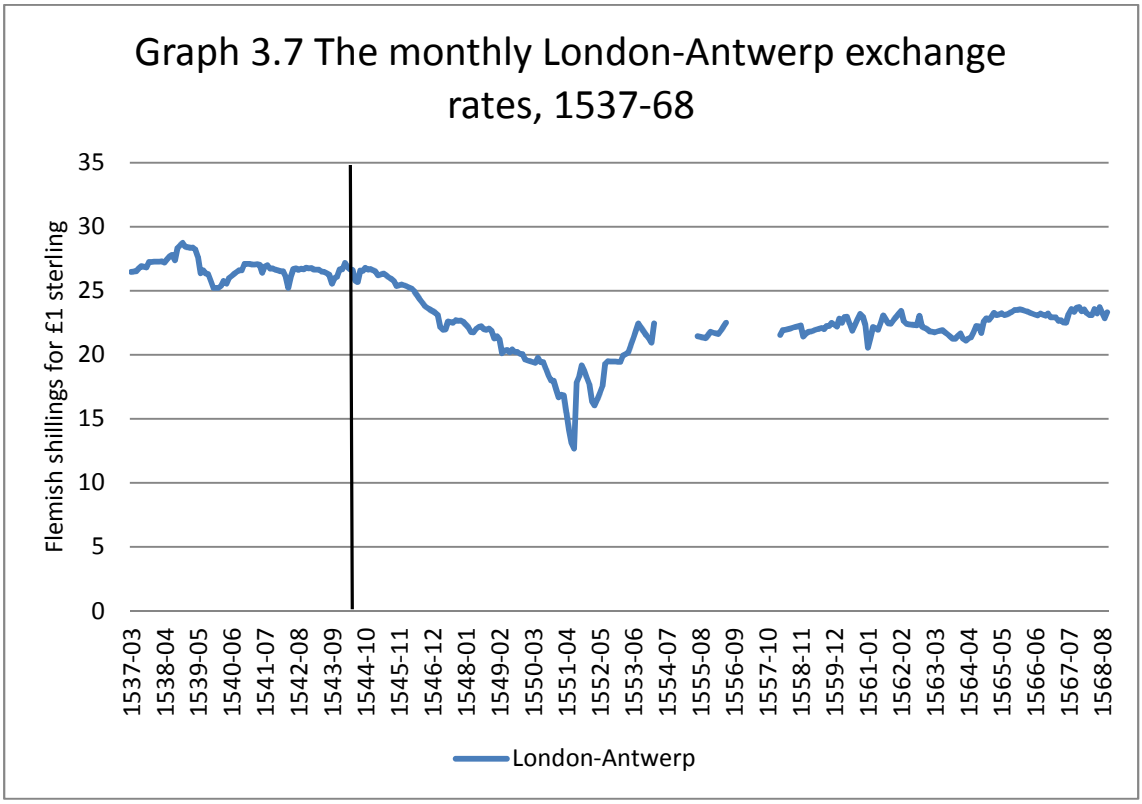
Because of differences in the demand and supply of each currency, market conditions and political circumstances, which can affect the level of exchange rates, the exchange rates quoted in London and Antwerp were structurally different from each other. The structural difference between two exchange markets may be reflected in the discrepancies in exchange rates quoted in these two markets at the same period. Therefore, the average of the difference between London-Antwerp and Antwerp-London exchange rates, when both are available in the same month, is used as a proxy of the structural difference between these two exchange markets. The concurrent exchange rates and their differences are presented in Appendix 3.D and the average difference is calculated at 0.443 Flemish shillings (or 5.316 Flemish groots).

According to the contemporary quotation of the exchange rate between English and Flemish money – a variable number of Flemish groots for either one pound sterling or one English noble – London always gave the 'certain' to Antwerp. London-Antwerp exchange rates should have always been higher than Antwerp-London rates.[222] Therefore, Antwerp-London exchange rates can be tentatively adjusted to London-Antwerp rates by adding 5.316 Flemish groots to the former. The resulting figures (about 42 per cent of total known monthly exchange rates), together with London-Antwerp rates, make up a series of monthly London-Antwerp usance rates of exchange for the period 1537-68. The actual figures for monthly London-Antwerp exchange rates are reported in Appendix 3.E and in graphic form in Graph 3.7.

For some months the exchange rates are unavailable and in the 1550s the data are quite scarce. Two approaches are employed here to estimate the missing data points: linear and the cardinal spline interpolation. Since a time series is concerned here, in conducting the interpolation one has to avoid excessively distorting the series of exchange rates. The omitted exchange rates for periods less than or equal

[222] de Roover, 'What is dry exchange?', pp. 186-7.

to 2 data points in a row are estimated by linear interpolation. Otherwise, the missing data are estimated by the cardinal spline interpolation. The two interpolation approaches imply that the movement of exchange rates during the period when the data are not available is consistent with neighbouring periods, i.e. that there was no sudden or remarkable deviation from neighbouring exchange rates in the missing period. Overall, 22 per cent of the sample of monthly exchange rates is the result of interpolation, which supplies figures for 66 months. There are 28 missing data points estimated by linear interpolation, 20 of which cover one month gaps. Cardinal interpolation is used for seven breaks in the series covering 3 missing data points, for two cases of 4 missing data points, and one case of 8 missing data points (April-November 1565). In the period of the Great Debasement, when exchange rates were likely to change greatly and rapidly, only 11 occasions require interpolation among which 4 cases involve three missing items of data in a row, and one missing data in the rest. For most of the time, the missing exchange rates occur outside the period of the debasement and thus interpolation does not cause much distortion.



Source: Appendix 3.E

According to Graph 3.7, the London-Antwerp exchange rates hovered around 26s 6d Flemish until mid-1545 – a year after Henry VIII began to debase the English coinage in 1544. The fall of the London-Antwerp exchange rates in 1545-51 was a result of the reduction in the bullion content of English coins. The falling trend of exchange rates was reversed from the second half of 1551 onwards, when the Great Debasement came to an end. In the early Elizabethan period, the London-Antwerp exchange rates averaged around 22s 6d Flemish until the trade disruption with the Netherlands and afterwards the exchange rates rose above 23s Flemish. Does the slow adjustment of exchange rates in the early years of the Great Debasement indicate some degree of market inefficiency? As the mint parity is a dominant element in deciding the level of the exchange rate, one must know the changes in Anglo-Flemish mint parity during the debasement in order to apprehend the movement of exchange rates and explain the unaffected exchange rates in 1544-5.

3.5 The calculation of the mint parity

Normally, bills of exchange did not specify the type of coin which had to be repaid, so that payments could be made in any kinds of coin in circulation. In periods of debasement, the money in circulation consisted of coins of various weights and fineness. In these circumstances and as long as prices remained unchanged, people could benefit from paying out debased coins which had the same face value as old coins. Whether they could actually do so depended on how effectively the government could force the public to accept the face value of debased coins; on how quickly debased coins were released into circulation; and on how soon the public learnt of the new bullion content of debased coins. Therefore, the mint parity between two currencies did not entirely depend on the standard of coins given in mint indentures (the official parity) but on 'the average metal content of the coins actually in circulation, in which payments were made' as Einzig rightly reminded us.[223] When the coinage was debased, the mint parity based on the coins actually in circulation was higher than the official mint parity, because it took time to replace the old coins in circulation by new debased ones. With the release of debased coins

[223] Einzig, *The History of Foreign Exchange*, p. 127.

and the withdrawal of previous issues which contained more precious metal, the mint parity gradually fell and moved towards official parity. How quickly the new debased money replaced the old coins in circulation dictated the level of the actual mint parity. Faced with little information as to the speed at which debased coins were released into circulation, there is no way of knowing the precise rate of replacement during the Great Debasement. However, the actual mint parity in the period of the debasement can still be tentatively estimated on the basis of several assumptions.

These assumptions are as follows: (1) the estimation is based on gold coins, at least until 1549; (2) the amount of debased coins released into and old coins withdrawn from circulation recorded in a certain period is evenly allocated each month; (3) before October 1546, 75 per cent of the debased coins are assumed to have been manufactured from old coins and this ratio rises to 90 per cent thereafter; (4) the mint parities between January 1549 and March 1551 are derived from two points: July 1549 and March 1551, by linear interpolation. The validity and feasibility of these assumptions is discussed in more detail below.

Compared to silver coins, payment made in gold involved lower counting and weighing costs; moreover in most cases gold coins were affected less frequently by government manipulation. Consequently, international and large payments were usually made in gold. It seems reasonable to estimate the mint parity based on gold coins, as the aim of this chapter is to analyse the difference between exchange rates, the international prices of English money, and the mint parity. However, in the late phase of the Great Debasement, the output of gold coins declined and gold gradually disappeared from circulation in England due to the bimetallic policy.[224] This unavoidably had an impact on the course of exchange rates and makes it unrealistic to estimate the mint parity solely on the basis of gold coins. Silver probably took up part of the payment of exchange in London at the time, when fewer gold coins remained in circulation but to what degree is unknown. What is certain is that in a late stage of the debasement, the influence of debased silver coins eroded the

[224] See Table 3.3 for the development of the gold-silver ratio during the Great Debasement. On several occasions, complaints that gold coins could be obtained only at a high premium were expressed in contemporary documents. Challis, *Tudor Coinage*, pp. 176-7 and 182,; Winchester, *Johnson Letters*.

exchange rate slowly but steadily. In order to incorporate the effect of silver coins on exchange rates, the mint parity from 1549 onwards is calculated on both gold and silver.

In 1526, a new standard of fineness (91.66 per cent) was introduced for gold coins, that is, for crowns. After this, English gold coins were struck at either the traditional 99.48 per cent standard or at the new one. Gould argues that, because, the angel of 99.48 per cent fineness was more acceptable abroad, he chose the mint equivalent related to the angel instead of the crown in calculating gold-silver ratios.[225] Can the mint parity also be calculated on the angel? The number of angels produced in 1526-44 was very small in relation to crowns and represented less than 10 per cent of the known output of gold in the period. Moreover, according to Challis, the great number of angels issued before 1526 may have disappeared in the melting pot during the debasement of that year.[226] Instead of the angel, it is therefore more appropriate, for the period of 1537-44, to calculate the mint parity on the basis of the crown of 91.66 per cent fineness.

The mint parity has to be estimated on a monthly basis to be compatible with the monthly rate of exchange. However, due to the format of the mint accounts at the time only annual data on the production of coins are available. In order to calculate the mint parity monthly, the debased coins issued in a certain period are assumed to have been released evenly into circulation every month. For example, between April 1545 and March 1546, the total production of gold coins was £372,179. An amount of £31,015 (£372,179/12 months) worth of gold coins was presumably released into circulation each month of the period. As pointed out above, the unrecorded output of debased coins in the years 1544-51 was estimated at £344,343 in silver, £24,688 in gold and £80,000 minted at Durham House.[227] When

[225] Gould, *Great Debasement*, Table IV.

[226] After the face value of the angel was enhanced from 6s 8d to 7s 6d in the debasement of 1526, the bullion content of the crown and the angel with the new denomination were too similar to induce the old angel to the mint. The quantity of fine gold contained in £1 in terms of the crown was 210 gr, and 212 gr in terms of the angel of the new denomination. Though admitting this, Challis argues that the large mint output of the crown in 1526-8 must have come from re-minting the old angel. Challis, *Tudor Coinage*, pp. 168-9, 221.

[227] The proportion of £80,000 produced from Durham House in gold is unknown. But Durham House was kept busy in 1549; therefore, this £80,000 may possibly have consisted of £8,000 in gold and £72,000 in silver following the pattern of production in the year (gold coins represent 10% of the total production, see Table 3.2). Ibid, p. 100.

calculating the monthly release of debased coins, these figures have to be included in the total known production of coins during this period, shown in Table 3.2.

In the 1540s, England was at war with France and Scotland and a great amount of money was sent abroad for military expenses and subsidising allies. Challis estimates the outflow of specie in 1544-6 at about £181,000. The amount of money sent abroad in the years 1547-51 can be guessed from the military expenditure during Edward's reign.[228] As the current mint parity is calculated on the basis of circulating English coins, the percentage of debased coins exported abroad will affect the calculation. Unfortunately, this percentage is obviously unknown. Nevertheless, as the debasement was introduced to relieve the strain on Henry VIII's finances of wars waged abroad, it is plausible that most of the subsidies sent overseas to finance military expenditure consisted of debased coins. As with the production of debased coins, it is necessary to assume that the quantity of exported coins was evenly distributed each month.

The other problem of calculating the mint parity concerns the origin of the bullion used to produce debased coins. In principle, there were four sources: (1) old coins or (2) dishoarded bullion which had previously been withdrawn from circulation (e.g. in the form of gold- or silverware, jewellery and decoration) and could be melted down and re-minted; (3) bullion or coins which could have been attracted from abroad by the high mint prices offered during the debasement; or (4) gold and silver provided directly by the government to the mint. The records kept by mints do not reveal the relative importance of these sources of bullion. The origin of the bullion used to manufacture debased coins is critical in determining the rate of replacement of old coins by debased coins. The more quickly old coins were recycled into debased coins, the fewer old coins remained in circulation, resulting in lower mint parities based on the average bullion content of the whole circulation.

It is impossible to know at any given time exactly how many old coins in circulation were absorbed into debased coins. However, based on the changes in the

[228] Challis, *Tudor Coinage*, pp. 241-2. During the first five years of Edward's reign, military expenditure amounted to a total of £1,386,687. If this expenditure was distributed evenly over a five year period and one-third was paid in hard coin exported from England, about £93,000 worth of coins would have disappeared from circulation. Calendar of State Papers, Domestic (abb. *SSD*), *Edward VI*, XV, no. 11.

mint price and the course of the output of debased coins, one can argue, to a fair degree, that a higher proportion of debased coins was manufactured from recycling the coins in circulation in the later phase of the debasement than in the early phase. The reason for this is that at the beginning of the debasement the public was not fully aware of it and as a result, being attracted by the increase in the mint price, people not only re-coined circulating old coins, but also dishoarded bullion and imported specie from abroad.[229] However, the enthusiasm for supplying bullion to the mints could not be maintained as the debasement continued. Once members of the public realised that, although the mint price rose, they actually received back debased coins with a smaller total precious metal content than they had brought in, the bullion from sources (2) and (3) supplied to the mint in exchange for debased coins declined rapidly. The only bullion available to the mint in the later stage of the debasement was coins in circulation, whose mint equivalent was less than the current mint price, brought in on private or government account.

As illustrated in Graph 3.3 and Table 3.2, the output of known debased coins started to decline in 1546. In order to encourage and sustain the supply to the mints, the mint price of gold was raised in October 1546 and March 1547 and that of silver in April 1547. Except for the rise of March 1547 in gold, the other two mint price adjustments were insufficient to stimulate the inflow of bullion (Table 3.1). The monthly average output in both money of account and precious metals continued to fall. This may imply that, after late 1546, the supply of bullion from dishoarding ran out, with circulating old coins becoming the only source of supply and obtainable only by consecutive increases in the mint price. Here, two recycling rates of old coins are arbitrarily assumed: 75 per cent before October 1546 for gold and April 1547 for silver and 90 per cent afterwards. These ratios are, of course, subjective and later a robustness test will be used to check how credible the ratios are. For now, the assumed ratios are accepted and used to calculate the mint parity.

The physical deterioration of circulating coins may affect the estimation of mint parity. As pointed out above, due to the primitive minting technology and the effects

[229] English mercantile documents demonstrate that in the early phase of the debasement specie (in the form of foreign coins, old gold coins and bullion) was imported from abroad. Winchester, *Johnson Letters*.

of wear and tear, the actual weight of circulating coins was different from their weight recorded in the indentures. Every individual coin was unique and there is no way of knowing the exact metallic content of each one. Hence, to calculate the mint parity and the recycling rate of old coins, circulating coins are assumed to be full-weight. This assumption understimates how many old coins remained in circulation, since more defaced coins than coins of full weight were required in exchange for a given number of debased coins. However, as the debasement went on, old coins were replaced by new debased coins which were likely to be full-weight. The effect of underestimating the number of coins required to re-mint into debased coins would therefore gradually disappear.

An estimate made in 1559 suggests that about £100,000 worth of English gold coins, issued before October 1551, had remained in circulation. However, scholars disagree over when exactly these gold coins were issued. On the one hand, Challis regarded them as pre-debasement gold coins. On the other, based on the fact that this £100,000 worth of gold coins was catalogued under the title 'sovereigns, half-sovereigns, angels, half-angels and crowns', Gould argued that some of them were issued during the debasement because the name *half-sovereign* did not appear until 1544.[230] Considering the high mint prices during and after the debasement (Table 3.1), gold coins issued before 1544 are unlikely to have escaped the melting pot. Most probably, the £100,000 worth of gold estimated in 1559 was the issue of 1546-9 (83.3 per cent fine), which was not at risk of being re-minted at the post-1549 mint prices. Therefore, this £100,000 worth of gold coins had to remain in circulation when the mint parity is calculated.

Take the previous case of April 1545-March 1546 as an example of calculation. In March 1545, the estimated total value of gold coins circulating in England was £492,704, consisting of £393,444 worth of old coins (79.9 per cent) and £99,260 (20.1 per cent) worth of debased coins of a fineness of 95.83 per cent, issued between 1542 and 1545. The mint parity based on circulating coins in this month is therefore calculated at 25.36s Fl (25.81s*0.799+23.55s*0.201) for one pound sterling (where 25.81s is the mint parity based on old coins which was now 79.9% of the total

[230] Challis, *Tudor Coinage*, pp. 241 and 243; Gould, *Great Debasement*, pp. 54-55.

circulation and 23.55s the mint parity of debased coins issued after 1542 May and accounting for the rest of the circulation).[231] Based on the assumed recycling rate of 75 per cent, £23,261 out of the £31,015 total worth of debased gold coins of 22c fineness (91.67 per cent purity and containing 11.404 grams of pure gold per £1 sterling) released monthly between April 1545 and March 1546 was manufactured from circulating coins (containing on average 13.617 grams of pure gold per £1 sterling). In order to produce this amount in debased gold coins, at least £19,481 worth of old coin should have been withdrawn from circulation every month during this period.[232] The £8,227 worth of debased gold coins is estimated to have been exported to finance military expenses on the Continent;[233] as a result, the actual amount of debased gold coins of 22c flowing into circulation in April 1545 was £22,788. The total value of circulating gold coins in April 1545 in England is estimated at £496,011; it consists of £373,963 worth of old gold coins (75.4 per cent), £99,260 worth of debased coins of 23c issued between 1542 and 1545 (20 per cent) and £22,788 worth of debased coins of 22c (4.6 per cent). Accordingly, the mint parity based on the circulating coins of April 1545 is calculated at 25.17s Fl (25.81*0.754+23.55*0.12+21.62*0.046). Following this approach, the mint parity between English and Flemish money is calculated until December 1548. From then onwards the effect of silver coins on exchange rates needs to be taken into consideration.

Table 3.1 shows that the mint price after March 1547 was high enough to make it profitable to re-mint the pre-1546 gold coins. Most of the pre-1546 gold coins may thus have disappeared from circulation by 1549 after being recycled into the 20c issue of 1546-9 and hoarded. As explained above, silver coins need to be taken into

[231] Unlike English coin whose bullion content was proportionate to denominations, the Flemish coin of large denominations usually contained higher percentage of precious metals in proportion to smaller denominations. The réal of gold and the double carolus of silver, which with their large denominations were much more likely to be used in the payment of bills of exchange, are chosen to calculate the Anglo-Flemish mint parity. A réal contained 10.55 grams of pure gold in 1527-1548, 10.05 grams in 1548-1551, 10.55 grams in 1551-1558. Enno van Gelder and Hoc, *Les Monnaies.*

[232] The debased gold coins contained 11.404 grams of pure gold per £1 sterling. Therefore, 353,695 grams of pure gold were required to produce £31,015 worth of debased gold coins every month (31,015*11.404). For 75 per cent of this amount of pure gold coming from re-minting old coins, £19,481 worth of old gold coins had to be withdrawn from circulation ($\frac{31{,}015*11.404*0.75}{13.617}$).

[233] Between the beginning of the debasement (June 1544) and March 1546, Challis estimates an amount of £181,000 being sent abroad. It was equivalent to £8,227 disappearing from circulation every month during this period. Challis, *Tudor Coinage*, p. 241.

account in calculating the mint parity from 1549 onwards. Although the degree of the effect of debased silver coins on exchange rates is unknown, one can be sure that from 1549 onwards the influence of debased silver coins eroded the exchange rate slowly but steadily. No further debasement on gold ensued after 1549; the continuous downward trend of the London-Antwerp exchange rates could have been attributed only to the re-coinage of the testoon in 1548-9 and the reduction of the fineness of silver coins to 25 per cent purity in April 1551.

In order to incorporate the effect of silver coins, the mint parities are calculated on one-third of silver and two-thirds of gold for the period January 1549 to March 1551 (the eve of the revaluation of debased silver coins). They are derived from linear interpolation of three points: December 1548, July 1549 and March 1551. The mint parity of July 1549 is based on the bullion content of silver coins of 50 per cent fineness issued in 1545-6 and the average bullion content of gold coins remaining in circulation. The silver coins used in calculating the mint parity of March 1551 are those issued between April 1546 and March 1551.[234] The assumption behind this estimation is that exchange rates slowly but steadily reacted to the effect of debased silver coins which came to predominate in the production of English coinage and there was no sudden plunge in observed exchange rates, at least not until March 1551. Due to the monetary chaos caused by the revaluation of debased silver coins and the introduction of 3 oz silver coins in April 1551, it becomes very difficult to calculate the mint parity for the rest of 1551 and any attempt seems inaccurate and arbitrary. Therefore, the analysis of London-Antwerp exchange market integration and efficiency during the Great Debasement will cover only the period of June 1544-March 1551.

In the second half of the sixteenth century, a great amount of American silver started to flow to Europe. The imports from the Americas probably result in the high proportion of silver coins minted in the Habsburg Netherlands and the relatively low gold-silver ratio maintained in England, also attributed to the domination of silver in the mint output (see Appendix 3.F and Table 3.3).[235] To reflect the predominance of

[234] The re-coinage is assumed to have been completed by the end of 1549 and most of the coins issued in 1545-6 would have disappeared from circulation by then.
[235] Meanwhile, denominations of silver coin as large as 70 groots began to be issued in the Habsburg Netherlands. Enno van Gelder and Hoc, *Les Monnaies*, pp. 97-113.

silver coins, the mint parities of 1558-68 are calculated on two-thirds of silver and one-third of gold. Based on the above assumptions, the composition of circulating gold coins in England and the mint parity between English and Flemish money are estimated and the results are presented in Appendix 3.G.

3.6 The econometric model: a three-regime TAR model

In the literature, many approaches have been suggested to measure market behaviour in terms of efficiency and integration. To begin with, mid-sixteenth century exchange market efficiency is simply tested against the weak form of the efficient market hypothesis by using the autoregressive of order one, AR (1), model. The effectiveness of arbitrage (how quickly arbitrage worked to resume the exchange rate to the equilibrium level after a shock) is econometrically examined in the framework of a threshold autoregressive model.

In the 1950s a group of economists started to examine market efficiency with empirical evidence collected from stock markets.[236] The test of market efficiency, according to Fama's definition, can be undertaken with three forms of hypothesis: the weak, the semi-weak and the strong forms. The weak form of the efficient market hypothesis (EMH) argues that current prices "fully reflect" the information implicit in historical prices.[237] According to this definition, the weak form of EMH for the London-Antwerp exchange rate can be formulated as follows:[238]

$$E_t = \phi E_{t-1} + \varepsilon_t \tag{3.1}$$

[236]Until the late 1960s, the study of price formation in competitive markets was based on the random walk model. Since then, the event study has been developed to identify whether there is a statistically significant adjustment of prices to new information so as to support the efficient market hypothesis. P. Samuelson, 'Proof that properly anticipated prices fluctuate randomly', *Industrial Management Review*, 6 (1965), pp. 41-49; E. Fama, L. Fisher, M. Jensen and R. Roll, 'The adjustment of stock prices to new information', *International Economic Review*, 10 (1969), pp. 1-21; R. Ball and R. Brown, 'An empirical evaluation of accounting income numbers', *Journal of Financial Economics*, 9 (1968), pp. 529-543; E. Fama, 'The behaviour of stock market prices', *Journal of Business*, 38 (1965), pp. 34-105; idem, 'Efficient capital markets: A review of theory and empirical work', *Journal of Finance*, 25 (1970), pp. 383-417.

[237] Fama, 'Efficient capital markets', pp. 383, 388.

[238] E. Goldman, 'Testing efficient market hypothesis for the dollar-sterling gold standard exchange rate 1890-1906: MLE with double truncation', *Economic Letters*, 69 (2000), pp. 253-9.

where $\{E_t\}$ is the exchange rate at time t; ϕ is the parameter to capture the relationship between E_t and E_{t-1}; and ε_t is a stationary process with $E(\varepsilon_t) = 0, Var(\varepsilon_t) = \sigma^2$. Equation (3.1) shows the relationship between the current exchange rate and a sequence of previous rates and also shows to what extent the information implicit in the previous rates was reflected in the current exchange rate.

Table 3.6 The results of testing the weak form of EMH for the London-Antwerp exchange rates, 1537-68

	1537-1551	1544-1551	1558-1568
OLS of ϕ	0.9932*** (0.012)	0.9738*** (0.0208)	0.8968*** (0.0389)
Sample size	168	87	128

Note: Standard errors are given in brackets.
*** denotes significance at the 1% level.

To test the weak form of EMH, a null hypothesis is given as H_0: $\phi = 1$ against the alternative hypothesis H_1: $|\phi| < 1$. The test is carried out in three sub-periods, 1537-51, 1544-51 and 1558-68, to see whether the weak form of market efficiency was violated by the Great Debasement. The results are reported in Table 3.6. The null hypothesis $(\phi = 1)$ cannot be rejected at the 1% significance level for all three periods. The sixteenth-century London-Antwerp exchange rates accord with the weak form of EMH: the current exchange rate fully reflects the information implicit in the previous rates. However, the test of the weak form of EMH does not show how exchange rates would change in the face of new information, i.e. the Great Debasement, which was not embedded in the previous rates. Hence, the question is how quickly and how far did exchange rates adjust during the debasement? This question is not only related to the semi-weak form of EMH, but also to the degree of integration between the London and Antwerp exchange markets.

The semi-weak form of EMH claims that if the market is competitive and efficient, prices will rapidly adjust to new publicly available information. In equilibrium, an efficient market expects that the return on any given investment is equal to the risk-adjusted expected return and no excessive return exists. The emergence of relevant new information will create an excess return/loss on the investment. During the process of adjustment, the excess return/loss disappears and

the expected return on investment converges towards the new level of risk-adjusted return, which absorbs the new information. The sooner the excess return/loss is exhausted the more efficient the market is. The speed of the disappearance of excess return/loss indicates the degree of efficiency – how long it has taken for the market to return to equilibrium where excess returns no longer exist.[239]

The semi-weak form of EHM implies that arbitrage operates effectively. The degree of market integration is conventionally measured by the speed of price adjustment in one market in response to changes of price in the other (shocks/new information). The driving force of adjustment implied by the semi-weak form of EMH and market integration is arbitrage. Therefore, a threshold autoregressive (TAR) model with three regimes is used here to analyse the semi-weak form of EMH and the integration of the London-Antwerp exchange market, to estimate the speed of adjustment and transaction costs involved in arbitrage, and to measure the impact of the Great Debasement on exchange markets.[240]

The threshold autoregressive model

The Great Debasement reduced the bullion content of English coins and thus changed the mint parity between English and Flemish money. As a result, the difference between the London-Antwerp exchange rates and the new mint parity increased. Within an efficient and integrated market, the value of English debased coins in terms of Flemish money would have adjusted quickly; arbitrage was soon carrying out to eliminate the gap and drive down exchange rates in accordance with the new parity. The speed of adjustment is regarded as a proxy for the degree of efficiency and integration.

As discussed, the quotations of London-Antwerp exchange rates are all converted to a variable number of Flemish groots for one pound sterling. The Anglo-Flemish mint parity is thus given as $E^{par} = \frac{ME(£1\ st.)}{ME(1d\ Fl)}$, where $ME(£1\ st)$ is the mint equivalent of one pound sterling and $ME(1d\ Fl)$ is the mint equivalent of one

[239] Fama, 'Efficient capital markets', pp. 383-417; idem, 'Efficient capital markets II', *Journal of Finance*, 64 (1991), pp. 1575-1617.
[240] The TAR model is based on the work of Canjels et al and of Volckart and Wolf. Canjels et al, 'Measuring market integration'; Volckart and Wolf, 'Estimating financial integration'.

Flemish groot. The difference between exchange rates and the mint parity at time t is defined as $X_t = E_t - E_t^{par}$. The London-Antwerp exchange rate is decided by the supply and demand of English and Flemish money in these two markets. Table 3.7 illustrates the effect of changes in demand and supply on the movement of London-Antwerp exchange rates. An increase in the demand for London-Antwerp bills (those drawn on Antwerp in London) implies that there are more buyers of Flemish money than sellers in the market producing an increase in the demand for Flemish money. The relative price of Flemish money has to rise to either depress the demand for Flemish money or excite supply. Under contemporary quotations, the London-Antwerp exchange rate should fall. But when sellers of Flemish money exceed buyers in the market, with an increase in the supply of London-Antwerp bills, exchange rates should go up. For Antwerp-London bills, changes in demand and supply on the movement of exchange rates have the opposite effect.

Table 3.7 The effect of changes in the demand and supply of bills on the movement of exchange rates

	London-Antwerp bills		Antwerp-London bills	
	increase in demand	increase in supply	increase in demand	increase in supply
The movement of exchange rates	-	+	+	-

Note: **+** indicates movement in the same direction of change and **–** movement in the opposite direction.

Hence, the London-Antwerp exchange rates depend on B_t, which represents the net demand (the difference between demand and supply) for bills of exchange in London. The functional form of exchange rates is assumed to be

$$E_t = a_1 - a_2 B_t + \epsilon_t \tag{3.2}$$

where a_1, a_2 are the parameters to be estimated and ϵ_t is a residual at time t. The negative sign of the parameter a_2 states that an increase in the net demand of bills in London leads to a depreciation of the pound sterling and a fall in exchange rates.

The alternative to the use of bills of exchange was to transport bullion and foreign coins. The net demand for bills in London would decline if merchants

transferred funds by shipping bullion. Therefore, the negative relationship between changes in the net demand of bills and the inflow of bullion can be given by

$$\Delta B_t = -k\Delta S_t \tag{3.3}$$

where ΔS_t is the inflow of bullion into London and $0 \leq k \leq 1$ is the parameter to capture the proportion of unbalanced funds covered by moving bullion.[241]

Shipping bullion to transfer funds was not cost free. Except for a few predominantly gold coins, foreign coins were usually not recognised as legal tender but as bullion. Merchants needed to bring foreign coins to local mints and pay the mint charge to convert them into local currency. Because of the mint charge, freight charges and insurance costs, and the risks of losing bullion due to wreckage, piracy and confiscation involved in shipping bullion, to transfer funds, bills of exchange were always preferred to moving bullion. Only when the difference between exchange rates and the mint parity was greater than these transaction costs did shipping bullion became cheaper than remitting funds by bills of exchange and then bullion began to move between markets. The cost function for arbitrage, which was to transfer funds by shipping bullion instead of exchange, depending on the quantity of transactions, is given as follows:

$$TC = \tau|\Delta S_t| + \frac{1}{2}b|\Delta S_t|^2 \tag{3.4}$$

where τ is an initial marginal cost and b an increasing marginal cost. The costs of chemically testing the coins and re-minting them and the costs of gathering sufficient sums to meet obligations rose as the quantity required increased. Hence, the total cost of transporting bullion quadractically rose with the quantity shipped.

From Equation (3.4), the marginal cost of shipping one extra unit of bullion is given by $MC = \tau + b|\Delta S_t|$ and the marginal gain is equal to X_t ($E_t - E_t^{par}$). Arbitrage would operate to the point where the marginal cost of shipping one extra unit of bullion equals the marginal gain from doing so ($MC = MR$). In the case of the import of bullion, $E_t > E_t^{par}$ and $\Delta S_t > 0$ and vice versa in the case of exports. When the deviation from parity was within the bounds of transaction costs, no bullion was

[241] $\Delta X_t = X_t - X_{t-1}$ for any variable X_t.

moved ($\Delta S_t = 0$). By equating MC and MR, the optimal flows of bullion as a function of transaction costs and deviation from parity can be obtained as follows:

$$\Delta S_t = \begin{cases} \frac{1}{b}(X_t - \tau) \ , where\ X_t > \tau \\ 0 \quad , where - \tau \leq X_t \leq \tau \\ -\frac{1}{b}(X_t - \tau) \ , where\ X_t < -\tau \end{cases} \tag{3.5}$$

This equation can be reformulated in terms of deviation from parity (X_t). Combining $\Delta E_t = a_2 k \Delta S_t + \Delta \epsilon_t$ derived from (3.2) and (3.3) with $\Delta X_t = \Delta E_t - \Delta E_t^{par}$, the relationship between changes in deviations from parity and inflow of bullion is shown as follows:

$$\Delta X_t = a_2 k \Delta S_t - \Delta E_t^{Par} + \hat{\epsilon}_t \tag{3.6.A}$$

where $\hat{\epsilon}_t = \Delta \epsilon_t$, which is assumed to be a stationary process. The combination of (3.5) and (3.6.A) is given by

$$\Delta X_t = \alpha(X_{t-1} - \tau) - \beta \Delta E_t^{par} + \beta \hat{\epsilon}_t \tag{3.6.B}$$

where $= \frac{a_2 k}{b - a_{2k}}$, $\beta = \frac{b}{1 - a_2 k}$ and assumes that $b - a_2 k < 0$.

The relationship between changes in deviation from parity, transaction costs and changes in the mint parity can be expressed in the form of a threshold autoregressive model with three different regimes and heteroskedasticity as follows;

$$\Delta X_t = \begin{cases} \alpha(X_{t-1} - \tau) - \beta \Delta E_t^{par} + \beta \hat{\epsilon}_t, \ when\ X_{t-1} > \tau \\ -\Delta E_t^{par} + \hat{\epsilon}_t \quad , when - \tau \leq X_{t-1} \leq \tau \\ -\alpha(X_{t-1} + \tau) - \beta \Delta E_t^{par} + \beta \hat{\epsilon}_t, \ when\ X_{t-1} < -\tau \end{cases} \tag{3.7}$$

where α, β and τ are the parameters to be estimated. The intuition behind Equation (3.7) is that when deviations from parity are sufficiently greater than the transaction costs of shipping bullion set by τ, arbitrage begins to operate and deviations from parity will revert toward the bounds of the transaction costs. Otherwise, the change in the deviation of the exchange rate from parity depends on the change in the mint parity. The speed of adjustment is measured by parameter α and $-1 < \alpha < 0$ because arbitrage results in reducing the scale of deviations. The bigger the absolute value of α is, the quicker arbitrage works to exploit the profitable arbitrage

opportunities, i.e. $X_{t-1} - \tau$. As a result of arbitrage, the exchange rate moves toward the new mint parity. Parameter α can thus be seen as an indicator of the degree of market integration and efficiency.

Before estimating the parameters, the deviation and its first difference have to be tested for stationarity. Because of arbitrage, deviations of the London-Antwerp exchange rate from parity were temporary and would sooner or later move back to within the bounds of the transaction cost. Hence, this model implies that the deviations from parity X_t and ΔX_t are stationary processes. Due to the availability of data and the analysis of the effect of the revaluation of 1539 in the Netherlands and the Great Debasement on exchange, the whole series is divided into four sub-periods: March 1537-May 1544 (the pre-debasement period), May 1539-December 1542 (the revaluation), June 1544-March 1551 (the Great Debasement) and March 1558-October 1568 (post-debasement). The unit root and stationarity tests are conducted in these four sub-series. Table 3.8 shows the results, both for the level series and the first difference, of the Augmented Dickey Fuller (ADF) test and the Phillip-Perron (PP) test for unit root and the Kwiatowski-Phillips-Schmid-Shin (KPSS) test for stationarity. Except for the debasement periods, the hypothesis of unit root for exchange deviations is rejected. However, those in the debasement period can be regarded as integrated of order of one because the hypothesis of unit root for them cannot be rejected for the level series but rejected at 1% significant level for the first differences. The results clearly support the use the TAR model to analyse the integration of exchange markets.

Table 3.8 The unit root and stationarity tests on deviations from parity (X_t), 1537-68

	1537-44	1539-42	1544-51	1558-68
		The level of series		
ADF test	-3.1075**	-3.0458**	1.9358	-2.751*
PP test	-2.7437*	-2.9418**	1.9358	-2.5926*
KPSS test	0.289	0.092	0.2912	0.5325**
		The first difference		
ADF test	-7.7579***	-5.1771***	-8.7093***	-9.9801***
PP test	-9.2537***	-5.5832***	-8.17***	-13.6557***
KPSS test	0.0821	0.2426	0.1624	0.08425

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively

The estimation of the above TAR model is carried out by a two-stage procedure. First, the threshold is identified by a grid search to minimise the sum of the squared residuals of Equation (3.7). Then, the adjustment parameter is estimated by using the conditional least square (CLS) to estimate the speed of adjustment.[242] Because of the asymptotic distribution of the threshold parameter, the standard procedure is unsuitable for calculating the standard error. Instead, Chan and Tsay's technique is used here to obtain the standard error and confidence intervals.[243]

The adjustment parameter α is interpreted in terms of a half-life time. A half-life indicates the time required to reduce deviations from parity outside the bounds of transaction cost by 50 per cent. Hence, Equation (3.7) is rearranged as follows

$$X_t = \rho X_{t-1} - \alpha\tau - \beta\Delta E_t^{par} + \beta\gamma\hat{\epsilon}_t \qquad (3.8)$$

where $\rho = 1 + \alpha$. A half-life time can be calculated as $Time_{T/2} = \frac{\ln(0.5)}{\ln(\rho)}$.

3.7 Empirical results and interpretation

The estimation results are reported in Table 3.9 and, for the comparison, the results obtained in the present chapter and those of previous studies are given in Table 3.10. The results suggest that between 1537 and 1568 the transaction costs involved in shipping English money between London and Antwerp were about 1.1 Flemish shillings per £1 sterling when there was no debasement and about 1.42 Flemish shillings per £1 sterling during the debasement. The estimations are divided by the mint parity so as to express them as a percentage of parity. During the debasement, the mint parity changed constantly. The average of parities is thus taken as the mint parity of the period 1544-51. Therefore, the transaction cost of non-debasement and debasement period is about 4.5-5 per cent and 6.6 per cent of parity, respectively, which is slightly lower than those estimated in previous studies.

[242] Prakash and Taylor, 'Measuring market integration', pp. 31-2.
[243] K. S. Chan and R. S. Tsay, 'Limiting properties of the least squares estimator of a continuous threshold autoregressive model', *Biometrika*, 85 (1998), pp. 413-26.

To put this in context, Chilosi and Volckart's analysis shows that the arbitrage cost between Basel and Cologne was 1.04 kilograms silver for shipping 1 kilogram gold in the late fifteenth century and fell to 0.55 kilograms in the first half of the sixteenth century. By dividing these values by 11.5, the prevailing gold-silver ratio,[244] one can calculate the arbitrage cost in terms of a percentage. They are 9 per cent and 4.8 per cent, respectively. According to Bernholz and Kugler, the transaction costs of arbitrage between the exchange rates of the Basle pound, the Rhinegulden and the gold-silver ratios in the late Middle Ages and of the exchange rates between Seville and Medina del Campo in the second half of the sixteenth century are estimated at 7 and 6 per cent, respectively.[245]

The relatively low transaction cost associated with the London-Antwerp exchange market is probably due to the short distance separating the two markets and the long-established commercial relationship between these two markets. The textile industry was one of the few important ones in the Middle Ages. The high quality of English wool was sought by cloth-makers in Europe. Apart from direct purchases by Italians, English wool was mainly exported to the Netherlands (after 1363 to the staple at Calais). The heavy dependence on English wool and later cloth was one of the pillars of the close commercial link between England and the Netherlands. Accompanying the wool and cloth trade, bills of exchange were frequently used to transfer the proceeds of exports and to draw on the coming revenues to pay for purchasing wool. The Anglo-Flemish exchange was in this way closely interwoven with its commerce and thus contributed to the low transaction costs of exchange arbitrage. The stable English and Flemish monetary system maintained in the first three decades of the sixteenth century further helped to keep transaction costs at a low level.

[244] The gold-silver ratio of 11.5, which was in line with the prevailing ratio in Europe, is implied in their working paper. Chilosi and Volckart, 'Money, states and empire', Working paper, p. 31. Van der Wee, *Antwerp Market*, Table XVI.
[245] Kugler, 'Rhinegulden and Basle pound', p. 12; Bernholz and Kugler, 'Financial market integration', p.10.

Table 3.9. The results of the estimation of the TAR model

	1537-44	1539-42	1544-51	1558-68
α	-0.261	-0.25	-0.129	-0.229
β[a]	-		-0.51	-
Threshold (τ)[b]	1.153 (4.4%)	1.187 (4.5%)	1.42 (6.63%)	1.148 (5%)
The speed of adjustment in half-life (months)	2.3	2.41	5.03	2.67
Observations outside the bounds (%)	36%	33%	46%	43%

Notes: a. Parity did not change in the periods 1537-44 and 1558-68 and the values of ß are thus not available.

b. The transaction cost in terms of the percentage of parity is given in brackets. For the years 1544-51, the average of parities is taken as the parity of the period.

Table 3.10 Some comparisons				
	Estimated threshold	Speed of adjustment (in a half-life time)	Estimated speed of communication	Sources
Flanders-Lübeck 1385-1450	0.344 grams silver	8 months	10-15 days	Volckart and Wolf
Flanders-Prussia 1385-1450	0.988 grams silver	21 months	20-30 days	
Basel-Cologne 1481-1532	9%-4.8%	6 months (reduced to weeks in the later period)	7-10 days	Chilosi and Volckart
Basle Pound-Rhinegulden 1365-1429	7%	Within a year	-	Kugler
Seville-Medina del Campo 1564-1603	6%	Within a year	10-14 days	Bernholz and Kugler
London-New York 1879-1913	0.67%	6 days	within a day[c]	Canjels et al
London-Antwerp 1539-68	4.4%-6.6%	2-5 months	5-9 days[d]	

Sources: E. Canjels, G. Prakash-Canjels and A. M. Taylor, 'Measuring market integration: foreign exchange arbitrage and the gold standard, 1879-1913', *The Review of Economic and Statistics*, 86 (4), (2004), pp. 868-882; O. Volckart and N. Wolf, 'Estimating financial integration in the Middle Ages: what can we learn from a TAR model?', *Journal of Economic History*, 66 (1), (2006), pp. 122-136; D. Chilosi and O. Volckart, 'Money, states, and empire: financial integration and institutional change in central Europe, 1400-1520', *Journal of Economic History*, 71 (2011), pp. 774-7; P. Bernholz and P. Kugler, 'Financial market integration in the early modern period in Spain: results from a threshold error correction model', working paper, 2008; P. Kugler, 'Financial market integration in late medieval Europe: results from a threshold error correction model for the Rhinegulden and Basle pound, 1365-1429;, Working paper, 2009.

Note: a. The thresholds are estimated as the percentage deviations from parity.

b. According to Spufford, couriers in the late Middle Ages covered on average 30-40 kilometres per day. At this speed, the speed of communication can be approximately estimated. Bruges is chosen to represent Flanders. Danzig, as an important trading place in Prussia, is used to calculate the speed of communication between Flanders and Prussia. P. Spufford, *Power and Profit: the Merchant in Medieval Europe* (London, 2002), p. 200

c. By ocean voyage, it took 9-14 days to transmit information across the Atlantic, but the time needed for communication was reduced to within a day by the telegraph. C. Hoag, 'The Atlantic telegraph cable and capital market information flows', *Journal of Economic History*, 66 (2006), p. 342

d. See Appendix 3.H.

How closely are the transaction costs estimated in Equation (3.7) in line with reality? The transaction costs of engaging in arbitrage included freight fees, opportunity costs, insurance costs, mint charges and other costs. During the time spent on transporting money and the wait for it to be converted into local coinage, capital, instead of being put to productive use, lies idle. This opportunity cost can be estimated by the interest rates. Because of these costs, it was better to send coins abroad that had a high bullion content. Collecting coins was likely to be a time-consuming and probably costly task and thus accounted for part of the transaction cost. One to two months would likely elapse between the preparation for shipping coins in London and receiving Flemish coins in Antwerp. This opportunity cost could be measured by the shadow interest rate estimated above.[246] The transaction cost of arbitrage in the non-debasement periods was about 4.5 per cent, which was roughly equivalent to 4 month interest. Considering the opportunities cost together with insurance costs (risk premium) and freight fees, one could argue that the estimated transaction costs here is quite close to reality.

Because of the fiscal incentives behind the Great Debasement, the mint charges, in terms of the percentage of English money minted from one Troy pound, greatly increased from 2.2 per cent to 61 per cent in silver and from 0.5 per cent to 15 per cent in gold during 1544-51.[247] Meanwhile, mint charges in the Habsburg Netherlands remained stable at around 1 per cent.[248] The rising transaction costs during the Great Debasement was partly attributed to the increasing mint charge and partly to the confusing state of the currency, which increased the costs of information related to detecting the mint parity. The transaction cost during the debasement estimated here (6.6 per cent) is similar to Gould's estimation (6 per cent).[249] The slight increase in transaction costs in the 1560s, compared with the pre-debasement level, was probably caused by Anglo-Netherlands trade disputes and religious unrest in the Habsburg Netherlands.

[246] The shadow interest rate of London calculated from the exchange rates suggests that on average it was 1.14% per month in the mid-sixteenth century. Cf. p. 111 above.
[247] Feavearyear, *Pound Sterling*, Appendices I and II.
[248] Pusch, *Staatliche Münz-und Geldpolitik*, pp. 84-5.
[249] Gould, *Great Debasement*, p. 109.

Before the debasement, in 1537-44, adjusting the Anglo-Flemish exchange rates took 2.3 months. Because of the repeated monetary alterations, the speed of adjustment declined to 5 months in the years 1544-51. As mentioned, the Great Debasement was fiscally motivated; information on the new bullion content of the debased coins was therefore not public. The face value, the weight and the fineness were altered to make it difficult to detect the intrinsic value of new coins. Hence, it took time for merchants to figure out the bullion content of the debased coins and the corresponding exchange rates. As a result, adjustment was delayed and transaction costs were increased during the debasement.

Furthermore, the results represented here enable us to solve the puzzle posed earlier: the London-Antwerp exchange rates remain unchanged within a year of the debasement when the bullion content of coins was reduced by 8 and 24 per cent of precious metals in gold and silver, respectively. The stable exchange rates are less indicative of inefficient exchange markets than of the time required to replace old with debased coins. When old coins were replaced by the debased coins in circulation and the bullion content of the circulating coins began to decline, the course of exchange rates followed suit. Based on the bullion content of the circulating coins, the estimation shows that, though delayed by the need to process information and impeded by the rising transaction costs, the London-Antwerp exchange market was able to reduce a deviation from parity with 5 months.

However, the delay in adjustment was temporary and the speed of adjustment recovered from 5 months to 2.7 months once the coinage was restored. After the English monetary standard was restored in 1560-1, exchange arbitrage regained its effectiveness and the speed of adjustment recovered to 2.7 months. This was still slightly longer than that before 1544 suggests not only that the Great Debasement may have done long-term harm to exchange dealings between England and the Netherlands, but also that the Anglo-Habsburg Netherlands commercial relationship and political and religious developments in the Netherlands influenced the degree of market adjustment adversarially.

In the sixteenth century, the Netherlands were the most important market for English goods and the primary source of imports. A large part of the exchange between London and Antwerp was used to accommodate the remittance of funds

involved in the cloth and woollen trades. Any trade dispute and arrest had a disruptive influence on exchange between England and the Netherlands. In December 1563, using plague as an excuse, the government of the Netherlands banned English ships from unloading cargo. In retaliation, the English in 1564 moved their cloth trade from the Netherlands to Emden. Although cloth was not sold in the Netherlands in 1564, most of the exchange and financial activities were still carried on in Antwerp. The separation of commodity trade and exchange dealings increased transaction costs and hindered exchange adjustments. Soon after trade between England and the Netherlands was restored in early 1565, the religious riots of 1566 again threatened commercial and exchange dealings. The commercial disruption with and religious crises in the Netherland exposed London-Antwerp exchange arbitrage to high risk and uncertainty and thus reduced the speed of adjustment in the 1560s.

3.7.1 Sensitivity tests

The estimations presented here are based on a few assumptions designed for calculating the mint parity. Two of these assumptions are tested here to examine the robustness of the results.

Assumption 1: the calculation of mint parity is based on gold coins

Because of the high value commanded by gold coins, payment made in gold incurred lower transaction costs in particular in the payment of bills of exchange.[250] One can test the robustness of this assumption (that payment was made entirely in gold) by estimating the adjustment parameters and transaction costs of 1544-51 on different percentages of gold coins in calculating the mint parity. The upper part of Table 3.11 gives the results based on three ratios (90, 80 and 75 per cent). The results show that compared with the estimation solely based on gold, the magnitude of the adjustment parameters (α and ß) is more or less the same but transaction costs

[250] According to Appendix 3.A, the payment of bills of exchange usually involved large sums. Every £100 of the bill, if made in coins, required 100 pieces of sovereign, which was given £1 of face value and was the largest denomination of gold coins issued in England at the time. However, in terms of silver coins, it needed 2,000 pieces of testoon valued at 1s. The transaction cost in accounting and weighing would have been extraordinarily high for the payment made in silver coins.

greatly increase when silver is used in estimation. This implies that the initial assumption may lead to an underestimate of transaction costs. Besides the relatively high cost of counting and transporting, the mint charge of silver coins grew more remarkably than that of gold; therefore, merchants would incur a great transaction cost of arbitrage by using silver in making the payment of bills of exchange. Once the difference exceeded this relatively lower transaction cost, the market adjusted exchange rates as efficiently as in the case of using gold only.

Although the estimation changes when payment involved in silver, the main result (entirely based on gold) is still preferred. In addition to the literature repeatedly claiming that gold was mainly used in international and large payment and silver in local and retail uses arbitrage (i.e. moving bullion to exploit the profit emerging from the debasement) actually operated by moving gold coins rather than silver, which is illustrated in contemporary mercantile documents[251].

Assumption 2: the 75 per cent of the recycling ratio

The mint parity is calculated on the average bullion content of circulating coins and thus one has to know how many old coins had been taken out of circulation when the debasement occurred. Above, 75 per cent of the debased coins are assumed to be manufactured from old coins withdrawn from circulation in the early stages of the debasement. In order to know whether the recycling ratio affects the results of the threshold and the speed of adjustment, the estimation is also carried out with four other recycling ratios (85, 80, 70 and 65 per cent), which present 5 and 10 per cent variance of upper and lower bounds. The estimations reported in the lower part of Table 3.11 show that the estimated thresholds and adjustment parameters do not alter much under different recycling ratios and the variance is not statistically different on the basis of the t-ratio test.

[251] Winchester, *Johnson Letters*.

Table 3.11. Sensitivity tests: recycling ratios and share of gold coins during the Great Debasement, 1544-51

	percentage of gold coins		
	90%	80%	75%
α	-0.11	-0.115	-0.141
β	-0.373	-0.714	-0.16
Threshold (τ)	1.95 (9.24%)	2.17 (10.46%)	3.1 (15.04%)
The speed of adjustment in half-life (months)	5.94	5.69	4.56
	Recycling ratio		
	85%	80%	70%	65%
α	-0.164	-0.117	-0.187	-0.15
β	-0.625	-0.599	-0.491	-0.493
Threshold (τ)	1.807 (8.51%)	1.422 (6.68%)	1.745 (8.15%)	1.415 (6.59%)
Speed of adjustment in half-life (months)	3.88	5.59	3.34	4.28

Table 3.12 Sensitivity test: sight exchange rates

	1537-44	1544-51	1558-68
α	-0.407	-0.181	-0.282
β	-	-0.53	-
Threshold (τ)	0.549 (2.13%)	1.512 (7.06%)	0.816 (3.67%)
Speed of adjustment in half-life (months)	1.32	3.46	2.09

Usance v.s. sight

In the analysis, all exchange rates extracted from documents are converted to the rate on the usance basis.[252] The usance exchange rates are equivalent to the sight exchange rates plus one month of interest (recalling that the usance of the London-Antwerp exchange in the sixteenth century was one month), which was to compensate for the month of illiquidity. Funds became less flexible and the cost of moving money to exploit arbitrage opportunities probably increased. Therefore, sight exchange rates would be preferable when one is measuring the effectiveness of arbitrage. But the number of sight rates only represents less than one-fifth observations. The following test checks the robustness of the estimations based on usance rates, and also shows whether the results improve or not if the analysis employs sight rates. Two things stand out from comparing the results in Table 3.9

[252] Cf. pp. 112-3, above.

with those in Table 3.12: based on sight exchange rates (1) in two non-debasement periods, the estimated transaction costs declines but adjustment parameters increase and (2) the adjustment parameter increases during the Great Debasement increased by nearly half.

The difference is owing to that sight exchange rates removed the one month interest embedded in usance rates, and therefore, it is not surprising to observe lower transaction costs of arbitrage in Table 3.12. The quicker adjustment lies with the uncertainty over money which money would not be received for up to a month with usance bills. The comparison between the Table 3.9 and 3.12 shows that the results are not substantially different when the parameters are estimated by sight rates. The other two tests also demonstrate that the calculation of Anglo-Flemish mint parity based on gold coins and 75 per cent of the recycling ratio more or less captures changes in the average bullion content of the total in circulation. These three sensitivity tests imply that the results presented in Table 3.9 are robust.

3.7.3 The role of information

Prices adjust according to the inflow of information. Hence, the speed of adjustment is only illustrative when it is compared with the speed of communication. The time required for information transmission can be estimated from mercantile correspondence. Merchants at the time were accustomed to recording the date of dispatching and receiving correspondence on the backs of the letters received. From this, the average time for a letter to travel between London, Antwerp and Calais in the mid-sixteenth century is calculated from Johnson's letters: it was about 5 to 9 days.[253] Comparing this with the estimated speed of adjustment in terms of a half-life, one can then judge whether the London-Antwerp exchange arbitrage worked effectively.

The London-Antwerp exchange markets seem apparently ineffective in terms of communication, even before the debasement: after all, sending a letter took just about a week but the market took 2.3 months to adjust to the inflow of information.

[253] See Appendix 3.H.

At least part of this lag must have been taken up with processing, analysing and confirming the relevant information. Furthermore, adjustment took time even once arbitrage had started. In the sixteenth century, the speed of market adjustment was affected by several factors: the speed of communication and information process, the predictability of future movement (speculation), regulations and so on. Through correspondence, merchants daily received not only useful information but also rumours. During the non-debasement period, changes in exchange rates were driven by the net demand of bills of exchange (Equation 3.2). Correspondence exchanged between merchants carried information which allowed merchants to establish the expectation of this net demand of bills and to speculate on the future movement of exchange rates. Faced with mixed news, judgements as to what to believe and what to disregard sometimes determined the success or failure of a business. Most of the time, news did not explicitly reveal useful information and a process of analysis and interpretation was required. The more implicit the information was, the more difficult for merchants to comprehend the true state of the market. Thus, in addition to communication, the speed of information processing had a critical effect on the speed of adjustment.

The experience of monetary alterations in England and the Low Countries is a good example of the way in which the varying accessibility of information affected the speed of adjustment. This can be assessed by comparing the speed of adjustment as a result of information process during the Great Debasement and the revaluation of 1539 in the Netherlands. As addressed above, the repeated alterations of the bullion content of English coins and the fiscal purpose behind the debasement made it difficult to calculate the mint parity between English and Flemish money. The public needed to weigh and test the new coins to determine the new parity. This was costly and time-consuming. The uncertainty and confusion involved in calculating the mint parity was further increased by successive issues of coins with progressively lower weights and fineness. The difficulty of distinguishing between different coins was manifested in Elizabeth's recoinage of 1560-1, when the government had to send

experts to the country to help people make a distinction and mark on different coins.[254] Consequently, during the Great Debasement the speed of adjustment grew.

Unlike the fiscal-orientated debasement initiated by Henry VIII, the revaluation of gold coins in the Netherlands in 1539 was intended to artificially increase the value of gold in terms of silver. Hence, the re-valued face value of gold coins was public knowledge. Compared to the extremely high information cost involved in calculating the new parity in 1544-51, information as to revaluating the mint parity was almost free in the case of the revaluation. Furthermore, while in 1539 the face value of gold coins could be changed overnight by proclamations, the English debasement of the 1540s was achieved by producing coins containing less precious metal. Debased coins could not replace the old coins in circulation immediately after the announcement was made. Not only was time required for the public to bring old coins to a mint to exchange for debased coins, but, due to the primitive technology, it took weeks or even months to produce a large enough quantity of debased coins to replace the old ones. Except for information cost, the involvement of time also made adjustment to monetary alteration slower in the 1540s than in 1539.

Illustration 2: Henry VIII's debased testoons: the left hand side one with a round face and right hand side lean face.

[254] Challis, *Tudor Coinage*, pp. 122-3. On the good testoon, Henry VIII appeared with a round face but lean face on the poor one. As Illustration 2 shows, one can tell how difficult to make a distinction between these two types of testoon.

As described above, detailed information about the revaluation of 1539 was recorded in Van der Molen's correspondence.[255] In two stages, the face value of the various gold coins circulating in the Habsburg Netherlands was reduced but meanwhile the bullion content of gold coins remained. The speed of adjustment and the transaction costs in 1539-42 are estimated at 2.41 months and 4.5 per cent of parity, respectively (see Table 3.9). That transaction costs during the revaluation were similar to those in the whole pre-debasement period (1537-44) confirms that the information costs involved in determining the new mint parity in the revaluation were nearly zero. Because of this, the speed of adjustment was not impeded by the revaluation. This simple comparison clearly points out that the speed of adjustment of Anglo-Flemish exchange rates to monetary alterations very much depended on whether information on monetary alterations was publicly available or not. When information was open to the public, as in the case of the revaluation of 1539, the speed of adjustment in exchange markets was not hindered by monetary alteration. However, the speed of adjustment was twice as long in the case of the debasement in the 1540s, when information was not explicit.

Before concluding this chapter, one last question remains to be answered. How well integrated were the mid sixteenth-century Anglo-Netherlands exchange markets compared with other markets in other periods? It makes sense to discuss the degree of integration only if one can compare the speed of adjustment with the speed of communication. The speed of communication is approximately estimated by dividing the distance between any two markets by the distance that a message can cover per day. Based on Spufford's estimation, couriers, on average, were able to cover 30-40 kilometres per day in the late Middle Ages. However, the speed varied according to terrain, weather and the type of transport.[256] The estimated speeds of communication are listed in Column 4 of Table 3.10. After telegraphs were introduced in the nineteenth century, information could cross the Atlantic within a day.[257]

[255] Edler, 'Financial measures of Charles V', pp. 668-9 and Cf. pp. 97-8 above.
[256] P. Spufford, *Power and Profit: the Merchant in Medieval Europe* (London, 2002), p. 200-3.
[257] C. Hoag, 'The Atlantic telegraph cable and capital market information flows', *Journal of Economic History*, 66 (2006), p. 342.

At first glance, Table 3.10 shows that, by late nineteenth century standards, integration between London and Antwerp in the mid-sixteenth century was still poor.[258] However, the London-Antwerp exchange markets were much more integrated and incurred smaller transaction cost than other late medieval and early modern markets. Among these results, the speed of adjustment between London and Antwerp (particularly in the non-debasement periods) in terms of communication was remarkably quick and the transaction costs were 1-2 times lower than between other market pairs. However, the impression that integration was weak given by other analyses may be due to their use of low frequency data. With low-frequency data such as annual data, it is difficult to precisely measure the speed of adjustment. Although in Volckart and Wolf's case of the Flanders-Lübeck market, the estimated speed of adjustment does not improve by using quarterly data,[259] higher-frequency data are necessary for precisely estimating the level of integration. Therefore, it would be rash to claim that financial market integration between London and Antwerp in the mid-sixteenth century was more advanced than it was in late medieval markets and contemporary Spanish internal markets.

Nevertheless, Volckart and Chilosi show that, though with mixed results, financial market integration in the Rhineland rapidly advanced in the late fifteenth century and the development of integration was closely connected to the revival of overland trade between South Germany and the Netherlands. It is very likely that the combined long-established commercial ties between England and the Low Countries and the revival and growth of commerce at the turn of the sixteenth century led to relatively well-integrated London-Antwerp exchange markets. Although the speeds of adjustment cannot be directly compared, transaction costs in each study shed light on the degree of integration between London and Antwerp in relation to other market pairs. Transaction costs were the constraint imposed on arbitrage. If two markets traded, the lower the transaction cost was, the smaller were price differentials tolerated and the more actively arbitrage could operate. Consequently, resources could cheaply move from one place to another and be more effectively employed in the most productive use. Compared to other markets, the transaction

[258] Canjels, et al, 'Measuring market integration', p. 876.
[259] Volckart and Wolf, 'Estimating financial integration', p. 136.

cost involved in London-Antwerp arbitrage was only one-third to half of them, and this could imply that the Anglo-Netherlands exchange markets were more integrated than other market pairs and the degree of integration improved from the late Middle Ages to the mid-sixteenth century.

3.8 Conclusion

The role of the market was particularly critical in economic development when investment levels were low and technological progress slowly and discontinuously. The study of market integration sheds light on economic development in the late medieval and early modern eras when aggregate data, such as GDP, income, the level of productivity and trade volumes, are generally unavailable. There are two advantages of studying market integration based on financial data such as exchange rates. Not only were financial markets to a large extent free from government regulation and intervention (though they were obviously affected by measures such as debasements), but transport costs, a great impediment in the integration of the grain market, played a far smaller role in financial markets. Hence, financial markets show us the maximum level of integration that could be achieved at the time.

The results of the present chapter, based on monthly data, add some new insights into the previous studies on financial market integration in the early modern era. Previous research examining late medieval and early modern exchange markets based on annual data shows that it required several months at least for arbitrage to remove deviation from parity. The results presented above make it clear that financial markets – at any rate the London-Antwerp exchange markets – were much better integrated than had been thought. Moreover, by taking the speed of communication into account, the present chapter provides a benchmark to evaluate how well financial markets performed in contemporary circumstances.

In the framework of a threshold autoregressive (TAR) model, the dynamic adjustment of the London-Antwerp exchange markets in the mid-sixteenth century is examined by using a newly compiled dataset of exchange rates. The speed of adjustment in terms of a half-life is estimated at 2.3 months and grew to 5 months

during the Great Debasement. At the time, transmitting information between London and Antwerp took on average 7 days. Compared to the contemporary speed of communication, the speed of adjustment estimated here indicates that some degree of integration was achieved in the mid-sixteenth-century London-Antwerp exchange markets but that the Great Debasement greatly disturbed exchange markets and doubled the time required for exchange rates to adjust. It is difficult to compare this result with the results of previous studies, due to the different frequencies of the data under scrutiny. However, data frequency less likely affect the estimation of the transaction costs involved in arbitrage. The transaction costs estimated in this chapter were about half as high as those found by previous analyses; this may suggest that the degree of market integration in the sixteenth century was higher than that in the late Middle Ages.

Information was a major determinant of the speed of adjustment. When information was implicit and required time and costs to process, as in the case of the Great Debasement, adjustment was delayed and took about 5 months, which is twice as long as during non-debasement periods. However, in the case of the revaluation of gold coins in the Habsburg Netherlands in 1539, the speed of adjustment remained almost unchanged: evidently because information about the new face value of the coins was public and free. The volume of trade flowing between markets was another factor determining the degree of integration. In the 1560s, because of a trade dispute which resulted in the removal of the cloth trade from Antwerp and later because of religious unrest in the Netherlands, the speed of adjustment declined and transaction costs grew. The less integrated London-Antwerp exchange markets probably resulted from the temporary removal of trade and the consequently increasing transaction cost.

In sum, by nineteenth century standards, transaction costs were high and the speed of adjustment low in the sixteenth century. However, markets had become more integrated since the late Middle Ages, as shown in the decline of transaction costs. Furthermore, when information was freely available, markets were able to adjust effectively. This chapter confirms the conventional wisdom that, along with the interdependent commodity trade between England and the Netherlands, London-Antwerp exchange financial markets had achieved a fair degree of

integration in the sixteenth century. Exchange arbitrage across the channel was effective and efficient when information was free and publicly available, but greatly impeded when acquiring and processing information required time and was costly and complicated. The analysis presented here thus points unequivocally to the crucial importance of communication and of the processing of information in determining the level of market integration.

Chapter Four Integration of the Northern European exchange market during the Franco-Dutch war

4.1 Introduction

Financial markets bridge credit seekers and those looking to invest, allowing capital to move towards its most productive use. Well integrated and efficient financial markets, according to neo-classical theory, promote resource allocation and facilitate economic development. The previous two chapters argue that the financial market, in so far as exchange markets are concerned, was fairly well integrated in the late fourteenth and sixteenth centuries, despite the constraint of transaction costs. Arbitrage effectively operated to adjust prices and bring markets back to equilibrium. The present chapter extends the examination of the efficiency and integration of exchange market to the seventeenth century.

Bills of exchange in the seventeenth century were commonly discounted and assigned to a third party with endorsement. Public banks were established to manage monetary affairs by receiving deposits, issue bank money and process bills of exchange.[260] Furthermore, information about the state of markets was widely available and easily accessed by the regular issue of price currents, sheets listing the current prices of commodities and exchange rates traded in markets.[261] Transaction costs incurred in the adjustment in financial markets reduced as a result of these developments. One of the purposes of this chapter, as part of the argument in the present thesis, is to show that the financial advance in the seventeenth century

[260] S. Quinn and W. Roberds, 'The big problem of large bills: the bank of Amsterdam and the origins of central banking', Federal Reserve Bank of Atlanta's working paper 2005-16, (2005); idem, 'Early bank of Amsterdam'; J. G. van Dillen, 'The Bank of Amsterdam', in J. G. van Dillen ed., *History of the Principal Public Banks Accompanied by Extensive Bibliographies of the History of Banking and Credit in Eleven European Countries*, (Hague, 1964), pp. 79-123; H. Sieveking, 'Die Hamburger Bank', in J. G. van Dillen ed., *History of the Principal Public Banks* (Hague, 1964), pp. 125-60; M. 't Hart, J. Jonker and J. L. van Zanden, *A Financial History of the Netherlands* (Cambridge, 1997), pp. 37-63.
[261] McCusker and Gravesteijn, *Commercial and Financial Journalism*.

mainly contributed more to reducing transaction costs than to improving market integration, which had already been achieved over the previous centuries. Individually, the present chapter extends the existing literature on the measure of financial market integration back to the 1670s.

The quantitative examination of the effectiveness of arbitrage in late seventeenth-century financial markets is based on triangular arbitrage: an analysis of the difference between direct- and cross-exchange rates. Due to the availability of data, the particular time period investigated runs from 1668 to 1680. In this period London fell victim to the Stop of Exchequer of 1672 and northwest Europe was ravaged by the Franco-Dutch War and the third Anglo-Dutch War. The impact of these events on exchange arbitrage is also investigated. The examination focuses on the exchange markets of London, Amsterdam and Hamburg. Furthermore, by comparing the speed of adjustment of triangular arbitrage via Amsterdam with that via Hamburg, this chapter shows that arbitrage in exchange operated more effectively and efficiently via the former than the latter. The results confirm quantitatively the long-standing view that Amsterdam in the seventeenth century was a major financial centre and clearing house for Europe.[262]

The rest of the chapter is divided into 5 sections. The financial innovations since the late sixteenth century are briefly described in section 4.2. Section 4.3 provides some historical background to set against the analysis, e.g. the Stop of Exchequer and the French-Dutch war. Section 4.4 addresses the econometric model used to estimate the effectiveness of arbitrage and the sources of the data employed. The statistical findings and their implications and interpretations are presented in section 4.5. Section 4.6 concludes the chapter.

[262] W. D. Smith, 'The function of commercial centers in the modernization of European capitalism: Amsterdam as an information exchange in the seventeenth century', *Journal of Economic History*, 44 (1984), pp. 985-1005; C. Lesger, *The Rise of the Amsterdam and Information Exchange: Merchants, Commercial Expansion and Change in the Spatial Economy of the Low Countries, c. 1550-1630* (Ashgate, 2006), pp. 214-57.

4.2 Financial innovations

The operation and dual function of bills of exchange are elaborated in Chapter 1. The bill of exchange was an innovation of the Italian merchants engaged in international trade to facilitate transfers of funds between distant places in the late thirteenth century. Due to the Church's prohibitions of usury and medieval secular laws, bills were neither discountable nor transferable. Discounting a bill implied taking interest on a loan. Meanwhile, no one would wish to take up a bill at its face vale before maturity, which meant the loss of interest. If he needs cash immediately, B (in Figure 1) could not sell the bill to a third party, but had to take up money by selling another bill. In the Middle Ages, if someone wanted to borrow money by dealing in bills, he had to deal with exchange and re-exchange. The rate of interest was determined by the fluctuation of exchange rates. Moreover, the right to collect the payment of a bill could not be transferred to a third party; in other words, no third party may sue a drawer for non-payment.

In the last quarter of the fifteenth century, as the transcontinental trade route was restored and the flow of trade increased, this primitive medieval financial method was by the mid-sixteenth century no longer able to cope with the pressure exerted on the demand for money. Against this backdrop, several innovations in financial method developed and finally matured in the seventeenth century into full and routine practice. In this section, four innovations are addressed: (1) discountability, (2) negotiability, (3) endorsement and (4) the issue of price currents.

Discountability

The liquidity problem embedded in the medieval financial method became severe when the flow of trade and the demand for money increased at the turn of the century. Van der Wee uses the Kitson papers, the mercantile documents of an English cloth exporter, to show how merchants dealt with the liquidity problem by discounting the letter obligatory.[263] This example demonstrates that in the sixteenth

[263] H. Van der Wee, 'Sporen van Disconton te Antwerpen tijdens de XVI^{e} eeuw', *Bijdragen voor de Geschiedenis der Nederlanden* , X (1955), pp. 68-70; H. Van der Wee, 'Antwerp and the new financial methods of the 16th and 17th centuries', in H. Van der Wee, ed. and L. Fackelman trans., *The Low Countries in the Early Modern World* (Variorum, 1993), pp. 163-6.

century the influence of the prohibition on usury waned and merchants were willing to discount credit instruments before interest payments became legalised.

In this atmosphere, the government in the Low Countries and England legitimised the charging of interest (up to 12 per cent and 10 per cent, respectively) in the mid-sixteenth century. The charging of interest was first permitted by an ordinance of Charles V issued on 4 October 1540, which allowed interest payments for commercial loans in the Habsburg Netherlands up to a limit of 12 per cent. Across the channel, Henry VIII made interest payments legal in 1545, up to a lower limit of 10 per cent, but this statute was repealed in 1552. In 1571, Elizabeth I restored permission to charge interest. The legal maximum percentage was reduced to 8 per cent in 1624, to 6 per cent in 1651, and then to 5 per cent in 1713. Laws against usury were completely abolished in 1854 and since then there has been no legal limit to the payable interest.[264]

Negotiability and endorsement

Once interest payment became legal, bills and other letters obligatory could be sold to a third party before the maturity. To allow a secondary market for these commercial credit instruments to properly emerge, they had to be negotiable. A negotiable commercial bill is one for which a court must recognise the full legal status of the third person who has bought the bill from its former holders. In the case of default, whoever was holding the bill has the right to take legal action against the original issuer and also the people who previously held the bill until the final payment is received. Munro argues that the first legal procedure to uphold the right of the bearer occurred in 'backward' England. He cites the case of Burton v. Davy in the London Mayor's law-merchant court in 1436 to show that the origin of negotiability may have been in the English law merchant. The court ruled that the current holder of the bill (the bearer) had the same rights and legal standing as the stipulated payer and should receive the full payment of the bill.[265]

[264] Munro, 'Usury, Calvinism, and credit'; Homer and Sylla, *History of Interest Rates*, pp. 111-21.
[265] J. H. Munro, 'The international law merchant and the evolution of negotiable credit in late-medieval England and the Low Countries', *Banchi pubblici, banchi privati,e monti di pietà nell'Europa preindustriale*, Genova, 1991, pp.63-80; idem, 'Origins of the financial revolutions', pp. 550-4; idem,

Despite several early precedents,[266] the first national legislation to recognise the full legal rights of the assignee was established in the Netherlands. Charles V's ordinances of 1536 and 1541 established the legal status of the negotiability of a bill of exchange in the Habsburg Netherlands.[267] These two ordinances state that the obligation between the assigner and assigner is not discharged until the assignee receives the final payment. If the original issuer defaults, the assignee has the right to sue not only the original issuer but also previous assigners.

A new problem emerged with this negotiability: how to identify debtors in a chain of assignment. Because all assigners hold a legal obligation to satisfy the final payment if the original issuer defaults, the credibility of the assigners becomes important in passing bills to a third party. To deal with this problem the practice of endorsement was created.[268] Merchants signed their name on the back of a bill, which would not only legally bind them to the final settlement of the debt, but also indicate the credibility of the chain of assignment. According to de Roover, the earliest example of endorsed bills dated from the 1610s and after this their use spread rapidly.[269] Negotiability and endorsement would increase the use and acceptability of the bill of exchange. The secondary markets for bills of exchange thus developed and exchange markets expanded and deepened.

The issue of price currents

By the turn of the seventeenth century, Amsterdam had replaced Antwerp as the commercial and financial centre of north Europe. Because of the large quantity of commodities and financial assets traded at the Amsterdam bourse, Amsterdam also acted as an information centre.[270] With the mounting level and variety of trade, commercially and financially, brokers had regularly to provide price information

'English "backwardness" and financial innovations in commerce with the Low Countries, 14th and 16th centuries', Working paper, Department of Economics, University of Toronto, 1998.

[266] After the case of Burton v. Davy, several rulings favouring the assignee were made: at Lübeck in 1499, Antwerp in 1507 and Bruges in 1527. Munro, 'Usury, Calvinism, and credit', p. 23.

[267] Van der Wee, *Antwerp Market*, Vol. II, p. 344; idem., 'Monetary, credit, and banking system', in E. E. Rich and C. Wilson, eds., *The Cambridge Economic History of Europe*, Vol. V: *The Economic Organization of Early Modern Europe* (Cambridge, 1975), p. 326.

[268] M. Kohn, 'Bills of exchange and the money market to 1600', Working paper, February 1999; idem., 'Payments and the development of financial in pre-industrial Europe', Working paper, November 2001; Munro, 'Origins of the financial revolution', pp. 549-56.

[269] De Roover, *Gresham on Foreign Exchange*, p. 122.

[270] Smith, 'The function of commercial centers'.

about various commodities to their customers. As early as the late sixteenth century, price currents which listed the prices of goods traded at the Amsterdam bourse were issued regularly. The Amsterdam price current was copied from that of Antwerp where business newspapers containing information on the prices of commodities and exchange rates were published in the 1570s.[271]

The first printed list of commodity prices appeared in London as early as 1608. The list of quotations of current exchange rates began to be issued in 1619. Hamburg, standing as an important commercial and financial centre in Northern Europe, probably began to publish printed commodity prices at the end of the sixteenth century and exchange rate currents from the mid-seventeenth century onwards. The Italian influence in European banking and financial sectors was maintained into the seventeenth century, as demonstrated in the first commodity price current, which probably appeared in Italy and the concurrence of the Italian version of the price currents issued in Amsterdam in the 1620s (Illustration 3). Extant price currents issued in Venice can be dated as early as the 1580s and its exchange rate current began to be printed in the 1620s. Several French cities, such as Bordeaux, Lyon, Marseilles and Rouen, were printing price currents in the seventeenth century.[272] In addition to these commodity prices, quotations of exchange rates with many trading cities also appeared on the lists. By regular issues of price currents, price information, which reveals the state of the market, can spread widely and is easy for the public to access. Price adjustment to shocks would thus have been quicker and markets more integrated.

The prices of financial assets for the very end of the seventeenth century and onwards are consistently and continuously preserved.[273] By consulting the share prices listed in London and Amsterdam (*the Course of the Exchange* and *Amsterdamsche Courant*), scholars are able to (1) estimate the degree of market integration and (2) test the efficient market hypothesis for the eighteenth-century northern European financial markets. These studies show that financial markets

[271] Posthumus collected a large number of price currents printed in Amsterdam for the years 1585-1813; his collection is now kept in the Nederlandsch Economisch-Historisch Archief, Amsterdam. Posthumus, *Inquiry*.
[272] McCusker and Gravesteijn, *Commercial and Financial Journalism,*; J. M. Price, 'Notes on some London price-currents, 1667-1715', *Economic History Review*, 7 (1954), pp. 240-50.
[273] See footnote 14 and 18.

(stock and exchange markets) of London and Amsterdam have since the 1720s been statistically confirmed to be well-integrated and efficient. Though supported by the qualitative evidence, however, the degree of integration and efficiency in the late seventeenth century has not yet been statistically measured.[274]

The following analysis uses exchange rates quoted in mercantile correspondence and price currents to examine financial market integration in the second half of the seventeenth century. Triangular arbitrage on exchange markets will be represented in a threshold error correction model to estimate the degree of integration and transaction costs. The method has the merit of both showing how well integrated exchange markets were in the late seventeenth century, and of shedding light on the speed of arbitrage when it occurred. The dataset also allows us to investigate how warfare and local market conditions affected the degree of arbitrage effectiveness.

4.3 Historical background

This chapter uses a new set of exchange rates to analyse the integration of exchange markets in the 1670s. The economic and political events of the time would have had an impact on the movement of exchange rates. The seventeenth century is characterised by chronic warfare, political turbulence and the Dutch hegemony in finance and trade. This section focuses on two events, one political and one financial: (1) the Franco-Dutch War of 1672-8, which led to a financial and banking crisis over Europe; and (2) the Stop of Exchequer of 1672 in England, due to the pressing financial situation of the Crown on the eve of the third Anglo-Dutch War. These two events, to different degrees, had an impact on exchange markets. How effectively merchants reacted to these incidents can be revealed from analysing the movement of exchange rates.

[274] See Chapter 1.

4.3.1 The Franco-Dutch War, 1672-8

The disruptive effects of warfare on market performance and arbitrage effectiveness – falling exchange rates caused by the need to finance the war, the increasing volatility of share prices and impeding adjustment, have been noted in the literature.[275] The period covered in the following analysis coincides with that of the Franco-Dutch War (1672-8) and includes the third Anglo-Dutch War (1672-4). At one point, the presence of French troops outside Amsterdam provoked a run on capital and widespread panic in the city. The prolonged conflict along the Rhine area and the Spanish Netherlands severely disrupted trade and created bankruptcies in northern Europe. The course of the war, as the international background against which exchange market integration is studied, is described below.

As one way of curbing the Dutch expansion in commerce and shipping, the Franco-Dutch War also served to avenge the betrayal by the Dutch in 1668 which formed a triple alliance with England and Sweden and thwarted Louis XIV's ambitions in the Spanish Netherlands during the War of Devolution. Drawing upon skilful diplomacy and generous subsidies, Louis dismantled the fragile Triple Alliance and gained the support of Charles II of England for a joint attack on the Dutch Republic by sea, which formed the third Anglo-Dutch War.[276] However, after several failed attempts to block the Dutch coastline and increasing demands in Parliament for peace, England withdrew and arranged a separate cessation of hostilities with the Dutch in early 1674.[277] The skirmishes and intermittent conflicts between France and the Republic and its German allies continued until the Peace of Nijmegen in 1678.

Two weeks after an English act of aggression, Louis XIV announced war against Dutch on 6 April. The French bypassed Maastricht and reached the heart of the

[275] Quinn, 'Gold, silver, and the Glorious Revolution'; Neal, *The Rise of Financial Capitalism*; and Schubert, 'Arbitrage'.
[276] J. A. Lynn, *The Wars of Louis XIV, 1667-1714* (Longman, 1999), pp. 105-12. In the early months of 1672, the possibility that England would be at war with Dutch Republic had already been mooted by merchants in Amsterdam and Hamburg. H. Roseveare, *Markets and Merchants of the Late Seventeenth Century: The Marescoe-David Letters, 1668-1680* (Oxford, 1987), Letter 181 and 183.
[277] C. J. Ekberg, *The Failure of Louis XIV's Dutch War* (The University of North Carolina Press, 1979), pp. 151-71; C. R. Boxer, 'Some second thoughts on the third Anglo-Dutch War, 1672-1674', *Transactions of the Royal Historical Society*, 19 (1969), pp. 67-94; K. H. D. Haley, *William of Orange and the English Opposition, 1672-4*, (Oxford, 1953).

Dutch Republic in the summer of 1672. They crossed the Rhine and captured Deventer in mid-June. On 20 June, Muiden, which was approximately 6 miles away from Amsterdam, was taken by the French, though the Dutch retook it the next day. To prevent the French from reaching Amsterdam, the Dutch broke the sluices to flood the land, which frustrated further incursions by the French and thus diverted the French to the Rhine area in the second half of 1672.

The surrender of Utrecht and the rapid advance of the French towards Amsterdam caused a wave of panic over the coastal cities. Faced with this daunting military situation, Johan de Witt, the political leader of the Republic, and his brother were lynched by a mob of angry people in August. People withdrew their deposits from banks and moved their financial assets to safe places, such as Antwerp and Venice. The runs on the bank resulted in the collapse of the Banks of Rotterdam and Middelburg, but the Bank of Amsterdam withstood the panic.[278] The exchange rates of Dutch gulden in other European cities immediately depreciated and the premium on bills with Antwerp broadened to 15 per cent.[279]

The Dutch withstood the French attack in 1672 and from this point the conflicts were diverted to the neighbouring areas – the Spanish Netherlands and the Rhineland.[280] For Amsterdam, the crisis was short-lived but intermittent conflicts blocked the trade routes and increased the risk of commercial ventures. The uncertainty of this period such as confused exchange rates and delays in business decision making through the fear of war, added to the speculation on commodities in the expectation of war, to a great degree interrupted international trade, as the commercial correspondence of the period demonstrates.[281]

4.3.2 The Stop of Exchequer, 1672

North and Weingast argue that the English government's commitment to property rights became more credible after the change in political institutions of 1688 and the

[278] 't Hart et al., *Financial History of Amsterdam*, p. 50; Dillen, 'The Bank of Amsterdam', pp. 91-2, 96. Due to a large and imminent withdrawal of Dutch funds, the Bank of Hamburg closed for nearly a year (May 1672 - April 1673). Sieveking, 'Die Hamburger Bank', p. 134.
[279] Roseveare, *Markets and Merchants*, p. 611; V. Barbour, *Capitalism in Amsterdam in the Seventeenth Century* (Baltimore, 1950), pp. 57-8.
[280] Lynn, *Wars of Louis XIV*, pp. 113-59; Ekberg, *Failure of Louis XIV's Dutch War*.
[281] Roseveare, *Markets and Merchants*, Letter 388, 390, 394, 395, 398, 410, 412.

cost of raising money from the market was thus largely reduced. In their view, the later British hegemony can be attributed to this political and constitutional development.[282] Before 1688, Stuart monarchs could, more or less, arbitrarily alter the terms of loans and unilaterally renege on contracts, a priori most blatantly manifested in the Stop of Exchequer of 1672.[283] The Stop resulted in credit contraction and a run on banks in London. Even as a domestic event, it sheds light on the connection between English domestic and international capital markets and the involvement of English goldsmiths in the international money market if one explores its impact on the exchange market.

In order to alleviate the Crown's long-standing fiscal problem, Treasury Orders were issued in anticipation of revenue. These orders were numbered, registered and assignable.[284] The system had been created to make royal borrowing more responsible and encourage lenders. However, the combination of the second Anglo-Dutch War, the plague of 1665 and the fire of 1666 delivered a severe blow to the royal revenue and damaged the government's financial situation in the late 1660s.[285] It became worse after Charles secretly committed himself to join Louis XIV in an attack on the Dutch.[286] Under the pressing demand for money to restore the Navy in anticipation of war, the issue of orders went out of control and exceeded the revenue assigned to it. The Stop of Exchequer was an unavoidable solution to Charles's embarrassing fiscal position and a reminder that the monarch was able to default at will on his obligations.

On 2 January 1672, the government decided to suspend for a year repayments and interest on registered Treasury orders, except for those paid for public services

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[282] D. C. North and B. R. Weingast, 'Constitutions and commitment: the evolution of institutions governing public choice in seventeenth-century England', *Journal of Economic History*, 49 (1989), pp. 803-32.
[283] B. G. Carruthers, 'Politics, popery, and property: a comment on North and Weingast', *Journal of Economic History*, 50 (1990), pp. 693-8; J. K. Horsefield, 'The "Stop of the Exchequer" revisited', *Economic History Review*, 35 (1982), pp. 511-28.
[284] Horsefield, 'The "Stop of the Exchequer"', p. 511; Carruthers, *City of Capital*, pp. 60-1; Feavearyear, *Pound Sterling*, pp. 111-3.
[285] C. D. Chandaman, *The English Public Revenue, 1660-1688* (Oxford, 1975), pp. 210-3; W. R. Scott, *The Constitution and Finance of English, Scottish and Irish Joint-Stock Companies to 1720* (Cambridge, 1921), Vol. 1, pp. 276-9; Feavearyear, *Pound Sterling*, p.112; D. C. Coleman, *Sir John Banks, Baronet and Businessman: A Study of Business, Politics and Society in Later Stuart England* (Oxford, 1963), p. 31; A. Browning and Douglas, D. C., *English Historical Documents, 1660-1714* (London, 1953), pp. 350-1; 831-2.
[286] Browning and Douglas, *Documents*, pp. 863-7.

and those secured on certain resources. The Stop was initially meant to be a temporary device to alleviate fiscal difficulties and divert money to urgent military uses. However, after further extensions in the next two years, with Charles II still in financial mire, the Stop became permanent.[287]

The goldsmiths of London, as the main subscribers to the orders, who lent money to the monarch on the security of the orders, suffered the most.[288] However, the money lent to the Crown did not belong to the goldsmiths, but represented deposits received from numerous clients. Probably in the mid-seventeenth century merchants and landowners started to deposit money with the goldsmiths, who sometimes paid interest on it. Those with money were reluctant to lend to the Crown, but preferred to put money into the goldsmiths' safekeeping.[289] The goldsmiths then lent out these deposits to the Crown, who offered an interest rate higher than the legal limit at the time (6 per cent). Therefore, when the Crown stopped honouring its obligations, not only did the goldsmiths suffer, but also those depositing money with the goldsmiths. The Stop of Exchequer thus caused the disruption of mercantile credit, an immediate liquidity crisis in London, and a high demand to withdraw deposits from goldsmiths. Several eminent goldsmiths went bankrupt in the 1680s: Colville by 1679, Backwell by 1682, Vyner by 1684 and Meynells in 1685 and no doubt the Stop played a part in their ruin.[290]

Not until 1674 when the conflict with the Dutch ended, was a solution worked out to settle these outstanding debts. The Treasury decided to pay interest at 6 per cent on the debts outstanding by June 1674, though not repaying back the principal. Even so, the goldsmiths continued to appeal for further compensation for their financial loss and brought the case to court. The dispute between the Treasury and the bankers over the settlement of their debts did not conclude until an Act was

[287] Horsefield, 'The "Stop of the Exchequer"', pp. 513-4.
[288] According to the Treasury's book in 1677, when the government tried to settle the debts left by the Stop of Exchequer, approximately 90% of the outstanding debts belonged to the goldsmiths, including Robert Viner, Edward Backwell, Gilbert Whitechall, Jeremiah Snow and so on. Browning and Douglas, *Documents*, p. 354; Horsefield, 'The "Stop of the Exchequer"', pp. 514-6; Carruthers, *City of Capital*, pp. 61-9.
[289] For the development of goldsmith-bankers in seventeenth-century England, see F. T. Melton, *Sir Robert Clayton and the Origins of English Deposit Banking, 1658-1685* (Cambridge, 1986), pp. 16-39; S. Quinn, 'Goldsmith-banking: mutual acceptance and interbanker clearing in Restoration London', *Explorations in Economic History*, 34 (1997), pp. 411-432.
[290] Horsefield, 'The "Stop of the Exchequer"', p. 524.

passed in 1701 which required the government to pay the interest at 3 per cent per annum on the total debts involved.[291]

4.4 The econometric model and data

The analysis of the effectiveness of arbitrage is based on the law of one price. Arbitrage works to close the gap between the price differential and transaction cost, if a profitable opportunity exists, i.e., if the price difference exceeds the cost of arbitrage. As a result, the violation of the law of one price will be transitory. The more integrated the markets are, the more quickly the gap is closed by arbitrage. The speed of adjustment to a profitable opportunity can be regarded as a proxy measuring the degree of arbitrage effectiveness and market integration. The econometric model employed here to analyse the late seventeenth-century exchange markets is a threshold error correction model. The TEC model is discussed in detail above in Chapter 1 and only a specific model for the triangular arbitrage between London, Amsterdam and Hamburg is briefly described here. In addition, the sources of the exchange rates used here and the construction of two series of cross-exchange rates (Hamburg-Amsterdam-London and Amsterdam-Hamburg-London) are addressed in this section.

4.4.1 A two-regime TEC model

When merchants use bills of exchange to transfer funds from one place to another, they can choose either direct-exchange or cross-exchange via a third place. Which exchange they use depends on exchange rates and transaction costs. Transaction costs include, in addition to the brokerage and post fee for the second bill, the interest forgone in a longer transaction and the extra risk arise from conducting the transaction in a third place. Hence, the transaction costs involved in cross-exchange are clearly greater than those associated with direct-exchange. For the following analysis, let E^{HL}, E^{HA}, E^{AL}, E^{AH} be the Hamburg-London, Hamburg-Amsterdam, Amsterdam-London and Amsterdam-Hamburg direct exchange rates and E^{HAL},E^{AHL}

[291] Ibid., pp. 514-23.

the cross-exchange rates of Hamburg-Amsterdam-London and Amsterdam-Hamburg-London, respectively. Because the pound sterling was quoted at certain, against the variable number of foreign currency, the higher the exchange rate was, the more expensive it was to remit £1 sterling to London and vice versa.

According to Equations (1.6.A) and (1.6.B), the triangular exchange arbitrage between London, Amsterdam and Hamburg can be written as follows:

$$\Delta E_t^{HL} = \begin{cases} \alpha_1(E_{t-1}^{HL} - E_{t-1}^{HAL} - C^{HAL}) + \varepsilon_t^1 & if\ E_{t-1}^{HL} - E_{t-1}^{HAL} > C^{HAL} \\ \varepsilon_t^1 & if\ E_{t-1}^{HL} - E_{t-1}^{HAL} \leq C^{HAL} \end{cases} \quad (4.1.A)$$

$$\Delta E_t^{HAL} = \begin{cases} \alpha_2(E_{t-1}^{HL} - E_{t-1}^{HAL} - C^{HAL}) + \varepsilon_t^2 & if\ E_{t-1}^{HL} - E_{t-1}^{HAL} > C^{HAL} \\ \varepsilon_t^2 & if\ E_{t-1}^{HL} - E_{t-1}^{HAL} \leq C^{HAL} \end{cases} \quad (4.1.B)$$

$$\Delta E_t^{AL} = \begin{cases} \alpha_3(E_{t-1}^{AL} - E_{t-1}^{AHL} - C^{AHL}) + \varepsilon_t^3 & if\ E_{t-1}^{AL} - E_{t-1}^{AHL} > C^{AHL} \\ \varepsilon_t^3 & if\ E_{t-1}^{AL} - E_{t-1}^{AHL} \leq C^{AHL} \end{cases} \quad (4.2.A)$$

$$\Delta E_t^{AHL} = \begin{cases} \alpha_4(E_{t-1}^{AL} - E_{t-1}^{AHL} - C^{AHL}) + \varepsilon_t^4 & if\ E_{t-1}^{AL} - E_{t-1}^{AHL} > C^{AHL} \\ \varepsilon_t^4 & if\ E_{t-1}^{AL} - E_{t-1}^{AHL} \leq C^{AHL} \end{cases} \quad (4.2.B)$$

where $(\varepsilon_t^1, \varepsilon_t^2, \varepsilon_t^3, \varepsilon_t^4) \sim Nid(0, \Omega)$. The differences of exchange rates ($E^{HL} - E^{HAL}$,ΔE_t^{HL}, ΔE_t^{HAL}, $E^{AL} - E^{AHL}$,ΔE_t^{AL}, ΔE_t^{AHL}) are assumed to be stationary processes. The parameters of $C^{HAL}, C^{AHL} > 0$ are the estimated transaction cost (the threshold triggering arbitrage). The parameters $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$ measure the speed of adjustment in exchange markets in respect to direct- and cross-exchange and their absolute value is expected to lie between 0 and 1. When the differential between direct- and cross-exchange rates (arbitrage gain) exceeds the trading cost associated with cross-exchange, arbitrage will be triggered to bring the difference between two exchange rates below transaction cost. Therefore, $\alpha_1, \alpha_3 < 0$ and $\alpha_2, \alpha_4 > 0$. The multitude of adjustment parameters indicates the speed of adjustment; therefore, a high value of $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$ means a rapid adjustment and integrated markets. Otherwise, the movement of exchange rates would follow a random walk.

In order to compare the degree to which arbitrage is carried out, the values of $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$ are transformed to the speed of adjustment in terms of half-life time by rearranging expressions (4.1.A), (4.1.B), (4.2.A) and (4.2.B) as follows:[292]

$$e_t^{HL} = \rho_1 e_t^{HL} + \mu_1 + \varepsilon_t^1, where\ \rho_1 = 1 + \alpha_1 \quad (4.1.a)$$

$$e_t^{HAL} = \rho_2 e_t^{HAL} + \mu_2 + \varepsilon_t^2, where\ \rho_2 = 1 - \alpha_2 \quad (4.1.b)$$

$$e_t^{AL} = \rho_3 e_t^{AL} + \mu_3 + \varepsilon_t^3, where\ \rho_3 = 1 + \alpha_3 \quad (4.2.a)$$

$$e_t^{AHL} = \rho_1 e_t^{AHL} + \mu_4 + \varepsilon_t^4, where\ \rho_4 = 1 - \alpha_4 \quad (4.2.b)$$

The implicit half-life time can be calculated as $Time_{1/2} = \frac{\ln(0.5)}{\ln(\rho)}$. A half-life indicates the time required to reduce the impact of shock to half of its original size.

4.4.2 The sources of exchange rates

To assess the integration of the exchange market, the first step is to construct a series of exchange rates and to form pair-cities for arbitrage in order to estimate the speed of adjustment and transaction cost. As mentioned, exchange rates in major trading cities in the seventeenth century were regularly published in price currents. These price currents are an important source of the rate of exchange. However, the surviving price currents are too fragmentary to compose a continuous series of seventeenth-century exchange rates.[293] Therefore, any analysis of exchange arbitrage in the seventeenth century has to rely on mercantile documents. As discussed in previous chapters, mediaeval merchants involved in long-distance trade, out of courtesy and to transmit information, adopted the custom of citing at the end of their correspondence the current exchange rates against important trading cities. Seventeenth-century merchants still followed this custom. As a result, information

[292] When arbitrage gets under way, expression (4.1.A) is equal to $\Delta E_t^{HL} = \alpha_1(E_{t-1}^{HL} - E_{t-1}^{HAL} - c^{HAL}) + \varepsilon_t^1$ and can be rewritten as
$E_t^{HL} - E_{t-1}^{HL} = \alpha_1 E_{t-1}^{HL} + \mu_1 + \varepsilon_t^1, where\ \mu_1 = \alpha_1(E_{t-1}^{HAL} - c^{HAL})$
$E_t^{HL} = (1 + \alpha_1)E_{t-1}^{HL} + \mu_1 + \varepsilon_t^1$
Likewise, expression (4.1.B), (4.2.A) and (4.2.B) can be rewritten according to the same procedure.
[293] McCusker and Gravesteijn, *Commercial and Financial Journalism*, pp. 43-83; P. Boorsma and J. van Genabeek, *Commercial and Financial Serial Publications of the Netherlands Economic History Archives*, (Amsterdam, 1991).

about the course of exchange rates was preserved in commercial letters. With the help of merchants' correspondence, supplemented by surviving price currents, a relatively continuous series of weekly exchange rates between Amsterdam, Hamburg and London from 1668 to 1680 can be constructed.

A large proportion of the exchange rates used here come from the Marescoe-David correspondence with their firm's agents in Europe. Charles Marescoe was a Lille-born merchant living in London, whose business mainly focused on the importation of pitch, tar, iron and copper from Sweden; he also acted as a commission agent on behalf of many European principals to purchase various English goods for exportation. After his death in 1670, his widow, Leonora Marescoe, continued her late husband's trading business, joining with a new partner, Jacob David, who had worked as a clerk for Charles Marescoe since 1668.[294]

Due to the dispute about the inheritance of Charles Marescoe, his son-in-law, Thomas Frederick (the husband of Charles Marescoe's eldest daughter), launched a lawsuit against Jacob David. Because of it, the mercantile documents of Charles Marescoe and Jacob David were ordered to be submitted to the court of Chancery and thus are preserved.[295] The Marescoe-David papers include up a variety of items: journals and ledgers (1664-80), various account books, including cash books, expenses books, receipt books and invoice books; more than ten thousand letters written between 1668 and 1680 and received from clients and agents abroad; and a huge number of miscellaneous documents.[296]

The Marescoe-David letters are a rich source of information about the course of exchange rates between London and other major European trading cities spanning the period 1668 to 1680. Numerous exchange rates are quoted in the letters, between London, Amsterdam, Paris, Rouen, Venice, Antwerp, Rotterdam and other cities.[297] Considering the completeness and continuity of the exchange rates series,

[294] Leonora Marescoe and Jacob David married in October 1675. Roseveare, *Markets and Merchants*, p.4.
[295] The original Marescoe-David papers are kept in the Public Record Office in London (the National Archives) under the title of 'Frederick *versus* David' (reference number: C114/63-78).
[296] Roseveare, *Markets and Merchants*, pp. 10-16.
[297] Besides presenting the content of 500 selective Marescoe-David letters, in the appendix of his *Markets and Merchants*, Roseveare tabulates the highest and lowest exchange rates within a week from 1668 to 1680 for several major trading cities, e.g. London, Hamburg, Amsterdam, Antwerp, Paris, Rouen and Venice. Roseveare, *Markets and Merchants*, pp. 592-630.

the following analysis of arbitrage focuses on the exchange markets of Amsterdam, Hamburg and London. Approximately 3,100 quotations of exchange rates between these places are extracted from the Marescoe-David letters.

In addition to these letters, the correspondence of William Attwood, a London merchant, with his agents in Hamburg and the United Provinces also provides some quotations of exchange rates between London and some European cities, e.g. Hamburg, Dordrecht, Rotterdam and Livorno, in the years 1655-82.[298] These exchange rates quoted in commercial correspondence supplementing those listed on price currents make up the dataset of exchange rates which is used to estimate the effectiveness and efficiency of arbitrage in the second half of the seventeenth century in northwest Europe's exchange markets.[299]

4.4.3 Representativeness

Most of the exchange rates are extracted from the Marescoe-David commercial letters. How reliable are these exchange rates, recorded in the correspondence of a couple of merchants? How well can they be regarded as market prices? One way to examine the representativeness of these quotations is to compare them with those which appeared on price currents, which are taken as market prices. Though fragmentary, a few price currents issued in Amsterdam and Hamburg in the 1670s are fortunately preserved.[300] Since price currents were issued once a week, the exchange rates quoted in the letters written within 4 day before and after (excluding) the date of issue of the price currents are used to calculate the percentage of deviations.[301] It implies that (1) price currents consolidated the

[298] Attwood's papers are kept in the National Archives under the title of Attwood v. Ware (reference number: C109/19-24).
[299] The whole exchange rate dataset is presented in Appendix 4.A.
[300] Many of the surviving price currents issued in Amsterdam are now held by Nederlandsch Economisch-Historisch Archief (NEHA), Amsterdam (reference number: Bijzondere Collecties 674). McCusker and Gravesteijn, *Commercial and Financial Journalism*, pp. 59, 228; Boorsma and Genabeek, *Financial Serial Publications*, pp. 4, 12. Besides those kept in Amsterdam, a few price currents issued in Amsterdam and Hamburg survive among the Marescoe-David letters in the National Archives. Roseveare, *Markets and Merchants*, Appendix H.
[301] As an example, on 20 April, 1671, the Amsterdam-London exchange rate at double usance was listed at 35 schelling-Vlaamsch and 9 groots for £1 sterling. From 16 April to 24 April (4 days before and after 20 April), there are 5 quotations of exchange rates ranging between 35s 8-8 1/2d and 35s 9-10d per £1 sterling found in the Marescoe-David correspondence (see Appendix 4.A). Therefore, the

prevalent exchange rates within 4 days before their publication and (2) when reporting current exchange rates, merchants were inclined to quote those on price currents within 4 days around their publication. The two assumptions are not unreasonable in that price currents acted as an indication of the general market situation.

The result of the comparison is given in Table 4.1. The average deviation, in absolute terms, of the exchange rates quoted in commercial letters from those listed on price currents ranges from 0.09-0.27 per cent. The differential is, if not small, quite modest. Although deviations as large as 1.55 per cent are observed (the Amsterdam-Hamburg exchange rate on 11 February, 1669), most of the deviations are well below a half of one per cent. Moreover, instead of consistently rating higher/lower, the exchange rates quoted in the correspondence fluctuated up and down the range of those listed on price. Hence, there was no structural difference between these two exchange rates which would mean that the exchange rates quoted in the correspondence did not persistently overrate/underrate those on price currents.

To sum up, according to Table 4.1, the exchange rates quoted in the merchants' letters were largely consistent with those listed on price currents. The occasional wide deviations may be due to typographic error or the rapid change of exchange rates over a very short period. It seems reasonable to regard the exchange rates quoted in commercial letters as market prices, even though wide deviations very occasionally occurred.

Table 4.1 The deviation of exchange rates quoted in correspondence from those quoted in price currents (%), 1668-79

	Amsterdam-London	Amsterdam-Hamburg
1668-05-28	0.00/0.72	-0.10/0.09
1668-07-23	0.00/0.24	0.00/0.19
1668-10-01	0.24/0.48	0.19
1669-01-21	-0.35/0.12	-0.19
1669-02-11	-0.06/0.12	1.36/1.55

deviation of quoted exchange rates from those on price currents is calculated at within the range of -0.17%-0.12%.

1669-02-18	0.00/0.06	-0.10/0.10
1669-02-25	0.06/0.12	0.10
1669-03-25	-0.24/-0.12	0.00
1669-04-15	-0.24/0.06	-0.10/0.00
1669-04-29	-0.12/0.24	-0.10
1669-05-27	0.06/0.12	-0.29/0.10
1669-06-03	-0.12/0.00	0.00
1669-06-17	-0.18/0.00	0.00
1669-09-09	0.12/0.24	-0.19
1669-09-16	0.00/0.06	0.10
1669-09-30	-0.35/0.12	-
1669-10-07	-0.24/-0.12	-0.29/-0.19
1669-10-14	-0.36/-0.12	-0.10/0.10
1669-10-21	-0.24	-0.10
1669-10-28	0.00/0.24	0.00
1669-11-04	-0.06/0.12	0.00/0.09
1669-11-11	0.00/0.18	0.00
1669-11-18	0.18	-
1669-11-25	0.00	0.19
1670-01-06	0.00/0.12	0.60
1670-01-28	0.24/0.36	0.99
1670-02-21	0.24	0.00
1671-04-20	-0.17/0.12	-0.09/0.00
1671-05-04	-0.12	0.00
1671-05-11	0.12/0.41	-0.19
1672-02-08	0.00/0.23	-0.19
1672-03-14	0.06	-0.17
1672-05-09	0.35	-
1677-02-01	0.12	-0.19/0.93
1677-04-12	0.00	-1.39/1.21
1679-02-20	-0.12	-
1679-12-18	0.11	-
Average of the absolute term	0.15	0.27

	Hamburg-London	Hamburg-Amsterdam
1668-04-24	-0.12/0.49	0.09/0.28
1668-05-15	-0.25/0.12	-0.10/0.00
1676-12-12	0.00	0.00
Average of the absolute term	0.20	0.09

Note: 1. The dates shown in the first column are the dates of the issue of price currents.

2. The range of deviation is given. But in some instances, only one exchange rate was quoted around the date of the issue of price currents, then the deviation is calculated on this rate.

4.4.4 Construction of cross-exchange rates

The weekly exchange rate is taken as the average of all quotations within a week, likewise the monthly exchange rates. The dataset allows us to construct four series of weekly exchange rates spanning the period January 1668 to March 1680: for Amsterdam-London (which is the exchange rate of a bill issued in Amsterdam and drawn on London), Amsterdam-Hamburg, Hamburg-London and Hamburg-London.[302] The numerical figures are shown in Appendix 4.B and the series are presented in graphic form in Graphs 4.1-4.4.

The pound sterling was quoted differently in Amsterdam and Hamburg. In Amsterdam, the exchange rate on London was quoted at double usance at a variable number of schelling- and groot-Vlaamsch (in bank money) per £1 sterling. As discussed in previous chapters, 'at sight' meant that a bill of exchange was payable on the same day or no later than 1-2 days after the bill being presented and accepted. The 'usance' is the length of time allowed for payment to be made after accepting the bill and it was not the same everywhere. Since the late Middle Ages, the usance between London and the Low Countries had been one month.[303] The Anglo-Netherlands exchange rates quoted in correspondence, if not specified, referred to the usance rate. Sometime in the seventeenth century, probably in the second quarter, most quotations changed from usance to double usance (Illustration 3). At the same time, price currents started to list the exchange rates quoted in both two terms.[304]

As a commercial and financial centre of northern Europe, Amsterdam was awash with a great variety of gold and silver coins, both domestic and foreign. The confusion of circulating coins was compounded by the repeated debasements

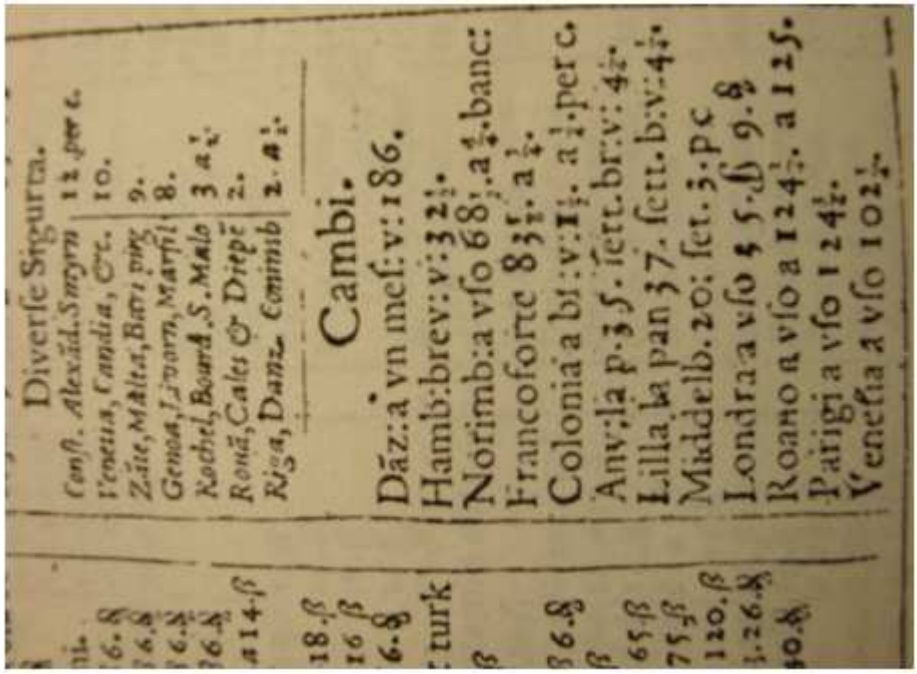
[302] The four series of weekly exchange rates are reported in Appendix 4.B.
[303] de Roover, *Money, Banking and Credit*, p. 60; idem, *Gresham on Foreign Exchange*, pp. 109-14.
[304] McCusker and Hart argue that after 1612 exchange rates between London and the Low Countries were predominately quoted at double usance, but this change occurred only in England; there was no 'equivalent change at Amsterdam'. This view is supported by the exchange rates quoted by Posthumus. Indeed, comparing the quotations in John Quarles's letters (1593-1600) with those in George Warner's papers (1637-43), it is clear that the quotations of the London-Netherlands exchange rates moved from usance to double usance in the first half of the seventeenth century. Furthermore, price currents started to list the exchange rates quoted both at usance and double usance from the 1630s onwards. J. J. McCusker and S. Hart, 'The rise of exchange on Amsterdam in London: 1590-1660', *Journal of European Economic History*, 8 (1979), pp. 694-5. The John Quarles (SP 46/176) and George Warner papers (SP 46/84) are kept in the National Archives.

experienced in the late sixteenth and early seventeenth centuries. The Bank of Amsterdam was found in 1609 to solve the chaotic monetary problem.[305] All bills of exchange valued at or over 600 guldens had to be settled through the Bank.[306] The silver gulden of 20 stuivers (1 stuiver=2 groots) was used by the Bank of Amsterdam as a unit of account for the value of coins and financial obligations.[307] At the time, two moneys of account were commonly in use in Amsterdam. One was based on the relationship of £1 equalling to 20 shilling-Vlaamsch and 1 shilling-Vlaamsch equalling 12 groot-Vlaamsch. As the gulden of 20 stuivers was used as the unit of account from the late sixteenth century onwards, the second monetary system based on the Flemish pound, gulden and stuiver emerged: £1=6 guldens=120 stuivers. Because 1 stuiver was also equivalent to 2 groot-Vlaamsch, the two moneys of account came to be used interchangeably in Amsterdam.[308]

The exchange rate between Amsterdam and Hamburg (no matter where quoted) was quoted as payable at sight at a variable number of stuives *banco* per Hamburg wechseltaler of 32 schillings-Lübeck, which was a unit of account.[309] The Bank of Hamburg was established in 1619 as an imitation of the Bank of Amsterdam and required all foreign exchanges to go through the bank and exchange rates quoted in bank money. At first, reichstaler and taler were real coins in circulation but they later developed into units of account for bank money. A reichstaler was equivalent to 1.5 taler and one taler was valued at of 32 schillings-Lübeck. Two moneys of account were used side by side in Hamburg. One was based on 1 mark equivalent to 16 schilling-Lübeck, which was equal to 12 pfennig. The other had its origin in Flanders: 1 pfund equal to 20 schilling-Flemish and 1 schilling Flemish to 12 groot-Flemish. Meanwhile, these two moneys of account can be linked by the

[305] Van Dillen, 'The Bank of Amsterdam', pp. 79-123; 't Hart et al, *Financial History of Amsterdam*, pp. 38-40; Quinn and Roberds, 'The big problem of large bills'; idem, 'Early bank of Amsterdam'.
[306] Since 1643, the minimum requirement was reduced to 300 guldens. 't Hart et al, *Financial History of Amsterdam*, p. 46.
[307] The silver gulden of 20 stuivers was first minted in 1543. The several debasements of stuiver in the second half of the sixteenth century gradually drove the silver gulden out of circulation. However, the relation between 1 silver gulden and 20 stuivers was preserved and the silver gulden thus became a unit of account. After the monetary reform of 1680, the United Provinces started to produce the silver gulden again.
[308] McCusker, *Money and Exchange*, pp. 42-5.
[309] The wechseltaler was the money-of-account only used in quoting exchange rates with Amsterdam. C. D. Ebeling and P. H. C. Brodhagen, *Gottfried Christian Bohns Wohlerfahrener Kaufmann* (Hamburg, 1789), pp. 12-3

relation of 6 schillings-Lübeck equivalent to 1 schilling-Flemish.[310] As in Amsterdam, the pound sterling was given certain and quoted payable at double usance at a variable number of schillings- and groot-Flemish (in bank money) for £1 sterling in Hamburg.



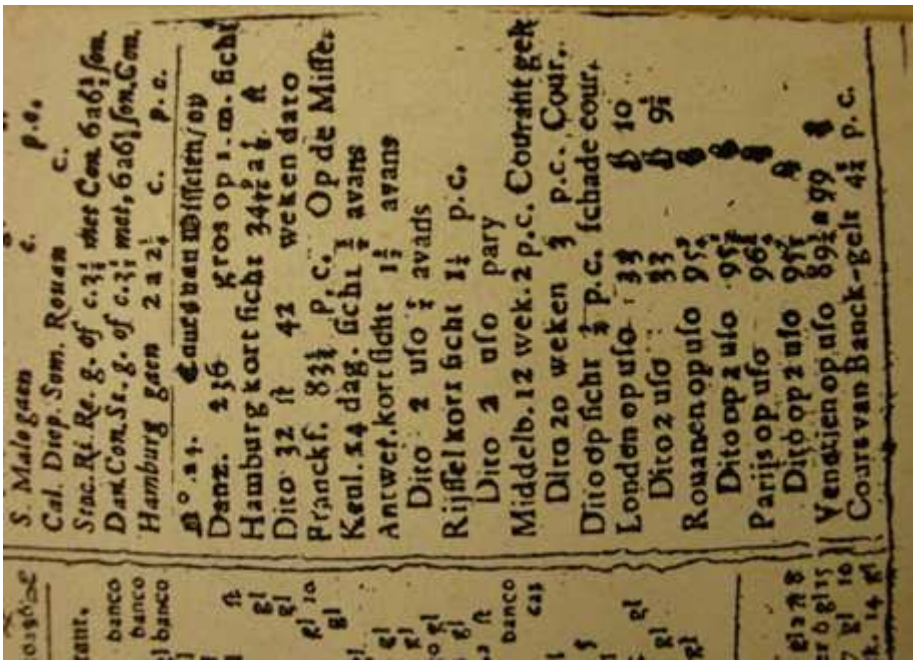
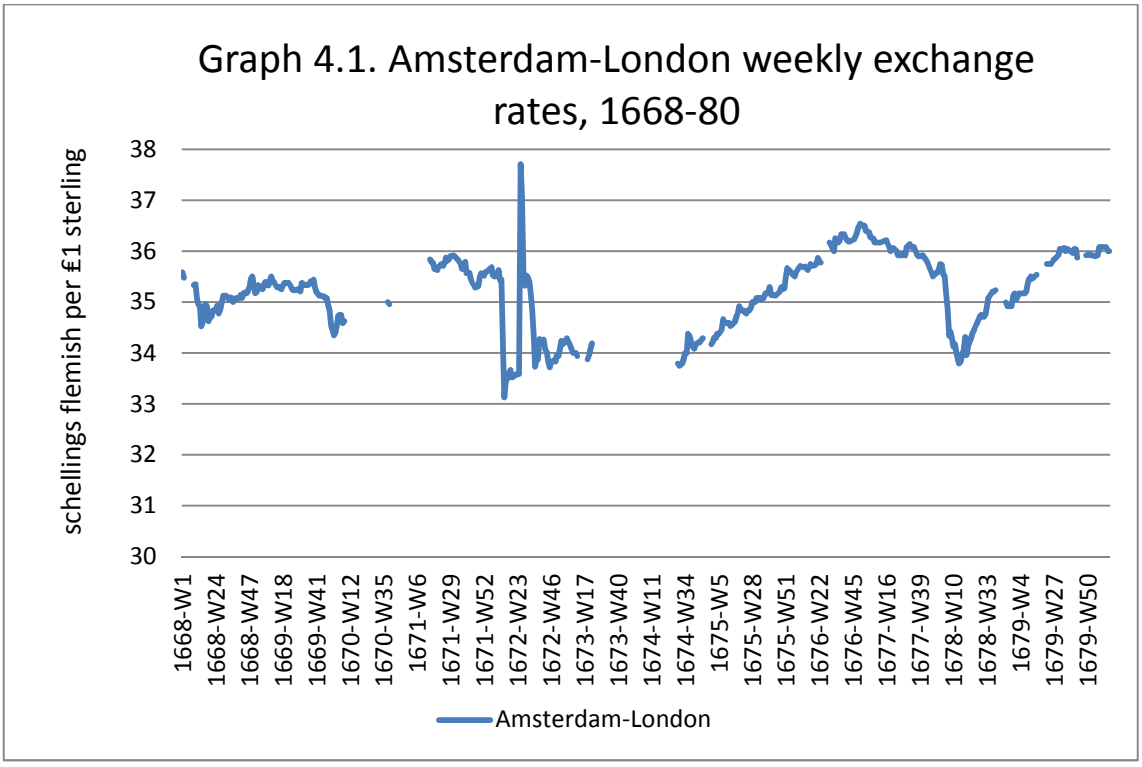
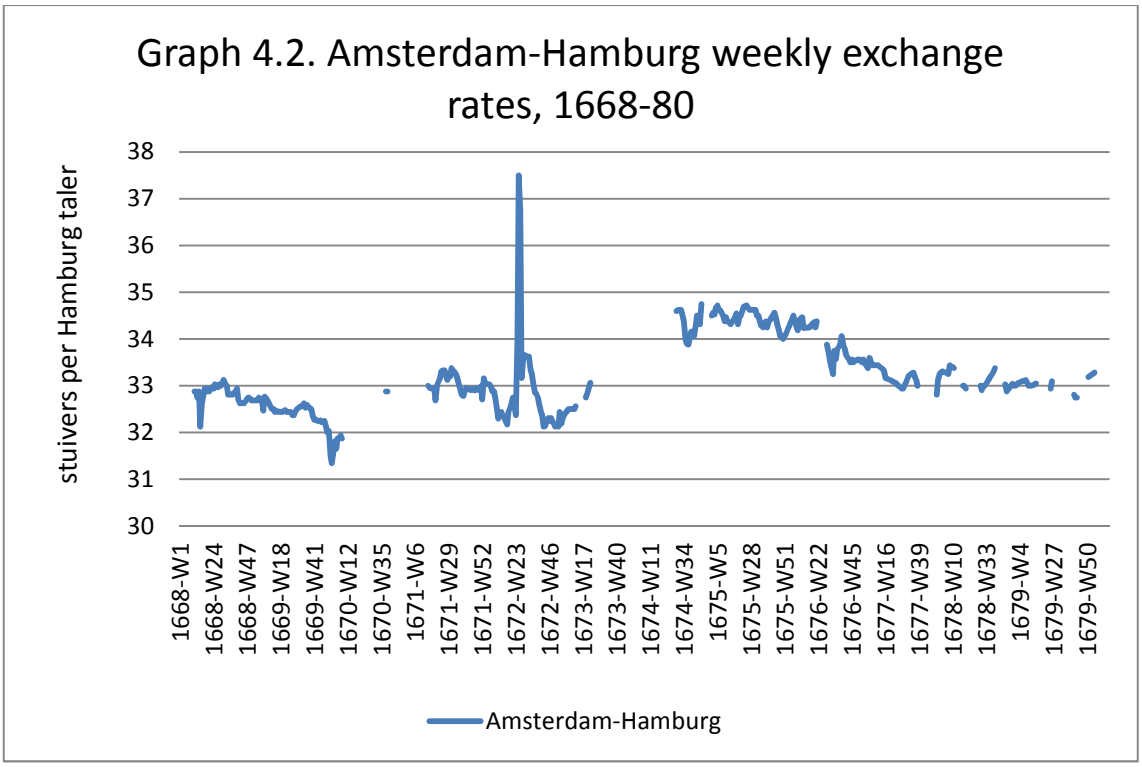


Illustration 3: Two exchange rate parts of price currents issued in Amsterdam. An Italian version of 13 August 1624 is on the left hand side, Flemish one of 16 July 1674 right hand side.

[310] McCusker, *Money and Exchange*, pp. 61-4.


Graph 4.1. Amsterdam-London weekly exchange rates, 1668-80
schellings flemish per £1 sterling
38
37
36
35
34
33
32
31
30
1668-W1
1668-W24
1668-W47
1669-W18
1669-W41
1670-W12
1670-W35
1671-W6
1671-W29
1671-W52
1672-W23
1672-W46
1673-W17
1673-W40
1674-W11
1674-W34
1675-W5
1675-W28
1675-W51
1676-W22
1676-W45
1677-W16
1677-W39
1678-W10
1678-W33
1679-W4
1679-W27
1679-W50
Amsterdam-London


Graph 4.2. Amsterdam-Hamburg weekly exchange rates, 1668-80
stuivers per Hamburg taler
38
37
36
35
34
33
32
31
30
1668-W1
1668-W24
1668-W47
1669-W18
1669-W41
1670-W12
1670-W35
1671-W6
1671-W29
1671-W52
1672-W23
1672-W46
1673-W17
1673-W40
1674-W11
1674-W34
1675-W5
1675-W28
1675-W51
1676-W22
1676-W45
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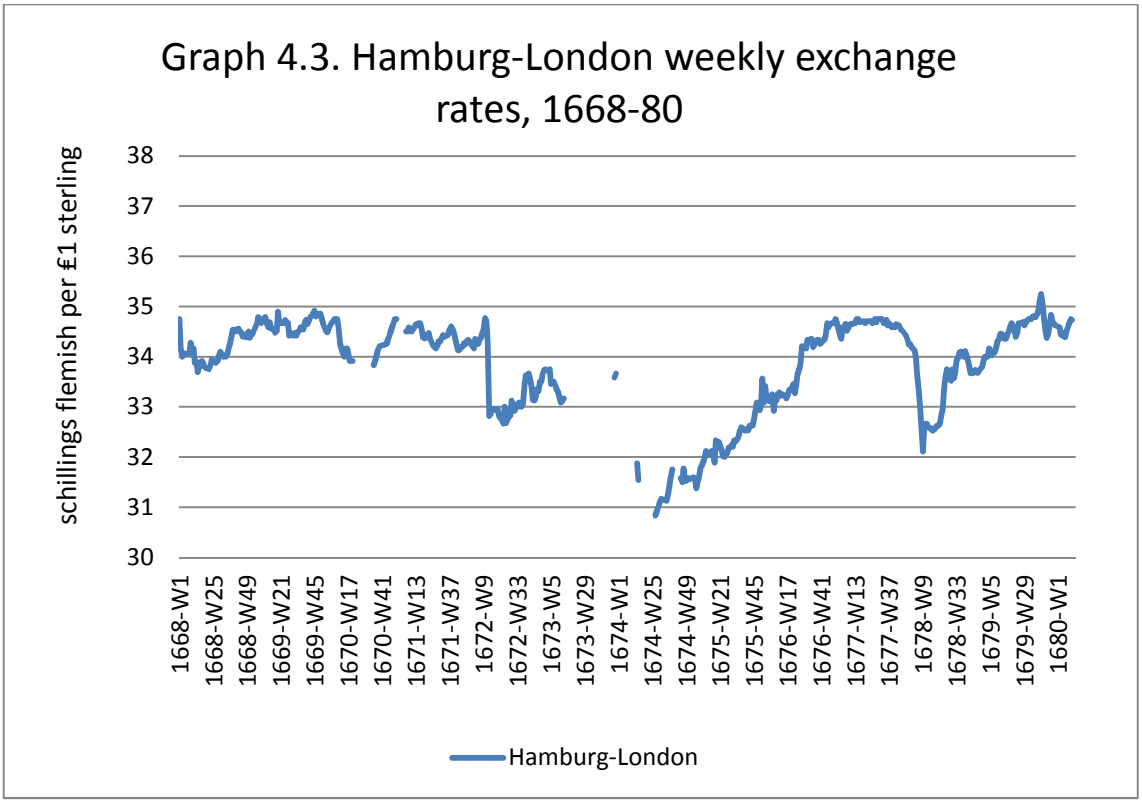
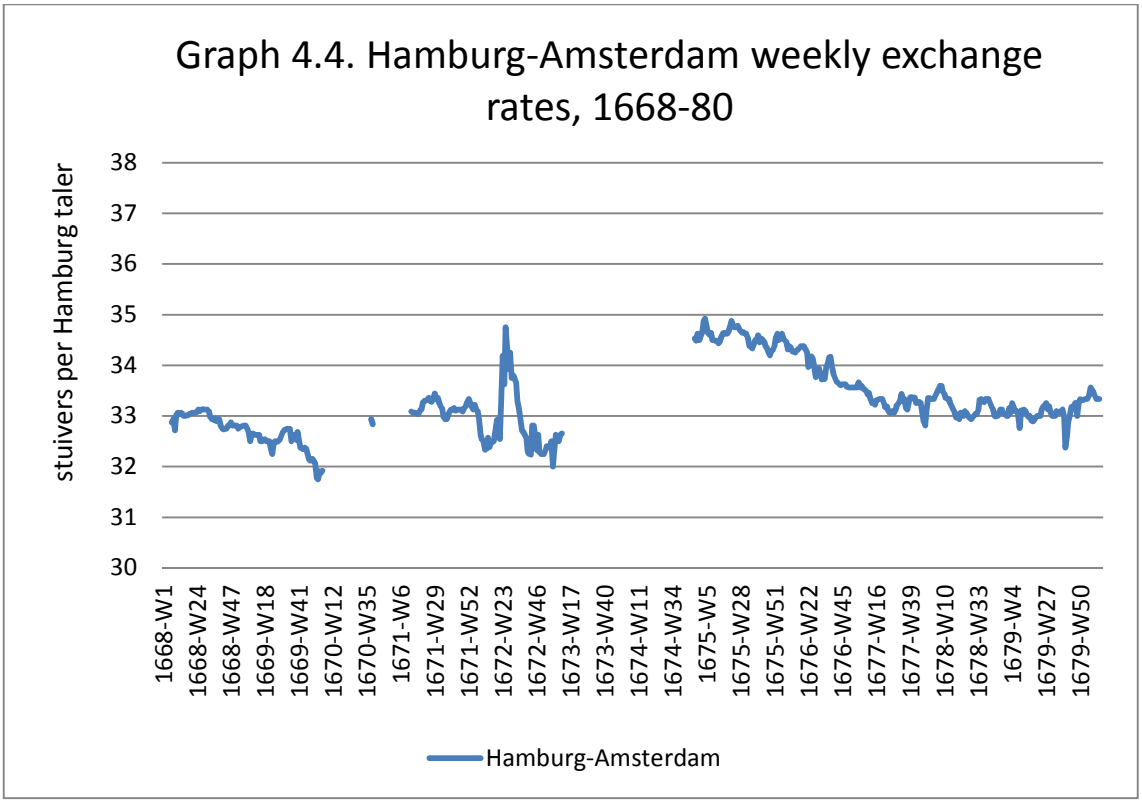
1679-W4
1679-W27
1679-W50
Amsterdam-Hamburg





Source: Graphs 4.1-4.4 see Appendices 4.A and 4.B

Graphs 4.1-4.4 show some lacunae in weekly exchange rates, mainly in two periods: one between March 1670 and April 1671 and the other between April 1673 and January 1675. So far it has been impossible to find any exchange rate available in these two periods. Owing to the discontinuity of the data, the whole dataset is divided into three sub-periods: 1668-70, 1671-3 and 1674-80 and the analysis is conducted on the three sub-periods in turn. For those irregularly missing data, as in previous chapters, two methods are employed to interpolate the missing exchange rates: linear interpolation/extrapolation is applied only to those having fewer than or equal to 4 missing items of data in a row; otherwise, the missing data are estimated by cardinal spline interpolation and polynomial extrapolation. More than 90 per cent of interpolation is estimated by linear interpolation.

The cross-exchange rates can be calculated on the basis of the direct-exchange rates. The latter tells us how much merchants had to pay in Amsterdam or Hamburg in order to obtain £1 sterling in London. The cross-exchange says that to obtain £1 sterling in London, instead of drawing a bill on London, merchants in Amsterdam (Hamburg) would draw a bill on Hamburg (Amsterdam) and from there the second bill on London was drawn. In other words, in order to remit funds to London, merchants could directly draw a bill on London or via a third place by using cross-exchange, depending on which rates were more favourable. The course of exchange rates between two places was decided by several factors: the metallic content of the two currencies, the supply and demand for one of the two currencies in each place, the balance of trade between places, the economic and political situation in each place, and so on.[311] Exchange rates fluctuated accordingly. For example, the Amsterdam-London exchange rates tended to fall around the time of the sale of the East India Company, due to a heavy demand for money in Amsterdam.[312] For merchants in Hamburg needing money to settle obligations in London, if the difference between direct- and cross-exchange rates was great enough, instead of drawing bills directly from Hamburg, they could take advantage of lower

[311] de Roover, *Gresham on Foreign Exchange*, pp. 128-61.
[312] Roseveare, *Markets and Merchants*, Letter 166 and 206. Because the quotation of Amsterdam-London exchange rate gives the pound sterling certain, a fall of exchange rates indicates a depreciation of English money but an appreciation of Dutch money. One can find a similar case in medieval Venice. At the time of sailing to the Levant, the demand for money in Venice tended to push up the exchange rate of the ducat. Mueller, *Venetian Money Market*, pp. 305-10.

Amsterdam-London exchange rates by remitting funds via Amsterdam. Merchants could profit from this temporary low exchange rate by arbitrage in the difference between the direct- and cross-exchange rates. When they did so, arbitrage operated to close the gap between two exchange rates and exploit the potential gains.

Due to the data constraint, the analysis will focus only on two cross-exchange rates: the Hamburg-Amsterdam-London and the Amsterdam-Hamburg-London exchange rates. As mentioned above, the Hamburg-Amsterdam exchange rates were quoted at a variable number of stuives banco per Hamburg taler of 32 schillings-Lübeck; furthermore, 1 schelling-Vlaamsch was equivalent to six stuivers and six schillings-Lübeck to 1 schillings-Flemish. Therefore, the cross-exchange rates of Hamburg-Amsterdam-London can be calculated according to the following formula:[313]

$$E_t^{HAL} = \frac{E_{t-1}^{AL}}{E_t^{HA}} * 32 \qquad (4.3)$$

where E^{AL}, E^{HA} and E^{HAL} are designated as the Amsterdam-London, Hamburg-Amsterdam and Hamburg-Amsterdam-London exchange rates, respectively. Because of the time element, the calculation of cross-exchange rates is based on the Amsterdam-London exchange rates at time t-1.[314]

Similarly, the cross-exchange rate of Amsterdam-Hamburg-London means the amount of schelling-Vlaamsch in Amsterdam one had to pay for whatever schillings-Flemish in Hamburg that would be equivalent to £1 sterling. The formula of the Amsterdam-Hamburg-London exchange rates is[315]

---

[313] $E_t^{HAL} = \frac{E_{t-1}^{AL}}{6} / \frac{E_t^{HA} * 32}{6}$. The quotation of Amsterdam-London exchange rates can be converted to a variable number of stuivers for £1 sterling by dividing by 6 (1 schelling-Vlaamsch=6 stuivers). If we divide the latter by the Hamburg-Amsterdam exchange rates, we will have the number of wechseltalers needed in Hamburg to receive £1 sterling in London. Because 1 wechseltaler was given a value of 32 schillings-Lübeck and 6 schillings-Lübeck was equivalent to 1 schillings-Flemish, the Hamburg-Amsterdam-London cross-exchange rates result from multiplying the number of talers by 32 and then dividing by 6. McCusker, *Money and Exchange*, p. 44.

[314] The speed of communication between Hamburg and Amsterdam was less than a week in the late seventeenth century. Therefore, E_{t-1}^{AL} and E_{t-1}^{HL} are used in calculating weekly cross-exchange rates.

[315] $E_t^{AHL} = \frac{E_{t-1}^{HL} * 6}{32} * \frac{E_t^{AH}}{6}$. The Hamburg-London exchange rates were quoted at a variable number of schillings-Flemish for £1 sterling. By multiplying by 6 and then dividing by 32, we will get a certain number of talers for £1 sterling. In order to obtain the equivalent value of this certain number of wechseltalers in schelling-Vlaamsch in Amsterdam, the number of wechseltalers is first multiplied by the Amsterdam-Hamburg exchange rates (in terms of a variable number of stuivers for 1 wechseltaler) and then divided by 6.

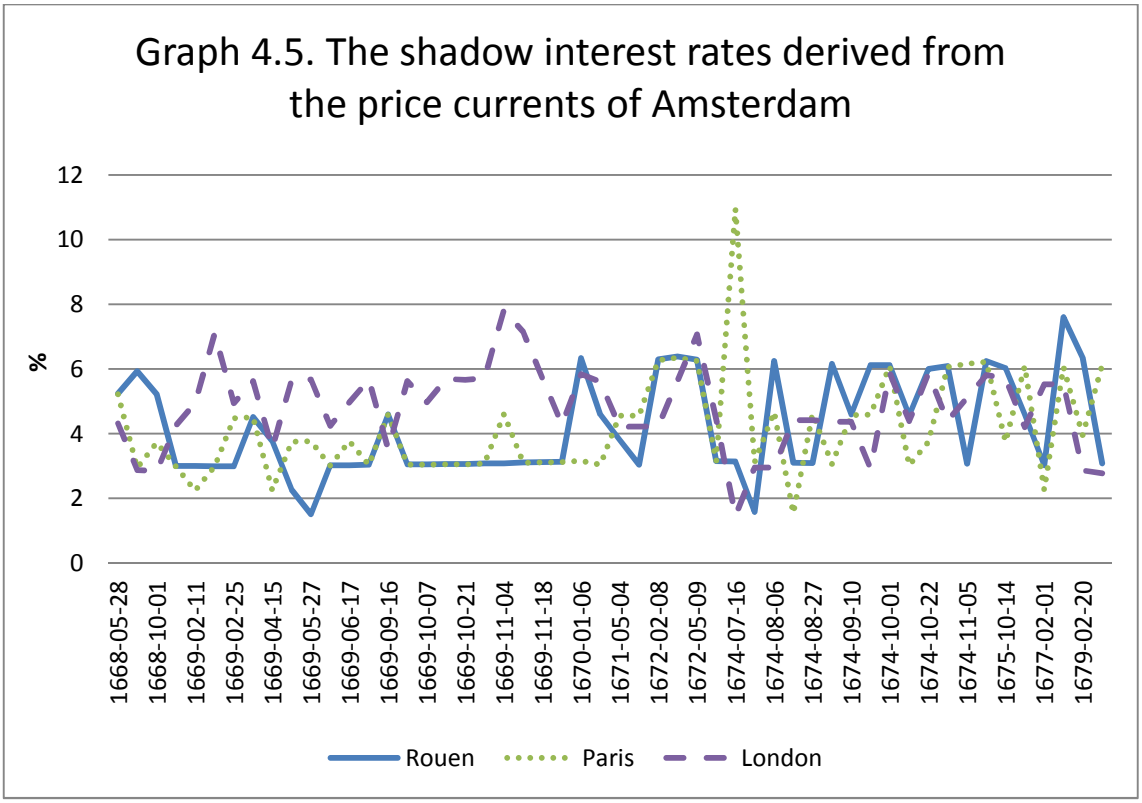
$$E_t^{AHL} = \frac{E_{t-1}^{HL}}{32} * E_t^{AH} \quad (4.4)$$

where E^{AH} and E^{AHL} are the Amsterdam-Hamburg and Amsterdam-Hamburg-London exchange rates, respectively. The direct- and resulting cross-exchange rates and the differences are reported in Appendices 4.C and 4.D.

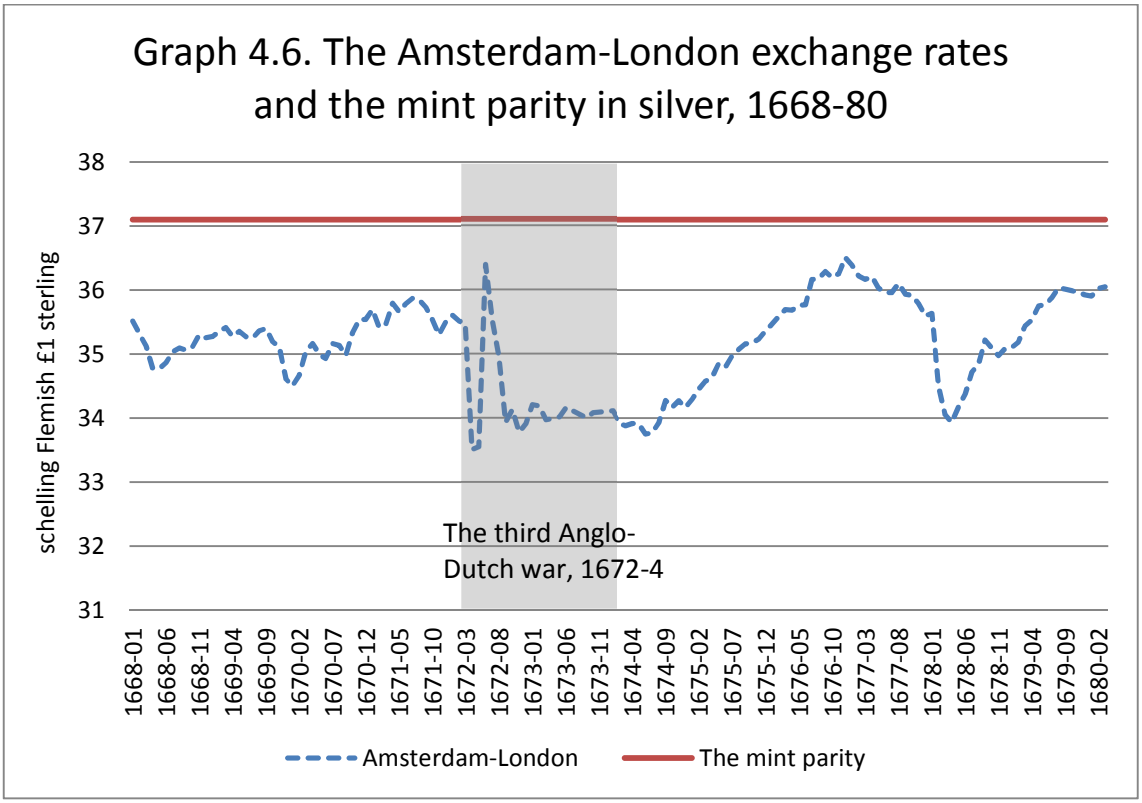
Because of slow communications and poor transport facilities, there was always until recent times a lapse of time between delivering a bill and receiving payment. Thus, in addition to facilitating the transfer of funds, bills of exchange also functioned as an instrument of credit.[316] As discussed in Chapter 3, the shadow interest rates can be obtained from exchange rates by comparing two exchange rates with different maturities. For the exchange rates listed in price currents, the exchange rates quoted on London, Rouen and Paris are reported at both usance and double usance. Therefore, the shadow interest rate embedded in the exchange rates of the three cities can be calculated and the results are reported in Appendix 4.E and Graph 4.5.

The interest rates implicit in the exchange rates were approximately at 4.2-4.8 per cent annually, which was similar to the normal interest rate prevalent in Amsterdam in the 1670s.[317] Graph 4.5 shows that the shadow interest rates derived from the Amsterdam-London exchange rates are slightly higher than those from Amsterdam-Rouen and Amsterdam-Paris exchange. However, after 1670, the difference disappeared and the three shadow interest rates more or less settle at a similar level. The high interest rates implied in the Amsterdam-London exchange cannot be regarded as evidence of a structural difference between the English and French credit markets. The parallel movement between shadow interest rates implicit in the Amsterdam-Rouen and Amsterdam-Paris exchange rates indicates close financial links between the pairs of cities.

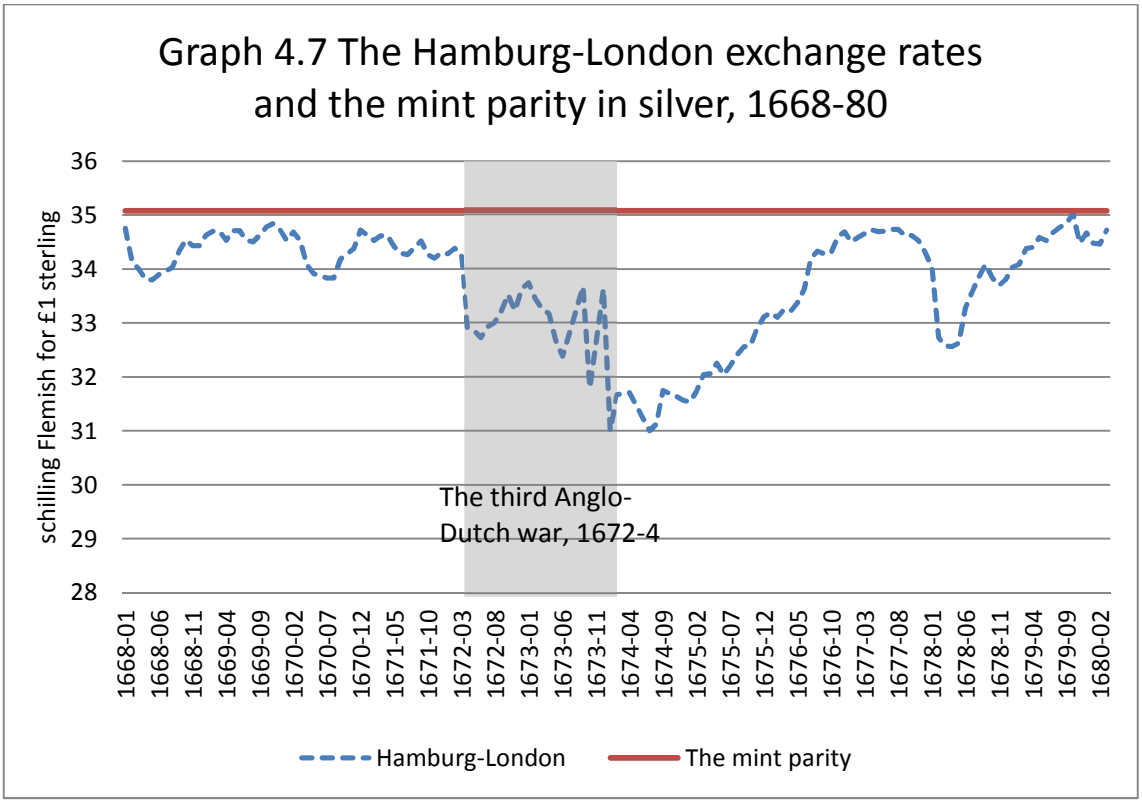
[316] See Chapter 1.
[317] 't Hart et al, *Financial History of Amsterdam*, p. 53.



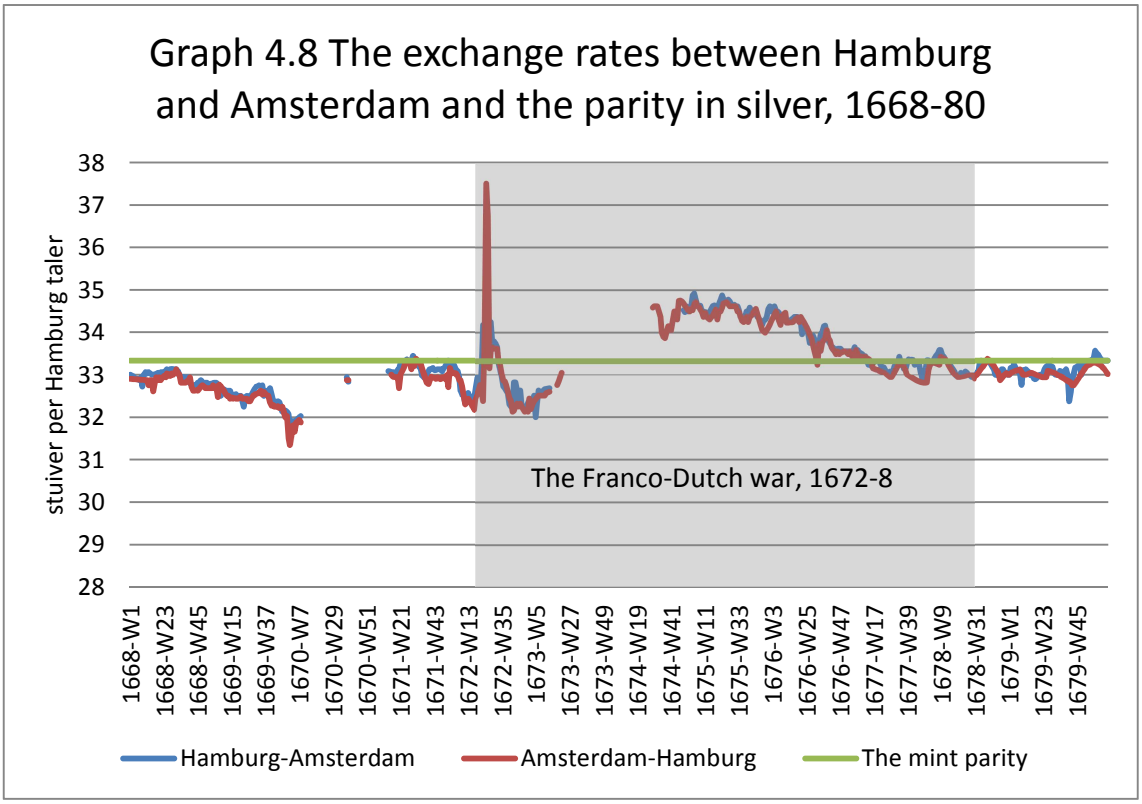
Source: PRO: C114/69-78, NEHA: Bijzondere Collecties 674



Sources: For the Amsterdam-London exchange rates, see Appendix 4.A. For the mint parity, see D. W. Jones, *War and Economy in the Age of William III and Marlborough*, (Basil Blackwell, 1988), pp. 69-80



Sources: For the Hamburg-London exchange rates, see Appendix 4.A. For the mint parity see C. D. Ebeling and P. H. C. Brodhagen, *Gottfried Christian Bohns wohlerfahrener Kaufmann*, (Hamburg, 1789), p. 14



Sources: For the exchange rates, see Appendix 4.A. For the mint parity see H. Roseveare, *Markets and Merchants of the Late Seventeenth Century: The Marescoe-David Letters, 1668-1680* (Oxford, 1987), p. 593

The relationship between exchange rates and mint parity is presented in Graphs 4.6-4.8. In the second half of the seventeenth century, the mint parity between London and Amsterdam for £1 sterling was at 37.868 schelling-Vlaamsch in silver and 36.284 in gold.[318] However, the actual course of the Amsterdam-London exchange rates was lower than the parity: varying roughly between 34.5 and 36 schelling-Vlaamsch per £1 sterling. The mint parity between London and Hamburg for £1 sterling was about 35.08 schilling-Flemish in the mark banco, but the Hamburg-London exchange rates fluctuated around 33.75-34.5 schilling-Flemish.[319] Compared with the mint parity, the pound sterling seems to have been undervalued by 3-5 per cent in the international money market, which may have been the result of England's unfavourable balance of trade with Europe at the time, in particular with the Republic. The exchange rates between Amsterdam and Hamburg were closer to but still below the parity (33 1/3 stuivers), except for the period of the Franco-Dutch war.[320]

The impact of wars on exchange rates is particularly striking. The exchange rates on London fluctuated little below mint parity until 1672, when the third Anglo-Dutch War broke out. Sterling depreciated during the conflict with the Dutch. Immediately after the English attack on the Dutch in March, the exchange rates of Amsterdam and Hamburg on London both plunged sharply, by 5.5 per cent and 4 per cent, respectively. The Hamburg-London exchange rates, with occasional recoveries, continued to fall until the end of hostilities sealed by the Treaty of Westminster in February 1674. Except for the critical summer of 1672 when a sudden outflow of

[318] D. W. Jones, *War and Economy in the Age of William III and Marlborough* (Basil Blackwell, 1988), pp. 69-80.

[319] The bullion content of English silver coins was stable in the seventeenth century: 111.37 grams of fine silver for £1 sterling. There were several changes in gold coins, but in the 1670s 7.89 grams of fine gold was contained in £1 sterling. Challis, *The Royal Mint*, pp. 309-12, 319, 340, 342 and 736-47. The mark banco was a purely artificial accounting unit. For each Cologne mark (233.856 grams) fine silver that the depositor paid in, the Bank of Hamburg credited him or her with a 27 mark 10 schilling banco. Hence, 1 mark banco = 8.4653 gram fine silver. Ebeling and Brodhagen, *Gottfried Christian Bohns Wohlerfahrener Kaufmann*, p. 14. However, the London-Hamburg mint parity based on current Hamburg silver coins is calculated at 31.26 schilling-Flemish for £1 sterling. G. A. S. V. Praun, *Grundliche Nachricht von dem Münzwesen insgemein, insbesondere aber von dem Deutschen Münzwesen älterer und neuerer Zeiten: und dann auch von dem Französischen, Spanischen, Niederländschen, Englischen und Dänischen Münzwesen* (Leipzig, 1784), pp. 116, 137. Since all foreign bills of exchange had to settle in the bank, it is more reasonable to look at the mint parity based on the mark banco. I would like to thank Dr Oliver Volckart for providing the information about Hamburg's silver coins.

[320] Roseveare, *Markets and Merchants*, p. 593.

capital from the Republic was caused by the French advance, the Amsterdam-London exchange rates remained at a low but stable level (34 schelling-Vlaamsch for £1 sterling) until the second half of 1674. At the outbreak of the war, the exchange between Amsterdam and Hamburg surged and remained above parity until the war ended. The appreciation of the Hamburg taler suggests that capital fled to Hamburg for security seasons. Overall, it took 2 years for the exchange rates to return to the pre-war level. The exchange rates on London began to fall again in the second half of 1677 towards the early months of 1678, when the English was likely to seek war with France.[321] Current or potential military activity strongly influenced the movement of exchange rates. However, to what extent did the war affect exchange markets? The weekly data are used below to examine the integration of exchange markets in London, Amsterdam and Hamburg at the time of international conflicts.

4.5 The results and their interpretation

The model described above indicates that, when the differentials of direct- and cross- exchange rates are within transaction costs, the first difference of exchange rates (ΔE_t^{HL},ΔE_t^{HAL},ΔE_t^{AL},ΔE_t^{AHL}) would follow a random walk. Once the law of one price was violated, i.e. once the differentials exceeded transaction cost, arbitrage would work to reduce the gap. Therefore, shocks would not have a long-term effect on exchange rates and differences between two exchange rates would eventually return to the band of transaction costs. This implies a stationary process of exchange rate differences. The hypotheses of unit root and stationarity are tested below to see whether shocks have a long-term effect on the exchange series, which invalidates the ideal of arbitrage underlying the TEC model. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests examine the series of exchange rates for the unit root and the Kwiatkowski-Phillips-Schmid-Shin (KPSS) test is used for the stationarity hypothesis. The results reported in Table 4.2 show that the exchange rates are

[321] The prospect of going to war with France began to be discussed in 1677. By early 1678 the fear of war was widespread on both sides of the Channel and not dispelled until the Dutch entered negotiations with France in late April 1678. *SSD, Charles II*, 1677-8, pp. 516-7,556, 558, 577, 581, 591; 1678, pp. 78, 118, 138. Merchants attributed the fall of the exchange rates in early 1678 to the fear of a war between England and France. Roseveare, *Markets and Merchants*., Letter 388.

stationary, and thus the TEC model can be applied to estimate the degree of integration in the seventeenth-century exchange markets.

Table 4.2. The results of the unit root and stationarity tests for the weekly Hamburg, Amsterdam and London exchange

	ADF test	PP test	KPSS test
		1668-70	
Δ Hamburg-London (ΔE^{HL})	-12.2406***	-12.1698***	0.0694
Δ Hamburg-Amsterdam-London (ΔE^{HAL})	-7.8867***	-11.1833***	0.1686
Δ Amsterdam-London (ΔE^{AL})	-8.6144***	-8.4700***	0.1166
Δ Amsterdam-Hamburg-London (ΔE^{AHL})	-12.7771***	-15.0059***	0.1026
The difference between direct- and cross-exchange rates ($E^{HL} - E^{HAL}$)	-4.0274***	-3.7549***	0.1965
cross-exchange rates of Amsterdam and London ($E^{AL} - E^{AHL}$)	-5.9407***	-6.1174***	0.1978
		1671-73	
Δ Hamburg-London (ΔE^{HL})	-8.2597***	-8.0923***	0.0598
Δ Hamburg-Amsterdam-London (ΔE^{HAL})	-9.4367***	-22.5385***	0.4903**
Δ Amsterdam-London (ΔE^{AL})	-9.2405***	-10.5625***	0.0364
Δ Amsterdam-Hamburg-London (ΔE^{AHL})	-11.5681***	-22.8368***	0.3111
The difference between direct- and cross-exchange rates of Hamburg and London ($E^{HL} - E^{HAL}$)	-6.4130***	-6.1042***	0.0987
The difference between direct- and cross-exchange rates of Amsterdam and London ($E^{AL} - E^{AHL}$)	-6.8957***	-5.4870***	0.0428
		1674-80	
Δ Hamburg-London (ΔE^{HL})	-9.5690***	-15.7248***	0.1774
Δ Hamburg-Amsterdam-London (ΔE^{HAL})	-15.5461***	-15.5474***	0.1858
Δ Amsterdam-London (ΔE^{AL})	-14.0451***	-14.6036***	0.1795
Δ Amsterdam-Hamburg-London (ΔE^{AHL})	-17.2193***	-17.2177***	0.1118
The difference between direct- and cross-exchange rates of Hamburg and London ($E^{HL} - E^{HAL}$)	-8.0569***	-8.1278***	0.0708
The difference between direct- and cross-exchange rates of Amsterdam and London ($E^{AL} - E^{AHL}$)	-7.5921***	-7.3984***	0.0482

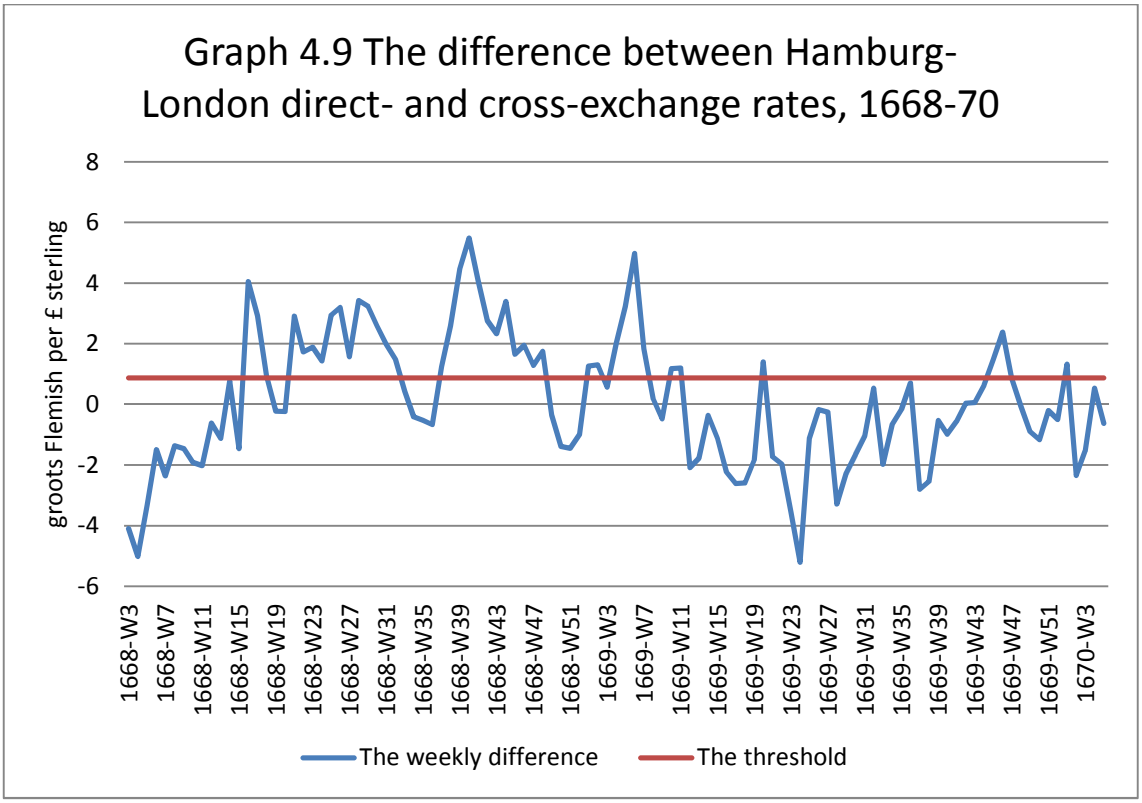
Note. *** and ** denote significance at the 1% and 5% level respectively.

Table 4.3. Estimation results: Hamburg-London via Amsterdam

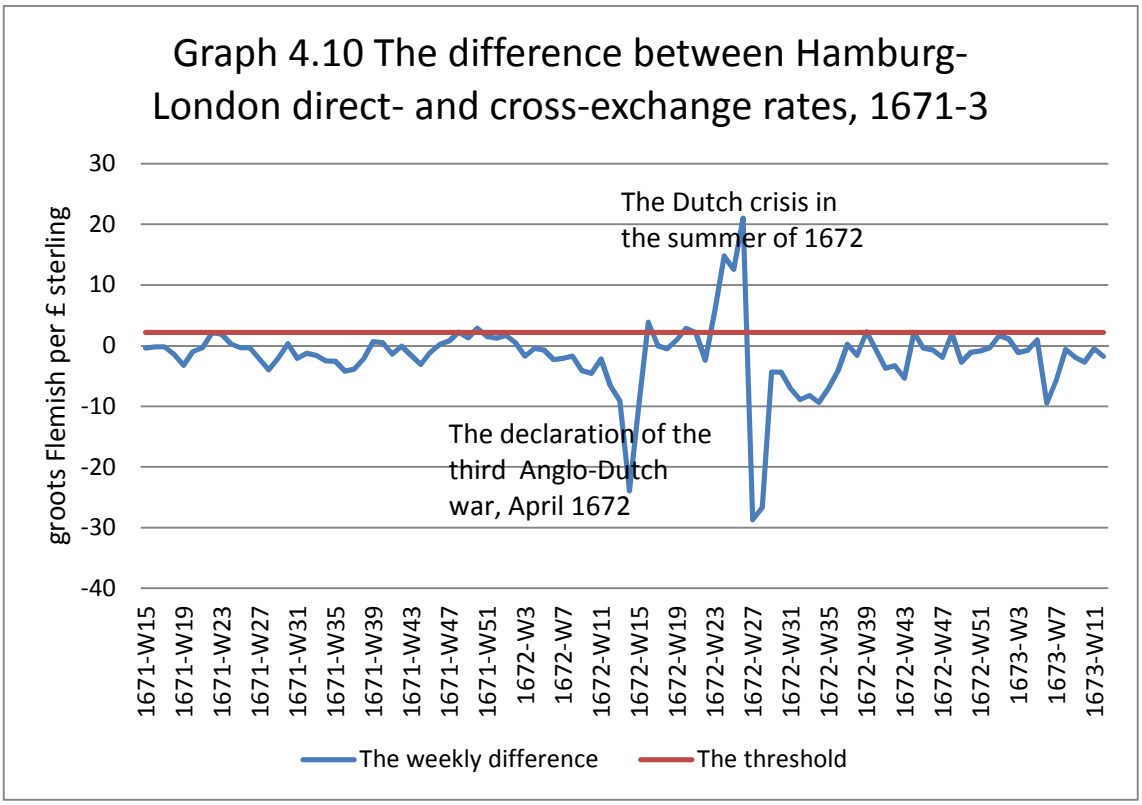
	Estimates	Speed of adjustment (weeks, in half-life time)
	Hamburg-London, 1668-70	
α_1	0.064	
α_2	0.356	1.58 weeks
c^{HAL}	0.87 groots (0.2%)	
	Hamburg-London, 1671-3	
α_1	0.035	
α_2	1.377	days
c^{HAL}	2.19 (0.5%)	
	Hamburg-London, 1674-80	
α_1	-0.238	2.55 weeks
α_2	0.267	2.23 weeks
c^{HAL}	0.79 (0.2%)	

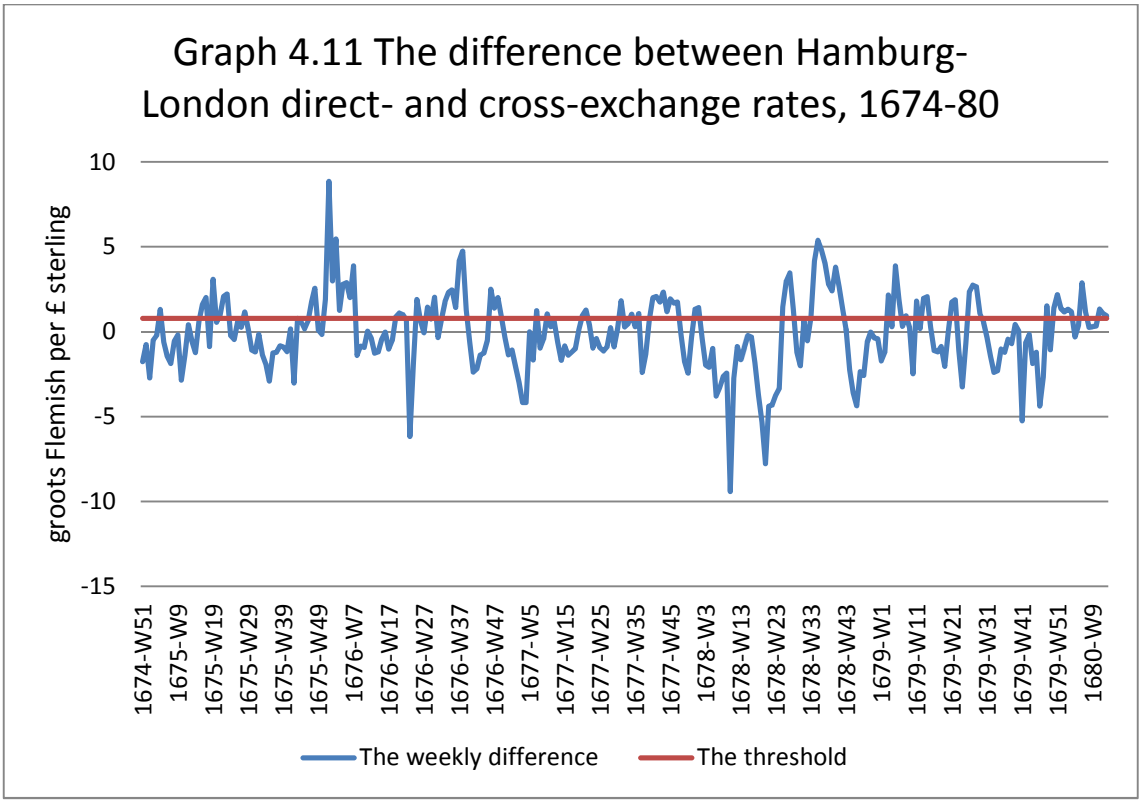
Table 4.4. Estimated results: Amsterdam-London via Hamburg

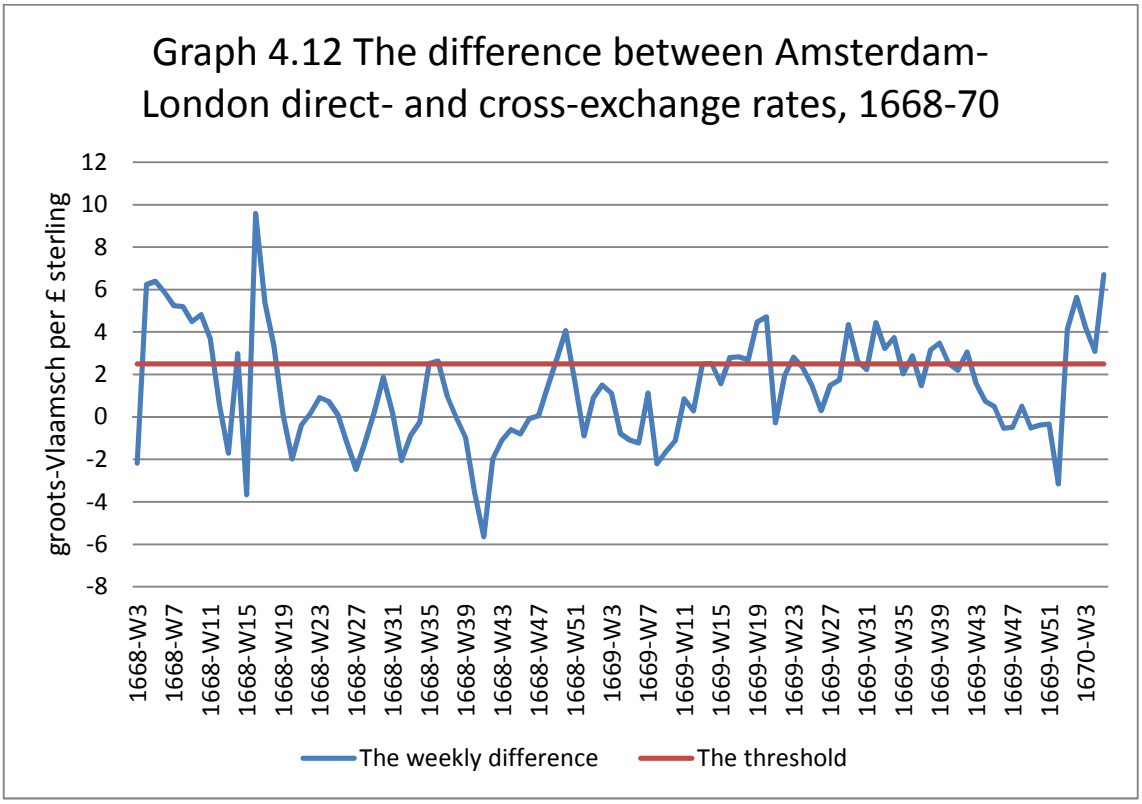
	Estimates	Speed of adjustment (weeks, in half-life time)
	Amsterdam-London, 1668-70	
α_3	0.077	
α_4	0.591	0.76 weeks
c^{AHL}	2.51 (0.6%)	
	Amsterdam-London, 1671-3	
α_3	-0.166	3.82 weeks
α_4	0.311	1.86 weeks
c^{AHL}	2.03 (0.5%)	
	Amsterdam-London, 1674-80	
α_3	0.03	
α_4	0.432	1.23 weeks
c^{AHL}	1.75 (0.4%)	



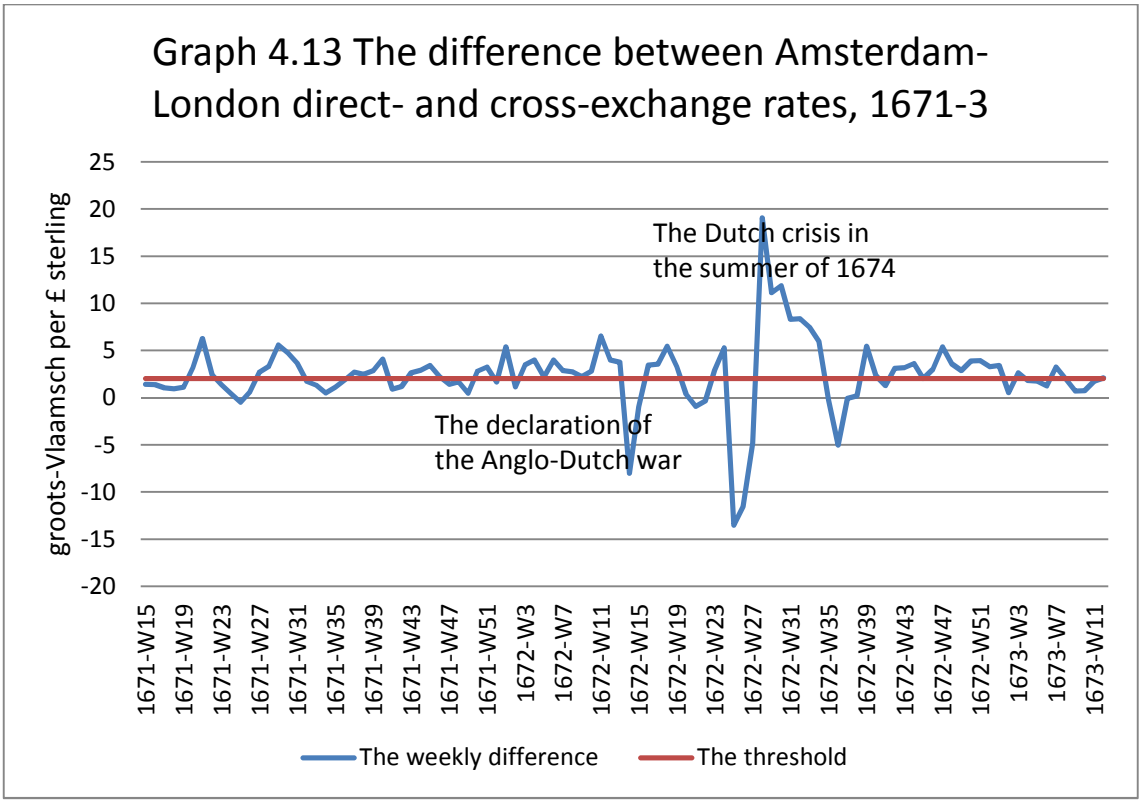
Source: Graphs 4.9-4.11 see Appendix 4.C

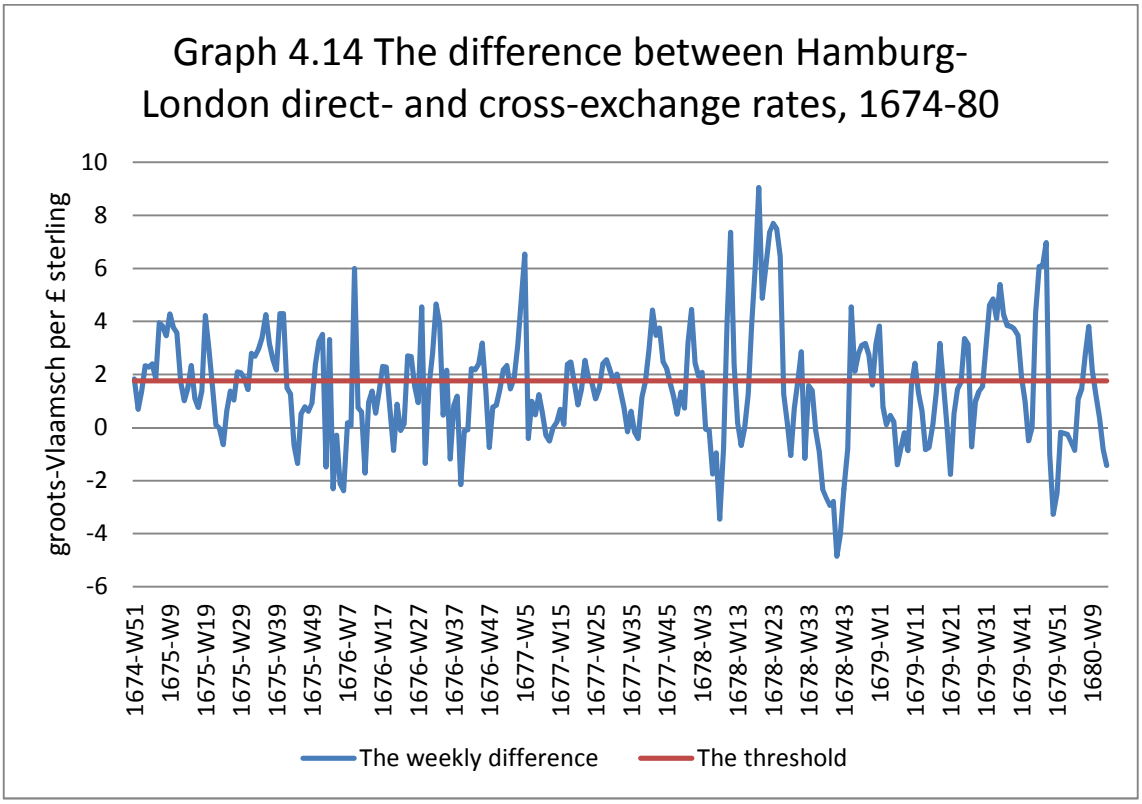






Source: Graphs 4.12-4.14 see Appendix 4.D


Graph 4.13 The difference between Amsterdam-London direct- and cross-exchange rates, 1671-3
groots-Vlaamsch per £ sterling
25
20
15
10
5
0
-5
-10
-15
-20
The Dutch crisis in the summer of 1674
The declaration of the Anglo-Dutch war
1671-W15
1671-W19
1671-W23
1671-W27
1671-W31
1671-W35
1671-W39
1671-W43
1671-W47
1671-W51
1672-W3
1672-W7
1672-W11
1672-W15
1672-W19
1672-W23
1672-W27
1672-W31
1672-W35
1672-W39
1672-W43
1672-W47
1672-W51
1673-W3
1673-W7
1673-W11
The weekly difference
The threshold


Graph 4.14 The difference between Hamburg-London direct- and cross-exchange rates, 1674-80
groots-Vlaamsch per £ sterling
10
8
6
4
2
0
-2
-4
-6
1674-W51
1675-W9
1675-W19
1675-W29
1675-W39
1675-W49
1676-W7
1676-W17
1676-W27
1676-W37
1676-W47
1677-W5
1677-W15
1677-W25
1677-W35
1677-W45
1678-W3
1678-W13
1678-W23
1678-W33
1678-W43
1679-W1
1679-W11
1679-W21
1679-W31
1679-W41
1679-W51
1680-W9
The weekly difference
The threshold

The estimated results of transaction costs and the speed of adjustment for the differential of direct- and cross-exchange rates across London, Amsterdam and Hamburg in three sub-periods are summarised in Tables 4.3 and 4.4. The graphic forms of weekly exchange rates and the estimated threshold (transaction cost) over the three periods are presented in Graphs 4.9-4.14. Overall, they indicate that the exchange markets in the late seventeenth century were integrated and arbitrage worked effectively. Below, the speed of adjustment and transaction costs of two exchange arbitrages in each sub-period are compared and discussed in detail.

Transaction cost

In the case of the Hamburg-London exchange, the threshold triggering exchange arbitrage via Amsterdam (C^{HAL}) is estimated at 2.19 Flemish groots per £1 sterling (0.5 per cent) during the crisis year of 1672, but remained at a relatively low level of 0.79-0.87 groots (0.2 per cent) in the two other periods. The transaction costs associated with cross-exchange included the brokerage and post fee of the second bill, the risk premium and the interest rate, which decided the opportunity cost of capital involved in cross-exchange.[322] The brokerage and post fee was more or less fixed, but the level of the interest rate was affected by the availability of funds and conditions of the market and the risk premium by the overall economic situations at the time. It is not surprising to see transaction costs increasing in 1671-3, when Amsterdam was so close to falling to the invading French. Although the conflict did not end until 1678, transaction costs returned to the pre-war level in the second half of the 1670s when a peace was concluded with the English, the survival of the Republic was ensured and most of the continuous fighting shifted outside of the Republic.

The transaction costs of the Amsterdam-London exchange are estimated to have been at a slightly higher level, 0.6 per cent, in 1668-70, than in the two other periods, 0.5 and 0.4 per cent, respectively. The perception that transaction costs

[322] It took longer to complete the remittance by cross-exchange than direct-exchange because of the time taken in negotiating the second bill and communication between three cities instead of two. During this period, capital was tied to exchange and could not quickly be switched to other uses. The loss of liquidity was the opportunity cost of cross-exchange and represented by the interest rate.

were higher in 1668-70 than in the conflict period seems to go against logic: the risk premium was relatively high during the conflict, which have resulted in high transaction costs. I cannot fully explain the relatively high transaction costs in 1668-70, but guess the explanation partially lies in the interest rate. As shown in Graph 4.5, the interest rates implicit in the Amsterdam-London exchange rates were higher in 1668-70 (5.15 per cent) than those implied in the French exchange, but they went down to a comparable level (4.49 per cent) in the rest of the period.[323] The high rate of implicit interest can only account for the high transaction cost of the Amsterdam-London exchange in 1668-70 in relation to the period of 1674-80, but leaves the relatively low transaction costs in the conflict period unexplained. Broadly speaking, regardless of the economic and political background, transaction costs on the Amsterdam-London exchange were largely stable.

Compared with those via Amsterdam(C^{HAL}), the transaction costs of the cross-exchange via Hamburg (C^{AHL}) was much higher, except for the period 1671-3. The comparison confirms Lesger's argument that Amsterdam was the centre of information in north Europe and its advantage was strengthened by the bilateral agreement between Hamburg and Amsterdam to require all the mail from Holland and England to and from Hamburg to pass through Amsterdam.[324] Amsterdam being a relay for postal traffic gave any cross-exchange via Amsterdam a great advantage in communication. For the Hamburg-London exchange, no matter whether direct- or cross-exchange, bills of exchange had to pass through Amsterdam and thus the length of time lost in the communication associated with the cross-exchange via Amsterdam was little. On the other hand, the Amsterdam-London cross exchange via Hamburg required a longer time for communication – the first bill had to be sent to Hamburg and the second one had to come back to Amsterdam before it arrived in London. Quick communication incurred less opportunity cost and, consequently, the transaction costs of cross-exchange via Amsterdam were low but via Hamburg were high.

Nevertheless, it is not surprising that the transaction costs of arbitrage, C^{HAL} and C^{AHL}, are estimated at a similar level in 1671-3. In this period, the advantages of

[323] See Graph 4.5 and Appendix 4.E.
[324] Lesger, *Rise of the Amsterdam Market*, pp. 238-41.

Amsterdam in postal traffic disappeared in the heat of the French advance. The difficulty and interruption of traffic passing through Amsterdam was concisely described in one letter sent from Hamburg to London: "this one [letter] is going through Antwerp because it seems quicker and we have today safely received yours … by the same route".[325] As soon as the disturbing effect of war abated, Amsterdam resumed her status as information centre for north Europe, which is visible in the relatively low transaction costs of cross-exchange via Amsterdam in 1674-80.

Speeds of adjustment

The adjustment parameters shown in Table 4.3 and 4.4 report that most estimates of coefficients (α_1, α_3) are close to 0. Remember that the bigger the value of the parameters, the more quickly prices adjust (f. 159). The very low value of (α_1, α_3) implies that direct-exchange took a long time to complete the adjustment; on the other hand, the coefficients (α_2, α_4) associated with cross-exchange, in terms of absolute value, are higher than (α_1, α_3) in all cases, which implies that arbitrage mainly took place by adjusting the cross-exchange rates rather than the direct-exchange rates. The value of α_2 for the Hamburg-London exchange in 1671-3 is greater than 1, which is interpreted as perfect integration or the outcome of military development. In the former case, the speed of adjustment is interpreted in a lower order of magnitude than the frequency used in measurement; that is days.[326]

No doubt the sharp spikes shown in Graph 4.10 and 4.13 are associated with the French approach to Amsterdam. They are short panics, and therefore, it is likely that the end of these spikes in exchange differences results from the end of these episodes of crisis, and business and financial market returned to normal. Speculation on exchange through arbitrage probably occurred at the time, but it is open to dispute whether arbitrage alone could adjust exchange rates and lead them back to equilibrium. In Table 4.3, the speed of adjustment is still presented as perfect

[325] This was a letter sent by Berenberg's widow in Hamburg to Leonora Marescoe in London on 2 August 1672. Antwerp was used as an alternative route for Hamburg-London postal traffic. Roseveare, *Markets and Merchants*, Letter 203, 252, 441 and 464.
[326] Chilosi and Volckart, 'Money, states and empire', pp. 775-6.

integration, but it must be borne in mind that this period is exceptional[327] and perhaps, for this period changes in exchange markets cannot be measured by the model described here. The sudden enlarging exchange differentials were caused by the prevailing fear of the fall of the Republic in face of French advance. It is likely that the return of equilibrium in the Dutch exchange might have been the result of the military development in the late 1672 and onwards: the French advance was halted; the future of the Republic was secured, and the focus of later conflicts was laid outside of Dutch territory. Nevertheless, the following discussion is based on the interpretation of perfect integration. Or one can alternatively regard the estimations of the non-crisis periods as the relevant ones for long-term comparison of integration.

The operation of arbitrage included two main elements: (1) discovering the profitable arbitrage opportunity and (2) action upon the recognised opportunity; both heavily relied on the flow of information. The arbitrage opportunity concerning us here is the difference between direct- and cross-exchange rates. Information on direct-exchange rates can be obtained in the home city, but the calculation of cross-exchange rates requires information about the exchange rates between the third city and the destination city as given in Equations (4.3) and (4.4). Furthermore, because of the time element whether or not to act upon the arbitrage opportunity was also affected by the expectation of future movement of exchange rates between t_o when the arbitrage took place and t_i when the arbitrage was completed. If the exchange rates had been expected to change greatly (to offset the exchange difference), merchants would have not carried out arbitrage, even faced with a profitable arbitrage opportunity.

Except for the Hamburg-London exchange in 1671-3, arbitrage worked more quickly to exploit profitable opportunities in the Amsterdam-London cross-exchange via Hamburg. Does this contradict the result of the low transaction cost via Amsterdam? Not necessarily. One main factor in determining the effectiveness of arbitrage in financial markets is information. Monopolising information is equivalent to holding a key to successful arbitrage. Being a relay for postal traffic, Amsterdam

[327] The Hamburg-Amsterdam-London cross exchange in years 1671-3 is the only period that the KPSS stationarity test is rejected (see Table 4.2).

had a great advantage over other places in terms of information and communication; it was likely to have received more up to date information and done so sooner. Consequently, Amsterdam was better equipped than other cities to undertake arbitrage. This advantage was not only reflected in the low transaction costs via Amsterdam ($C^{HAL} < C^{AHL}$), but also in the quicker adjustment in arbitrage initiated in Amsterdam than that in Hamburg ($\alpha_4 > \alpha_2$).

However, in 1671-3 the speed of adjustment (which was to exploit a profitable arbitrage opportunity) was no longer quicker for arbitrage initiated in Amsterdam than in Hamburg. As shown in Table 4.3, the estimated adjustment of cross-exchange arbitrage initiated in Hamburg at this period shows perfect adjustment. This quick adjustment could have been a result of speculation of the depreciation of Dutch currency in the summer of 1672. As shown in Graph 4.10, adjustment on exchange differences occurred only when capital flowed out of the panic-stricken Republic. Merchants expected the depreciation and pre-adjusted the exchange rates; therefore, the Hamburg-London cross-exchange was in perfect adjustment in 1671-3.[328]

The existing literature clearly points out that war had a heavy impact on market adjustment and integration.[329] The period surveyed in this chapter coincides with the Franco-Dutch war and some effects of war on exchange markets are addressed above. In the following discussion, the response of the exchange markets to the war and the Stop of Exchequer in England is examined in detail.

In 1668-70, arbitrage operating on the Hamburg-London cross-exchange took 11 days to reduce the difference of exchange rates exceeding transaction costs by 50 per cent, but only 5 days for the Amsterdam-London exchange. Before the outbreak of the third Anglo-Dutch War, the rumour that Charles II had already secretly committed himself to helping Louis XIV to invade the Dutch Republic was widespread and causing speculation. The speculation may have resulted in the depreciation of English currency. Graphs 4.1 and 4.3 show that in early 1670 the exchange rates of the pound sterling in Amsterdam and Hamburg fell.[330] In 1672, the year of disaster

[328] Federico, 'Market integration in Europe', pp. 476-8.
[329] Neal, *The Rise of Financial Capitalism*; idem, 'Integration and efficiency'; Schubert 'Arbitrage'.
[330] The falling exchange rate of the pound sterling can also be observed in the French and Venetian exchange markets. Roseveare, *Markets and Merchants*, Appendix G.

(the rampjaar), the Dutch faced an English invasion by sea and a French one by land at the same time. The danger of being conquered by foreign powers, the presence of bellicose troops and continuous warfare in the 1670s were fully reflected in the movement of exchange rates. Graphs 4.1, 4.2 and 4.4 show that the close approach of the French army and the miserable prospects for the city manifested themselves in the sudden plunge in exchange rates of Dutch money in the summer of 1672. During this summer the exchange rate of Dutch money depreciated by 4 per cent in Rouen but remained relatively stable in Venice.[331] In the autumn, as soon as the danger abated, exchange rates returned to the pre-summer level. As a result of the on-going warfare in the Dutch Republic in 1672-3, the speed of adjustment in Amsterdam-London declined to 1.86 weeks (more than twice that in 1668-70) when war had broken out. However, the speculation of the outflow of capital from Amsterdam and depreciation of Dutch currency resulted in pre-adjustment in the Hamburg-London exchange arbitrage: the adjustment parameter (α_2) is greater than 1, even in the face of increasing transaction costs of arbitrage.

The effect of war, moreover, can be seen from the distribution of the exchange difference ($E_{t-1}^{d} - E_{t-1}^{c}$). Unlike the other two periods, in 1671-3 a high proportion of exchange differences, as shown in Graphs 4.10 and 4.13, locates either above 0 (in the Amsterdam-London case, 89 per cent) or below 0 (in the Hamburg-London case, 71 per cent). The exchange rate is the amount of local money that one has to give in order to receive a unit of foreign money in the other place. Without considering transaction costs, the positive exchange difference indicates that cross-exchange is favourable and the negative means preferably using direct-exchange. Because of the financial chaos and outflow of capital in Amsterdam, a profitable arbitrage opportunity arose and it became more favourable to remit funds from Amsterdam to London via Hamburg; conversely, direct-exchange between Hamburg and London was preferred in order to avoid passing through Amsterdam, except for the summer of 1672 (the peak of speculation).[332] As regards transaction costs, the uncertainty

[331] Ibid,.
[332] It is noticeable in Graph 4.13 that profitable opportunities for arbitrage were created by the speculative atmosphere in the Amsterdam market in the summer.

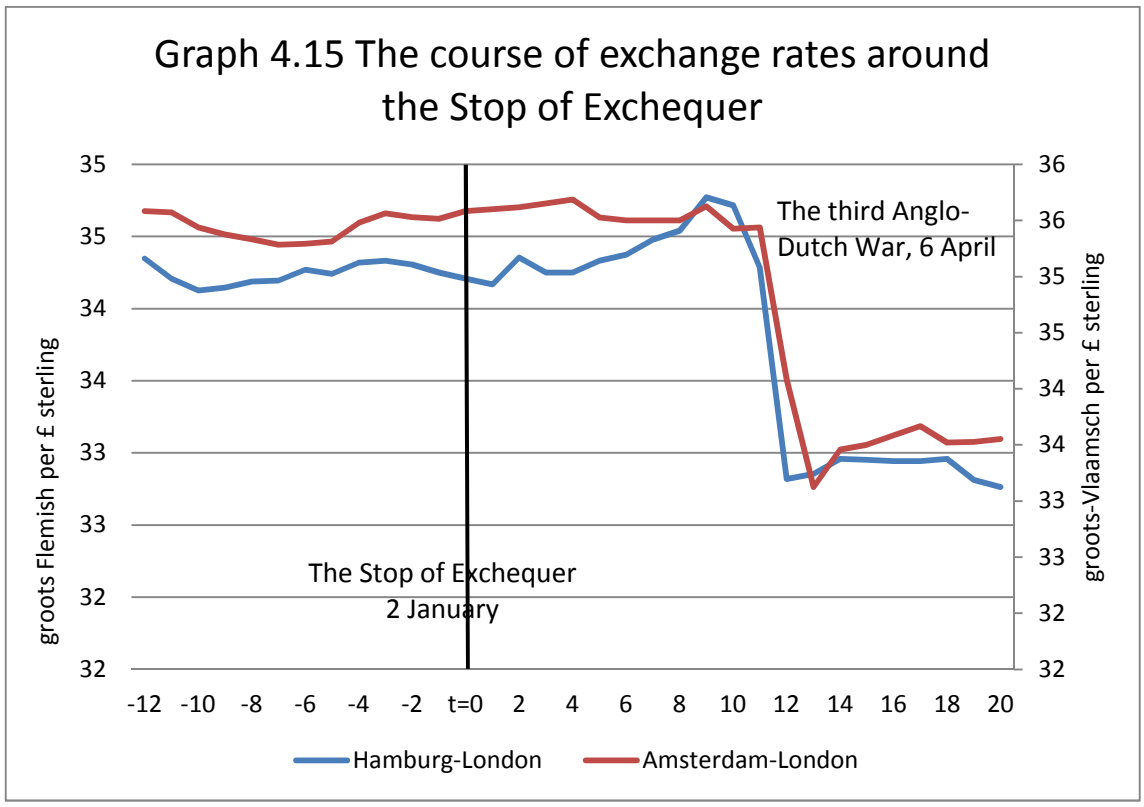
and high risk incurred by the war probably led to high interest rates and thus raised transaction costs.

The speed of adjustment had already achieved a high level (within 1-3 weeks) in the late seventeenth century. Warfare did interrupt international exchange arbitrage but only transiently and to a limited degree. The speed of adjustment of the Amsterdam-London cross-exchange was reduced from the pre-war speed of 0.76 week to 1.86 weeks during the war period. Although in most of the period merchants still had to face intermittent conflicts and the interruption of trade routes, in 1674-80 arbitrage worked to reduce the differential by half at a speed of 1.2 weeks. The improvement in the speed of adjustment reflected the recovery of Amsterdam. The restoration of her dominant position in transmitting information over north Europe was also manifested in the decline in transaction costs of exchange via Amsterdam (C^{HAL}), which fell back to the pre-crisis level.

However, the speed of adjustment in the Hamburg-London cross-exchange (2.23 weeks) in 1674-80 was slower than in the years 1671-3. The perfect adjustment achieved by the Hamburg-London cross-exchange in 1671-3 was due to the speculation on depreciation of Dutch money in the summer of 1672. As shown in Graph 4.10, the most profitable opportunities for Hamburg-London exchange arbitrage occurred this summer. The panic created the outflow of capital and the depreciation of Dutch money. Markets responded to them by pre-adjusting exchange rates and thus led to a perfect adjustment ($\alpha_2 > 1$). As soon as the political and financial situation in Amsterdam improved and the speculation caused by the panic diminished, the speed of adjustment slowed down and converged to the pre-crisis level.

In contrast to the visible impact of warfare on exchange rates, it seems that the Stop of the Exchequer in London had no impact at all on international exchange markets. Graph 4.15 shows the course of the pound sterling's exchange rates in Amsterdam and Hamburg before and after the Stop. No sign of change in the exchange rates is observed before or after the Stop. However, a clear depreciation occurred after England declared war on the Dutch Republic in April 1672. The reason for the unaltered exchange rates after the Stop can be found in the source of money affected. Due to the mounting military expenses of preparing the third Anglo-Dutch

War, the Crown unilaterally suspended its debt repayment in January 1672. A large part of the defaulted loans came from London goldsmiths, who were the main creditors in question. Moreover, a great number of people who had not directly lent money to the Crown were also hurt by the Stop because their money, deposited with the goldsmiths, had indirectly been lent to the government. Consequently, credit and money in London grew tighter. However, as illustrated on the course of exchange, English international mercantile credit and bills of exchange were not affected by this domestic credit contraction; though the merchants abroad were well-informed about the default and worried about subsequent bankruptcy.[333] Does this imply poor integration between London's domestic and international credit markets in the 1670s?[334]



Source: Appendix 4.B

The money deposited with the London goldsmiths was mainly associated with agrarian wealth not with commerce. The goldsmiths' banking business was

[333] Roseveare, *Markets and Merchants*., Letter 179.
[334] Eagly and Smith's work suggests that London's domestic capital market was closely linked with Amsterdam in the second half of the eighteenth century. Eagly and Smith, 'Domestic and international integration'.

constructed around the agricultural season. Country gentlemen needed money in London to pay off their expenditure on luxury goods or the time spent living in the city. However, their income was generated from agrarian but urban sources and therefore, funds had to be transferred from the countryside to London. Depositing money with the goldsmiths that could be withdrawn at short notice became a popular solution.[335] Perhaps, because of the agrarian source of the money deposited with the goldsmiths, the Stop would never have caused much disturbance to the course of exchange rates, which was closely related to the mercantile credit associated with foreign trade. However, the available credit for commerce would be, to some degree, contracted by the Stop due to the shortage of money in London. The impact of the Stop was soon surpassed by that of the Franco-Dutch war.

The effectiveness of arbitrage can be judged only by comparing the estimated speed of adjustment with contemporary communication. Contemporaries customarily recorded the dates of a letter's being delivered and received on the cover. Therefore, the speed of communication (i.e. the travelling time for commercial letters) can be calculated from the Marescoe-David letters: on average, 5 days between London and Amsterdam and 9 days between London and Hamburg.[336] Since the 1660s a regular packet-boat system (twice a week) had begun to travel between London and Amsterdam. The travelling time between them was approximately 3-6 days, depending on the weather.[337] Moreover, an information network based on a credit nexus was established during the seventeenth century which enabled merchants to operate arbitrage in international capital markets.[338] North-European financial markets are expected to be integrated as information became easier to transmit.

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[335] Melton, *Robert Clayton*, pp. 20-1; E. Kerridge, *Trade and Banking in Early Modern England* (Manchester University Press, 1988); M. G. Davies, 'Country gentry and payments to London, 1650-1714', *Economic History Review*, 24 (1971), pp. 15-36.

[336] See Appendix 4.F and 4.G. Roseveare, *Markets and Merchants*, p. 54. The speed of communication between Hamburg and Amsterdam is estimated at 4-5 days, the difference between these two speeds, because postal traffic between Hamburg and London had to pass through Amsterdam. Lesger, *Rise of Amsterdam Market*, p. 239.

[337] P. Koudijs, 'The boats that did not sail: news, trading and asset price volatility in a natural experiment', Job Market Paper, (2010). Even the third Anglo-Dutch War did not cause much interruption to the postal service between England and the Dutch Republic. Boxer, 'Some second thoughts on the third Anglo-Dutch War', pp. 67-94.

[338] L. Neal and S. Quinn, 'Networks of information, markets, and institutions in the rise of London as a financial centre, 1660-1720', *Financial History Review*, 8 (2001), pp. 7-26.

The speed of adjustment, in terms of half-life time, is estimated at 1-2 weeks in the 1670s and this suggests that exchange markets in late seventeenth-century northern Europe was already well-integrated, with arbitrage working effectively to exploit profitable opportunities. Warfare rather than a local financial crisis[339] was the main source of disruption to integration. Moreover, markets were very resilient. The disruptive effect of warfare on market adjustment, integration and transaction cost was only temporary and as soon as the imminent danger was removed and the situation improved, the level of integration rapidly recovered.

4.6 Conclusion

The literature based on stock prices establishes that financial markets, at least between Amsterdam and London, were already well integrated by the early eighteenth century. By using exchange rates, this chapter shows that triangular arbitrage in exchange rates of the 1670s operated effectively to reduce 50 per cent of the difference exceeding transaction costs in accordance with the time for communicating information. It also quantitatively supports the qualitative evidence of early integration in the late seventeenth century. Warfare was widespread and prolonged over the period that this analysis covers, but arbitrage operations were only temporarily interrupted and soon recovered. Except for the crisis years of 1671-3, arbitrage initiated in Amsterdam worked more effectively to exploit profitable opportunities than that initiated in Hamburg, which reflects the fact that Amsterdam was the information centre of northern Europe. The status of Amsterdam in the flow of information is further confirmed by the relatively low transaction costs of exchange arbitrage via Amsterdam.

The other finding of this chapter is that shadow interest rates implied in exchange rates of different maturities exhibited a downward trend from 13.68 per cent annual in the mid-sixteenth century to 4.8 per cent in the late seventeenth

[339] Several bankruptcies in Hamburg and Amsterdam between November 1677 and April 1678 were caused by warfare. However, it seems not to have affected the speed of adjustment. Roseveare, *Markets and Merchants*, p. 180, Letter 377, 381, 388, 411 and 504.

century. Because the shadow interest rate is derived from exchange rates, the fall suggests that the financial innovations occurred at the turn of the seventeenth century largely expanded the use of bills of exchange and greatly reduced the cost and risk involved in exchange dealings. Furthermore, the fall in implicit interest rates is consistent with other evidence of the downward movement of interest rate in Europe at the time.

The study of market integration based on exchange rates sheds light on our understanding of the degree of integration in the late seventeenth century which was only speculated based on qualitative evidence. Bills of exchange functioned as instruments of credit and an easy way to transfer funds between distant places. Integrated exchange markets can greatly facilitate the international flow of capital and allocate resources to the place where they are most needed. Consequently, with the help of integrated exchange markets, regardless of their economic and political background, merchants occupied in foreign trade can borrow efficiently to finance commercial ventures in distant places and adjust shocks effectively by moving capital around. Credit, as the bloodstream of commerce, would thus flow to the most profitable investment opportunity and European commerce accordingly progressed.

Conclusion

The empirical study of financial market integration and efficiency in early modern Europe has heavily relied on *the Course of the Exchange* and the *Amsterdamsche Courant*, which recorded the share prices and exchange rates in the eighteenth century. Recently, scholars have begun to explore late medieval financial markets but with low frequency data (annual). So far our understanding of financial market performance in the early period has remained ambiguous on a number of questions: How integrated and efficient were financial markets before the eighteenth century? What factors determined the degree of integration and efficiency? Did the financial innovations occurring in the late sixteenth and early seventeenth centuries have any impact on the financial market, in terms of speed of adjustment and transaction costs?

This thesis sets out to answer these questions by employing cointegration models to examine international exchange arbitrage. It explains the dual function of the bill of exchange – as a means of remittance and an instrument of credit – that allowed people to take commercial loans from exchange markets and use them to finance international trade. Because of this, before the emergence of modern capital markets, exchange markets can be regarded as international commercial credit markets. The effectiveness of arbitrage on exchange markets, therefore, indicates how well the financial market was performing in late medieval and early modern Europe. Furthermore, the surviving rates of foreign exchange provide us with a high-frequency data (monthly and weekly) that allow us to more precisely measure the degree of market integration and efficiency. One of the drawbacks of previous research is that it had no criterion for judging the results obtained about market performance. Because information plays a critical role in price adjustment, the contemporary speed of communication is taken as a benchmark in the present work

to measure how well arbitrage worked on exchange markets by the standards of the time.

My approach has been to develop series of three individual papers covering the late fourteenth, mid-sixteenth and late seventeenth centuries which each in turn examines how exchange market performed against different historical, economic and political backgrounds. These chapters together help to address the long-term development of exchange markets in terms of integration and efficiency. They find that: (1) the late medieval exchange markets were better integrated than existing studies have shown and arbitrage operated rapidly to exploit the profitable opportunities created by the government's interventions in exchange dealings; (2) in the sixteenth century the London-Antwerp exchange market had achieved some level of integration, which was consistent with the long-established and close commercial relationship between these two markets; and the more explicit information was, the more efficiently markets responded to shocks (i.e. monetary alterations); and (3) financial innovations did not increase the level of integration but largely reduced the transaction costs of arbitrage. Together they suggest that exchange markets in the late Middle Ages and early modern era were capable of allocating capital efficiently and bridging the demand and supply of funds effectively within the limits of contemporary conditions, particularly communication speeds. Consequently, though faced with the prevalent anti-usury doctrine, commercial ventures were financed in an economical way.

My findings about the speed of adjustment over these periods are summarised in Table 5.1. Comparing them with the result extracted from Canjels et al, it shows a long-term development of financial markets. One has to bear two things in mind in drawing comparisons. First, the degree of market integration shown here is based on different data-frequency: daily frequency in the late nineteenth century, weekly frequency in the late fourteenth and seventeenth centuries and monthly frequency in the mid-sixteenth century. The accuracy of the results may be influenced by this varying data-frequency. Second, the estimation of London-Antwerp market integration in the mid-sixteenth century and London-New York in the gold standard period is based on the difference between the nominal exchange rate of two currencies and the mint parity; this is not the same as the other two periods, when it

is based on triangular exchange arbitrage. Arbitrage operated in the former approach by shipping bullion between markets but in the latter by engaging in cross-exchange. As a result, the transaction costs associated with triangular arbitrage would be much lower than the cost of shipping bullion and exchange rates adjusted quicker through triangular arbitrage.

Table 5.1 Some comparisons in the speed of adjustment and transaction costs

	The estimated transaction cost	The speed of adjustment (in half-life term)	The travelling time for commercial information
1399-1410 Venice-Bruges-Paris	1%	1.8 weeks	28-30 days
1399-1410 Venice-Bruges-Barcelona	8%	4.6 weeks	40-45 days
1537-1544 London-Antwerp*	4.4%	2.3 months	5-9 days
1668-1680 Amsterdam-Hamburg-London	0.4%-0.6%	0.76-1.86 weeks	5 days
1668-1680 Hamburg-Amsterdam-London	0.2%-0.5%	1.58-2.23 weeks	9 days
1879-1913 London-New York*	0.67%	6 days	within 1 day

Note: * Unlike the triangular arbitrage in other periods, the degree of integration in the mid-sixteenth and late-nineteenth centuries is calculated on the arbitrage between market exchange rates and the bullion content of coins. As a result, the estimated transaction cost would have to be higher than that of triangular arbitrage. Sources: E. Canjels, G. Prakash-Canjels and A. M. Taylor, 'Measuring market integration: foreign exchange arbitrage and the gold standard, 1879-1913', *The Review of Economics and Statistics*, 86(2004), pp. 868-882. By ocean voyage, it took 9-14 days to transmit information across the Atlantic, but the telegraph reduced the time needed for communication to within a day. C. Hoag, 'The Atlantic telegraph cable and capital market information flows', *Journal of Economic History*, 66 (2006), p. 342

This comparison shows that in the late fourteenth century exchange markets were already integrated with regard to communication. Overall, from the late fourteenth century to the early twentieth, the time for arbitrage operation to reduce 50 per cent of the difference is in close accordance with the contemporary speed of communication. However, the transaction costs associated with arbitrage declined over time. One of the elements of transaction cost is the opportunity cost of the

money involved in arbitrage. The remarkably low transaction cost of Venice-Bruges-Paris is attributed to the close geographical proximity of Bruges and Paris and thus the low opportunity cost. The fall in transaction costs since the sixteenth century may be due to the expansion of markets resulting from financial innovations and the legislation of the interest payment up to a certain level.

In sum, this thesis contributes two major advances to the literature on financial markets. First, it uses monthly and weekly data in a medieval context and takes to a new level in the quantitative analysis of late medieval financial markets. The high frequency data produces a more precise measurement of the degree of integration and, in contrast to the existing studies, the results do indicate that a high level of integration was achieved in the late Middle Ages. Second, this thesis uses the speed of communication as a benchmark. Although Chilosi and Oliver find that the financial integration was associated with the fall in information cost,[340] this thesis further connects the flow of information to the speed of price adjustment. This is a new and useful idea in judging how well financial markets did, since the flow of information plays an important role in financial arbitrage.

[340] D. Chilosi and O. Volckart, 'The Knowledge economy of the Renaissance: the advent of printing and financial integration in central Europe', *Czech Historical Review,* 109 (2011), pp. 262-282.

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Appendices

Appendix 2.A The weekly exchange rates of Venice, Bruges and Paris in 1395-1410

Date	Venice-Paris	Venice-Bruges	Bruges-Paris	Venice-Bruges-Paris	The difference
1399-w14	21.875	21.500	34.167	-	-
1399-w15	22.000	21.500	34.000	-	-
1399-w16	22.000	21.500	34.167	-	-
1399-w17	22.167	21.532	33.896	-	-
1399-w18	21.125	21.563	34.000	22.325	-1.200
1399-w19	22.250	21.646	34.125[a]	22.302	-0.052
1399-w20	22.333	21.667	34.250	22.433	-0.100
1399-w21	22.333	21.667	34.250	22.255	0.078
1399-w22	22.250	21.563	34.250	22.216	0.034
1399-w23	22.062[a]	21.448[a]	33.854	22.179	-0.117
1399-w24	21.875	21.333	33.792	22.141	-0.266
1399-w25	21.875[a]	21.291[a]	34.000	22.098	-0.223
1399-w26	21.875	21.250	33.889	22.055	-0.180
1399-w27	21.750	21.125	33.875	21.672	0.078
1399-w28	21.611	21.000	34.000	21.504	0.108
1399-w29	21.417	21.000	33.667	21.636	-0.220
1399-w30	21.641	21.000	33.611	21.566	0.075
1399-w31	21.709	21.063	33.667	21.621	0.088
1399-w32	21.750	21.125	33.500	21.765	-0.015
1399-w33	21.750	21.830	33.417	22.271	-0.521
1399-w34	21.833	21.125	33.556	21.516	0.317
1399-w35	22.000	21.250	33.611[a]	21.679	0.321
1399-w36	22.415	21.209	33.667	21.530	0.885
1399-w37	22.000	21.500	33.667	21.771	0.229
1399-w38	21.938	21.229	33.667	21.586	0.351
1399-w39	21.844[a]	21.239[a]	33.750	21.633	0.211
1399-w40	21.750	21.250	33.792	21.679	0.071
1399-w41	21.875	21.250	33.854[a]	21.679	0.196
1399-w42	21.875	21.250	33.917	21.679	0.196
1399-w43	21.875	21.125	34.250	21.605	0.270
1399-w44	22.250	21.667	34.125	22.187	0.063
1399-w45	22.250	21.709	33.500	22.270	-0.020
1399-w46	22.333	21.854	33.500	22.461	-0.128
1399-w47	22.250	21.750	33.417	22.574	-0.324
1399-w48	22.125	21.667	33.000	22.406	-0.281
1399-w49	22.167	21.667	33.417	21.995	0.172
1399-w50	22.125	21.625	33.250	21.953	0.172
1399-w51	22.209	21.646	33.583	21.919	0.289
1399-w52	22.250	21.667	33.458[a]	21.667	0.583
1400-w1	22.250[a]	21.667[a]	33.333	21.941	0.309
1400-w2	22.250[a]	21.667[a]	33.500	21.831	0.419
1400-w3	22.250[a]	21.667[a]	33.500[a]	22.050	0.200
1400-w4	22.250	21.667	33.500	21.968	0.282
1400-w5	22.333	21.750	33.500	21.970	0.363

1400-w6	22.667	21.875	33.542	22.206	0.461
1400-w7	23.000	22.000	33.597	22.333	0.667
1400-w8	22.938	22.440	33.708	22.780	0.158
1400-w9	23.000	22.250	34.097	22.587	0.413
1400-w10	22.875	22.209	34.250	22.573	0.302
1400-w11	23.000	22.750	34.083	23.162	-0.162
1400-w12	23.313	22.709	34.083	23.196	0.117
1400-w13	23.208[a]	22.527[a]	34.146	23.276	-0.068
1400-w14	23.104[a]	22.346[a]	34.000	23.192	-0.089
1400-w15	23.000	22.167	34.083	22.895	0.105
1400-w16	22.937[a]	22.250[a]	34.125	22.980	-0.043
1400-w17	22.875	22.333	33.778	23.108	-0.233
1400-w18	22.938	22.459	33.250	23.139	-0.202
1400-w19	23.000	22.750	33.333	23.497	-0.497
1400-w20	22.875	22.354	33.000	23.116	-0.241
1400-w21	22.875	22.333	32.833	22.859	0.016
1400-w22	22.812[a]	22.354[a]	33.333	22.523	0.289
1400-w23	22.750	22.375	33.333	22.601	0.149
1400-w24	22.667	22.500	33.354[a]	22.500	0.167
1400-w25	22.813	22.584	33.375	22.469	0.343
1400-w26	22.875	22.667	33.333	22.896	-0.021
1400-w27	22.813	22.563	33.389	22.791	0.022
1400-w28	22.584	22.313	33.389	22.552	0.032
1400-w29	22.618[b]	22.354[b]	33.389	22.608	0.010
1400-w30	22.654[b]	22.398[b]	33.333	22.624	0.030
1400-w31	22.691[b]	22.444[b]	33.354	22.708	-0.017
1400-w32	22.730[b]	22.490[b]	33.458	22.755	-0.026
1400-w33	22.768[b]	22.536[b]	33.917	22.802	-0.034
1400-w34	22.805[b]	22.582[b]	33.875	22.810	-0.005
1400-w35	22.841[b]	22.626[b]	33.896	22.868	-0.027
1400-w36	22.875	22.667	33.958	22.982	-0.107
1400-w37	22.875	22.500	33.917	23.125	-0.250
1400-w38	22.875	22.250	33.791[a]	22.840	0.035
1400-w39	23.000	22.333	33.667	22.939	0.061
1400-w40	22.833	22.167	33.708	22.811	0.022
1400-w41	22.899[b]	22.246[b]	33.500	22.864	0.035
1400-w42	22.969[b]	22.330[b]	33.583	22.866	0.103
1400-w43	23.042[b]	22.417[b]	33.708	22.870	0.172
1400-w44	23.114[b]	22.504[b]	34.000	22.987	0.127
1400-w45	23.184[b]	22.588[b]	34.000	22.931	0.254
1400-w46	23.250	22.667	34.000	23.068	0.182
1400-w47	23.500	23.000	33.667	23.494	0.006
1400-w48	23.687[a]	23.062[a]	33.250	23.761	-0.075
1400-w49	23.875	23.125	33.188	23.826	0.049
1400-w50	23.563	23.630	33.667	24.346	-0.783
1400-w51	23.563	22.938	33.500	23.401	0.162
1400-w52	23.531[a]	22.844[a]	33.542	23.017	0.515
1401-w1	23.500	22.750	34.250	22.879	0.621
1401-w2	23.625	22.979	34.500	23.443	0.182
1401-w3	23.667	23.188	34.167	23.539	0.128
1401-w4	23.667	23.000	34.188	23.378	0.289

1401-w5	23.750	23.000	34.177[a]	23.871	-0.121
1401-w6	24.000	23.125	34.167	24.176	-0.176
1401-w7	24.000	23.167	34.167	23.986	0.014
1401-w8	24.000[a]	23.208[a]	34.250	24.044	-0.044
1401-w9	24.000	23.250	34.125	24.079	-0.079
1401-w10	24.000	23.167	34.167	23.986	0.014
1401-w11	23.875[a]	23.021[a]	34.167	23.834	0.040
1401-w12	23.750	22.875	34.250	23.741	0.009
1401-w13	23.625[a]	22.906[a]	34.167	23.687	-0.063
1401-w14	23.500	22.938	34.120[a]	23.749	-0.249
1401-w15	23.500	22.875	34.073	23.684	-0.184
1401-w16	23.583[a]	22.906[a]	34.014	23.774	-0.191
1401-w17	23.667	22.938	34.000	23.749	-0.082
1401-w18	23.771	23.000	34.083	23.780	-0.009
1401-w19	23.635[a]	22.937[a]	34.333	23.683	-0.048
1401-w20	23.500	22.875	34.633	23.578	-0.078
1401-w21	23.500	22.750	34.567[a]	23.439	0.061
1401-w22	23.250	22.750	34.500	23.497	-0.247
1401-w23	23.167	22.500	34.313	23.409	-0.242
1401-w24	23.250	22.500	34.875	23.614	-0.364
1401-w25	23.125[a]	22.500[a]	34.375	23.568	-0.443
1401-w26	23.000	22.500	34.187[a]	23.523	-0.523
1401-w27	23.125	22.500	34.000	23.395	-0.270
1401-w28	23.500	22.333	33.875	23.602	-0.102
1401-w29	23.125	22.333	33.865[a]	23.264	-0.139
1401-w30	23.125	22.333	33.854[a]	23.136	-0.011
1401-w31	23.146	22.354	33.844[a]	23.031	0.115
1401-w32	23.125	22.302[a]	33.833	22.893	0.232
1401-w33	23.000	22.250	33.694	22.833	0.167
1401-w34	22.750	22.000	33.750	22.569	0.181
1401-w35	23.750	22.125	33.750	22.691	1.059
1401-w36	23.125	22.333	33.722	22.897	0.228
1401-w37	23.125	22.333	33.736[a]	22.803	0.322
1401-w38	23.313	22.500	33.750	23.011	0.302
1401-w39	23.125	22.125	34.250	22.628	0.497
1401-w40	22.750	21.625	34.278[a]	22.098	0.652
1401-w41	22.750	21.750	34.306	22.235	0.515
1401-w42	22.750	21.500	34.875	21.989	0.761
1401-w43	22.500	21.250	34.854[a]	22.055	0.445
1401-w44	22.500	21.000	34.833	21.813	0.687
1401-w45	22.500	21.250	34.333	22.091	0.409
1401-w46	22.583[a]	21.375[a]	34.444[a]	22.589	-0.006
1401-w47	22.667	21.500	34.555[a]	22.708	-0.041
1401-w48	22.667	21.500	34.667	22.694	-0.027
1401-w49	22.667	21.125	34.833	21.979	0.688
1401-w50	22.667	21.500	34.708[a]	22.441	0.226
1401-w51	22.667	21.375	34.583	22.382	0.285
1401-w52	22.667	21.354	34.583	22.432	0.235
1402-w1	22.625	21.375	34.500[a]	22.563	0.063
1402-w2	22.500	21.250	34.417	22.350	0.150
1402-w3	22.500	21.375	34.417	22.401	0.099

1402-w4	22.667	21.333	34.417	22.357	0.310
1402-w5	22.563	21.375	34.500	22.347	0.216
1402-w6	22.500	21.375	34.500	22.293	0.207
1402-w7	22.500	21.333	34.583	22.249	0.251
1402-w8	22.500	21.333	34.667	22.249	0.251
1402-w9	22.333[a]	21.229[a]	34.750	22.194	0.139
1402-w10	22.167	21.125	34.833	22.085	0.081
1402-w11	22.496[a]	21.125[a]	34.875	22.139	0.357
1402-w12	22.830	21.125	35.104	22.192	0.638
1402-w13	22.000	21.000	35.052[a]	22.114	-0.114
1402-w14	22.000	21.000	35.000	22.167	-0.167
1402-w15	22.125	21.125	34.917	22.325	-0.200
1402-w16	22.125	21.125	35.000	22.472	-0.347
1402-w17	22.167	21.125	34.958	22.439	-0.272
1402-w18	22.250	21.000	35.014[a]	22.273	-0.023
1402-w19	22.250[a]	21.125	35.069	22.352	-0.102
1402-w20	22.250	21.125	35.243[a]	22.405	-0.155
1402-w21	22.250	21.630	35.417	22.914	-0.664
1402-w22	22.000	21.000	35.583	22.282	-0.282
1402-w23	21.654[a]	20.653[a]	35.417	21.949	-0.295
1402-w24	21.313	20.313	35.417	21.693	-0.380
1402-w25	21.125	20.125	35.167	21.599	-0.474
1402-w26	21.250	20.125	35.750	21.700	-0.450
1402-w27	21.125	20.125	35.083	21.599	-0.474
1402-w28	21.125	20.000	35.139	21.465	-0.340
1402-w29	21.250	20.167	34.860[a]	21.491	-0.241
1402-w30	21.167	20.125	34.583	21.802	-0.635
1402-w31	21.000	20.000	34.583	21.263	-0.263
1402-w32	21.000	19.938	34.791[a]	21.230	-0.230
1402-w33	20.875	19.750	35.000	20.863	0.012
1402-w34	20.667	19.667	35.167	20.611	0.056
1402-w35	21.750	20.750	35.167[b]	21.746	0.004
1402-w36	21.500	20.500	35.167[b]	21.613	-0.113
1402-w37	21.125	20.000	35.167[b]	21.212	-0.087
1402-w38	21.250	20.125	35.167[b]	21.446	-0.196
1402-w39	21.333	20.250	35.167[b]	21.580	-0.247
1402-w40	21.333	20.250	35.167[b]	21.580	-0.247
1402-w41	21.333[a]	20.291[a]	35.167[b]	21.624	-0.291
1402-w42	21.333	20.333	35.167	21.668	-0.335
1402-w43	21.250	20.333	35.333	21.668	-0.418
1402-w44	21.500	20.250	35.333[a]	21.580	-0.080
1402-w45	21.667	20.333	35.333[a]	21.668	-0.001
1402-w46	21.750	20.500	35.333	21.846	-0.096
1402-w47	21.812[a]	20.500[a]	35.219[a]	21.949	-0.137
1402-w48	21.875	20.500	35.104	21.949	-0.074
1402-w49	21.500	20.000	35.125	21.414	0.086
1402-w50	21.333	20.000	35.104[a]	21.414	-0.081
1402-w51	21.250	19.750	35.083	21.078	0.172
1402-w52	21.125	19.750	35.125	21.009	0.116
1403-w1	21.000	19.500	35.125	20.756	0.244
1403-w2	20.875	19.438	35.208	20.677	0.198

1403-w3	21.250	20.125	35.250	21.396	-0.146
1403-w4	21.333	20.125	35.292	21.421	-0.088
1403-w5	21.125	20.250	35.750	21.554	-0.429
1403-w6	21.435[a]	20.291[a]	35.375	21.649	-0.214
1403-w7	21.750	20.333	35.437[a]	21.719	0.031
1403-w8	21.593[a]	20.229[a]	35.500	21.634	-0.040
1403-w9	21.438	20.125	35.500[a]	21.802	-0.364
1403-w10	21.250	20.000	35.500[a]	21.439	-0.189
1403-w11	21.333	20.167	35.500	21.657	-0.324
1403-w12	21.667	20.333	35.500	21.873	-0.206
1403-w13	21.750	20.333	35.416[a]	21.873	-0.123
1403-w14	21.500	20.125	35.333[a]	21.650	-0.150
1403-w15	21.500	20.167	35.250	21.695	-0.195
1403-w16	21.563	20.125	35.250	21.650	-0.087
1403-w17	21.500[a]	20.062[a]	35.250	21.531	-0.031
1403-w18	21.438	20.000	35.417	21.414	0.024
1403-w19	21.333	19.833	35.417	21.185	0.148
1403-w20	21.500	19.625	35.417	20.963	0.537
1403-w21	21.500	20.125	35.542	21.497	0.003
1403-w22	21.667	20.167	35.583	21.644	0.023
1403-w23	21.500	20.000	35.611[a]	21.465	0.035
1403-w24	21.249[a]	19.875[a]	35.639[a]	21.330	-0.082
1403-w25	21.000	19.750	35.667	21.271	-0.271
1403-w26	20.875	19.375	35.625	20.892	-0.017
1403-w27	20.750	19.250	35.625	20.773	-0.023
1403-w28	21.000	19.333	35.604[a]	20.879	0.121
1403-w29	21.500	20.125	35.583	21.751	-0.251
1403-w30	21.667	20.000	35.500	21.591	0.076
1403-w31	21.500	20.000	35.458[a]	21.591	-0.091
1403-w32	21.333	19.875	35.417	21.443	-0.110
1403-w33	21.333	20.000	35.250	21.566	-0.233
1403-w34	21.500	20.250	35.271	21.784	-0.284
1403-w35	21.875	20.667	35.375	22.207	-0.332
1403-w36	21.875[a]	20.667	35.458[a]	22.180	-0.305
1403-w37	21.875	20.667	35.541[a]	22.076	-0.201
1403-w38	21.833	20.500	35.625	21.911	-0.078
1403-w39	21.875	20.750	35.583	22.243	-0.368
1403-w40	22.000	20.750	35.479[a]	22.296	-0.296
1403-w41	22.250	20.667	35.375	22.259	-0.009
1403-w42	22.000	20.667	35.167	22.311	-0.311
1403-w43	22.125	20.500	35.167	22.105	0.020
1403-w44	22.000	20.333	35.083	21.860	0.140
1403-w45	22.166[a]	20.664[a]	35.042[a]	22.151	0.015
1403-w46	22.333	21.000	35.000	22.379	-0.046
1403-w47	22.333	21.000	35.333	22.379	-0.046
1403-w48	22.333	21.750	35.375	23.123	-0.790
1403-w49	22.667	21.000	35.479[a]	22.299	0.368
1403-w50	22.750	21.000	35.583	22.273	0.477
1403-w51	22.333	20.667	35.583	22.128	0.205
1403-w52	22.250	20.500	35.583	21.975	0.275
1404-w1	22.333	20.500	35.417	22.040	0.293

1404-w2	22.500	20.667	35.604	22.285	0.215
1404-w3	22.583	20.667	35.667	22.285	0.298
1404-w4	22.333	20.500	35.646[a]	22.105	0.228
1404-w5	22.500	20.500	35.625	22.001	0.499
1404-w6	22.250	20.375	35.708	21.983	0.267
1404-w7	22.125	20.333	35.667	21.976	0.149
1404-w8	22.333	20.667	35.750[a]	22.324	0.009
1404-w9	22.500	20.667	35.833	22.311	0.189
1404-w10	22.333	20.500	35.833	22.182	0.151
1404-w11	22.167	20.333	35.750	21.976	0.191
1404-w12	22.125	20.333	35.833	22.027	0.098
1404-w13	22.125	20.500	35.819	22.260	-0.135
1404-w14	22.000	20.500	35.750	22.260	-0.260
1404-w15	22.125	20.667	35.500	22.389	-0.264
1404-w16	22.167	20.667	35.389[a]	22.441	-0.274
1404-w17	22.250	20.750	35.277[a]	22.523	-0.273
1404-w18	22.167	20.667	35.167	22.389	-0.222
1404-w19	22.250	20.667	35.000	22.233	0.017
1404-w20	22.250	20.667	35.125	22.163	0.087
1404-w21	22.333	20.750	35.187[a]	22.182	0.151
1404-w22	22.500	20.938	35.250	22.313	0.187
1404-w23	22.375	20.875	35.167[a]	22.140	0.235
1404-w24	22.500	21.000	35.083	22.352	0.148
1404-w25	22.500	21.000	34.250	22.392	0.108
1404-w26	22.333	20.750	35.278	22.165	0.168
1404-w27	22.333	20.750	35.333[a]	22.112	0.221
1404-w28	22.333	21.000	35.389	22.326	0.007
1404-w29	22.500	21.000	35.250	21.795	0.705
1404-w30	22.667	21.000	35.278[a]	22.449	0.218
1404-w31	22.250	21.000	35.306	22.485	-0.235
1404-w32	22.333	20.875	35.333	22.386	-0.053
1404-w33	22.333	20.750	35.333	22.165	0.168
1404-w34	22.333	21.000	35.250	22.449	-0.116
1404-w35	22.333	21.000	35.000	22.467	-0.134
1404-w36	22.250	20.833	35.000	22.306	-0.056
1404-w37	22.054[a]	21.012[a]	35.000	22.498	-0.444
1404-w38	21.860[a]	21.193[a]	35.333	22.638	-0.778
1404-w39	21.667	21.375	35.375[a]	22.670	-1.003
1404-w40	21.750	20.500	35.417	21.742	0.008
1404-w41	21.915[a]	20.583[a]	35.250	21.830	0.085
1404-w42	22.082[a]	20.666[a]	35.250	22.128	-0.046
1404-w43	22.250	20.750	35.500	22.243	0.007
1404-w44	22.250	21.000	35.500	22.538	-0.288
1404-w45	22.875	21.125	35.500	22.565	0.310
1404-w46	22.433[a]	21.083[a]	35.437[a]	22.521	-0.088
1404-w47	22.000	21.042[a]	35.375[a]	22.636	-0.636
1404-w48	22.124[a]	21.000	35.312[a]	22.591	-0.467
1404-w49	22.249[a]	21.313[a]	35.250	22.927	-0.678
1404-w50	22.375	21.630	35.354	23.228	-0.853
1404-w51	22.667	21.250	35.333	22.779	-0.112
1404-w52	22.646[a]	21.250[a]	35.305[b]	22.739	-0.093

1405-w1	22.625	21.250	35.275[b]	22.699	-0.074
1405-w2	22.310[a]	21.250[a]	35.245[b]	22.766	-0.456
1405-w3	22.000	20.500	35.213[b]	21.949	0.051
1405-w4	22.000	20.875	35.183[b]	22.332	-0.332
1405-w5	22.166[a]	21.000[a]	35.153[b]	22.446	-0.281
1405-w6	22.333	21.125	35.125	22.561	-0.228
1405-w7	22.250	21.125	35.218[a]	22.542	-0.292
1405-w8	22.291[a]	21.062[a]	35.312[a]	22.457	-0.165
1405-w9	22.333	21.000	35.406[a]	22.371	-0.038
1405-w10	22.291[a]	20.937[a]	35.500	22.286	0.006
1405-w11	22.250	20.875	35.500	22.278	-0.028
1405-w12	22.250	20.875	35.333	22.338	-0.088
1405-w13	22.250[a]	20.875[a]	35.375[a]	22.397	-0.147
1405-w14	22.250	20.875	35.417	22.456	-0.206
1405-w15	22.125	21.630	35.333	23.269	-1.144
1405-w16	22.312[a]	21.439[a]	35.222[a]	22.955	-0.643
1405-w17	22.500	21.250	35.111[a]	22.779	-0.279
1405-w18	22.750	21.500	35.000	23.074	-0.324
1405-w19	23.000	21.500	35.250	23.020	-0.020
1405-w20	23.031[a]	21.542[a]	35.250	22.992	0.039
1405-w21	23.062[a]	21.583[a]	35.208[a]	22.964	0.099
1405-w22	23.094[a]	21.625[a]	35.167	22.936	0.158
1405-w23	23.125	21.667	35.250	23.144	-0.019
1405-w24	23.250	21.667	35.250	23.144	0.106
1405-w25	22.875	21.438	35.250	22.873	0.002
1405-w26	22.875	21.375	35.250	22.778	0.097
1405-w27	22.667	21.250	35.208[a]	22.699	-0.032
1405-w28	22.485[a]	21.124[a]	35.167[a]	22.565	-0.080
1405-w29	22.304[a]	20.999[a]	35.125	22.431	-0.127
1405-w30	22.125	20.875	35.500	22.298	-0.173
1405-w31	21.937[a]	20.875	35.167	22.272	-0.335
1405-w32	21.750	20.813	35.146[a]	22.179	-0.429
1405-w33	21.750[a]	20.740[a]	35.125	22.075	-0.325
1405-w34	21.750	20.667	35.139[a]	22.233	-0.483
1405-w35	21.875	20.875	35.153[a]	22.246	-0.371
1405-w36	21.687[a]	20.812[a]	35.167	22.166	-0.479
1405-w37	21.500	20.750	35.250[a]	22.086	-0.586
1405-w38	21.750	20.667	35.333	22.007	-0.257
1405-w39	21.666[a]	20.555[a]	35.444[a]	21.896	-0.230
1405-w40	21.583[a]	20.444[a]	35.555[a]	21.786	-0.203
1405-w41	21.500	20.333	35.667	21.719	-0.219
1405-w42	21.994[a]	20.664[a]	35.687[a]	22.125	-0.131
1405-w43	22.500	21.000	35.708[a]	22.555	-0.055
1405-w44	22.500[a]	21.000[a]	35.729[a]	22.626	-0.126
1405-w45	22.500	21.000	35.750	22.697	-0.197
1405-w46	22.500	21.220[a]	35.750	22.948	-0.448
1405-w47	22.583[a]	21.442[a]	35.541[a]	23.202	-0.619
1405-w48	22.667	21.667	35.333	23.459	-0.792
1405-w49	22.611[a]	21.267[a]	35.417	23.040	-0.428
1405-w50	22.556[a]	20.875	35.396[a]	22.615	-0.059
1405-w51	22.500	20.875	35.375	22.482	0.018

1405-w52	22.500[a]	20.937[a]	35.375[a]	22.418	0.082
1406-w1	22.500	21.000	35.375[a]	22.538	-0.038
1406-w2	22.687[a]	21.062[a]	35.375	22.592	0.095
1406-w3	22.875	21.125	35.417	22.645	0.230
1406-w4	22.875	21.167	35.417	22.690	0.185
1406-w5	22.875	21.250	35.375	22.779	0.096
1406-w6	23.125	21.250	35.333	22.779	0.346
1406-w7	22.833	21.333	35.417	22.895	-0.062
1406-w8	22.833[a]	21.333[a]	35.444[a]	22.895	-0.062
1406-w9	22.833[a]	21.333[a]	35.472[a]	22.868	-0.035
1406-w10	22.833	21.333	35.500	22.841	-0.008
1406-w11	22.833[a]	21.385[a]	35.500	22.952	-0.119
1406-w12	22.833	21.438	35.500[a]	23.026	-0.193
1406-w13	22.875	21.500	35.500	23.111	-0.236
1406-w14	23.000	21.500	35.500[a]	23.129	-0.129
1406-w15	23.125	21.500	35.500	23.129	-0.004
1406-w16	23.125	21.667	35.542	23.308	-0.183
1406-w17	23.062[a]	21.583[a]	35.500[a]	23.218	-0.156
1406-w18	23.000	21.500	35.458	23.129	-0.129
1406-w19	23.062[a]	21.531[a]	35.583	23.163	-0.100
1406-w20	23.125	21.563	35.500	23.224	-0.099
1406-w21	23.333	21.667	35.562[a]	23.308	0.025
1406-w22	23.407[a]	21.600[a]	35.625	23.209	0.198
1406-w23	23.481[a]	21.533[a]	35.667	23.218	0.263
1406-w24	23.555[a]	21.466[a]	35.456[a]	23.092	0.463
1406-w25	23.630	21.399[a]	35.248[a]	23.061	0.569
1406-w26	23.418[a]	21.333	35.040[a]	23.030	0.388
1406-w27	23.208[a]	21.250[a]	34.833	22.967	0.241
1406-w28	23.000	21.167	34.729[a]	22.743	0.257
1406-w29	23.125	21.250	34.625	22.697	0.428
1406-w30	23.027[a]	21.208[a]	35.250	22.519	0.508
1406-w31	22.930[a]	21.167[a]	34.750	22.343	0.587
1406-w32	22.833	21.125	34.792[a]	22.232	0.601
1406-w33	22.750	21.125	34.833	22.165	0.585
1406-w34	22.750	21.500	35.417	22.966	-0.216
1406-w35	22.750	21.125	35.417	22.245	0.505
1406-w36	22.875[a]	21.187[a]	35.458[a]	22.338	0.537
1406-w37	23.000	21.250	35.500	22.431	0.569
1406-w38	22.875[a]	21.187[a]	35.250	22.739	0.136
1406-w39	22.750	21.125	35.583	22.672	0.078
1406-w40	22.667	21.000	35.500[a]	22.564	0.103
1406-w41	22.750	21.125	35.417	22.725	0.025
1406-w42	22.625[a]	21.062[a]	35.333	22.498	0.126
1406-w43	22.500	21.000	34.667	22.644	-0.144
1406-w44	22.666[a]	21.000[a]	34.833[a]	22.591	0.075
1406-w45	22.833	21.000	35.000	22.538	0.295
1406-w46	22.791[a]	21.000[a]	34.583	22.485	0.307
1406-w47	22.750	21.000	34.791[a]	22.061	0.689
1406-w48	22.791[a]	21.000[a]	35.000	22.166	0.625
1406-w49	22.833	21.000	35.083	22.273	0.560
1406-w50	22.805[a]	21.110[a]	35.292	22.123	0.682

1406-w51	22.778[a]	21.221[a]	35.417	22.373	0.404
1406-w52	22.750	21.333	35.458[a]	22.626	0.124
1407-w1	22.750	21.250	35.500	22.592	0.158
1407-w2	23.040[a]	21.560[a]	35.500	23.057	-0.018
1407-w3	23.333	21.875	35.417	23.477	-0.144
1407-w4	23.229[a]	21.812[a]	35.444[a]	23.437	-0.209
1407-w5	23.125	21.750	35.472[a]	23.398	-0.273
1407-w6	23.333	21.750	35.500	23.398	-0.065
1407-w7	23.333[a]	21.812[a]	35.417	23.410	-0.077
1407-w8	23.333	21.875	35.333	23.495	-0.162
1407-w9	23.333	21.333	35.375	22.931	0.402
1407-w10	23.333	21.500	35.417	23.129	0.204
1407-w11	23.291[a]	21.583[a]	35.583	23.164	0.128
1407-w12	23.250	21.667	35.625[a]	23.199	0.051
1407-w13	23.333	21.750	35.667	23.315	0.018
1407-w14	23.333	21.875	35.604[a]	23.477	-0.144
1407-w15	23.333[a]	21.812[a]	35.542	23.520	-0.187
1407-w16	23.333	21.750	35.667	23.480	-0.147
1407-w17	23.333	22.000	35.625	23.778	-0.445
1407-w18	23.250	21.500	35.667	23.197	0.053
1407-w19	23.250	21.500	35.549[a]	23.156	0.094
1407-w20	23.333	21.750	35.432[a]	23.508	-0.175
1407-w21	23.354[a]	21.750[a]	35.316[a]	23.480	-0.126
1407-w22	23.375	21.750	35.199[a]	23.508	-0.133
1407-w23	23.500	21.750	35.083	23.430	0.070
1407-w24	23.500[a]	21.708[a]	35.583	23.308	0.192
1407-w25	23.500	21.667	35.333	23.187	0.313
1407-w26	23.500	21.500	35.250	22.933	0.567
1407-w27	23.500	21.563	34.833	22.924	0.576
1407-w28	23.458[a]	21.625[a]	35.000[a]	23.318	0.140
1407-w29	23.417[a]	21.687[a]	35.167	23.221	0.196
1407-w30	23.375	21.750	35.246[b]	23.233	0.142
1407-w31	23.187[a]	21.812[a]	35.330[b]	23.024	0.163
1407-w32	23.000	21.875	35.417[b]	23.200	-0.200
1407-w33	23.750	22.000	35.504[b]	23.444	0.306
1407-w34	23.875[a]	22.000[a]	35.588[b]	23.500	0.375
1407-w35	24.000	22.000	35.667	23.555	0.445
1407-w36	24.000[a]	22.000[a]	35.625[a]	23.611	0.389
1407-w37	24.000	22.000	35.583	23.666	0.334
1407-w38	23.750	22.000	35.500	23.722	0.028
1407-w39	23.750	22.000	35.250	23.778	-0.028
1407-w40	24.000	21.000	35.420[b]	22.670	1.330
1407-w41	23.667	21.124[a]	35.603[b]	22.778	0.889
1407-w42	23.611[a]	21.249[a]	35.792[b]	22.858	0.753
1407-w43	23.556[a]	21.374[a]	35.980[b]	22.831	0.724
1407-w44	23.500	21.500	36.163[b]	23.082	0.418
1407-w45	23.583[a]	21.416[a]	36.333	23.109	0.475
1407-w46	23.667	21.333	36.417	23.135	0.532
1407-w47	23.583[a]	21.389[a]	35.833	23.313	0.271
1407-w48	23.500	21.444[a]	36.000	23.491	0.009
1407-w49	23.563	21.500	35.750	23.672	-0.109

1407-w50	23.500	21.416[a]	35.500	23.633	-0.133
1407-w51	23.458[a]	21.332[a]	35.500	23.164	0.294
1407-w52	23.416[a]	21.249[a]	35.667	23.181	0.235
1408-w1	23.375[a]	21.166[a]	35.667	22.930	0.445
1408-w2	23.333	21.084	35.625[a]	22.681	0.652
1408-w3	23.467[a]	21.279[a]	35.583	22.891	0.577
1408-w4	23.602[a]	21.476[a]	35.556[a]	23.211	0.391
1408-w5	23.738[a]	21.674[a]	35.528[a]	23.426	0.312
1408-w6	23.875	21.875	35.500	23.615	0.260
1408-w7	23.771[a]	21.771[a]	35.597[a]	23.475	0.296
1408-w8	23.667	21.667	35.694[a]	23.345	0.322
1408-w9	23.583[a]	21.771[a]	35.792	23.438	0.145
1408-w10	23.500	21.875	35.750	23.532	-0.032
1408-w11	23.500	22.000	35.687[a]	23.731	-0.231
1408-w12	23.563	21.750	35.625	23.526	0.037
1408-w13	23.500	21.750	35.583	23.590	-0.090
1408-w14	23.534[b]	21.767[b]	35.572[b]	23.582	-0.046
1408-w15	23.569[b]	21.785[b]	35.560[b]	23.560	0.011
1408-w16	23.606[b]	21.803[b]	35.548[b]	23.538	0.069
1408-w17	23.644[b]	21.822[b]	35.535[b]	23.530	0.113
1408-w18	23.681[b]	21.840[b]	35.523[b]	23.541	0.137
1408-w19	23.716	21.858	35.511	23.552	0.162
1408-w20	23.750	21.875	35.500	23.564	0.186
1408-w21	23.500	21.875	35.458[a]	23.556	-0.056
1408-w22	23.333	21.750	35.417	23.413	-0.080
1408-w23	23.333	21.500	35.361[a]	23.137	0.196
1408-w24	23.500	21.750	35.305[a]	23.398	0.102
1408-w25	23.312[a]	21.499[a]	35.250	23.100	0.212
1408-w26	23.125	21.250	35.125	22.806	0.319
1408-w27	23.125[a]	21.375[a]	35.062[a]	22.904	0.221
1408-w28	23.125	21.500	35.000	23.002	0.123
1408-w29	23.000	21.333	35.083[a]	22.788	0.212
1408-w30	22.667	21.250	35.167	22.618	0.049
1408-w31	23.000	21.333[a]	35.208[a]	22.666	0.334
1408-w32	23.017[b]	21.416[a]	35.250[a]	22.714	0.304
1408-w33	23.036[b]	21.500	35.292[a]	22.857	0.180
1408-w34	23.054[b]	21.375[a]	35.333	22.778	0.278
1408-w35	23.074[b]	21.250	35.375	22.672	0.402
1408-w36	23.093[b]	21.267[a]	35.389[a]	22.717	0.376
1408-w37	23.113[b]	21.283[a]	35.403[a]	22.761	0.350
1408-w38	23.131[b]	21.300[a]	35.417	22.806	0.324
1408-w39	23.150[b]	21.316[a]	35.333	22.851	0.298
1408-w40	23.167	21.333	35.500	22.877	0.290
1408-w41	23.167	21.500	35.583	23.065	0.102
1408-w42	23.125	21.375	35.437[a]	22.940	0.185
1408-w43	23.250	21.333	35.290[a]	22.841	0.409
1408-w44	23.250[a]	21.333[a]	35.145[a]	22.949	0.301
1408-w45	23.250[a]	21.333[a]	35.000	23.003	0.247
1408-w46	23.250	21.333	34.333	22.908	0.342
1408-w47	23.336[a]	21.421[a]	34.333	22.908	0.428
1408-w48	23.421[a]	21.510[a]	34.665[a]	22.908	0.514

1408-w49	23.508[a]	21.599[a]	35.000	22.908	0.600
1408-w50	23.594	21.688	35.500	22.564	1.030
1408-w51	23.588[a]	21.725[a]	35.333[a]	22.603	0.985
1408-w52	23.582[a]	21.763[a]	35.166[a]	22.861	0.721
1409-w1	23.575[a]	21.800[a]	35.000	23.121	0.454
1409-w2	23.569[a]	21.837[a]	35.066[a]	23.492	0.077
1409-w3	23.563	21.875	35.133[a]	23.421	0.142
1409-w4	23.563	21.688	35.200[a]	23.111	0.452
1409-w5	23.750	22.000	35.266[a]	23.333	0.417
1409-w6	23.541[a]	21.875[a]	35.333	23.244	0.296
1409-w7	23.333	21.750	35.417	23.156	0.177
1409-w8	23.541[a]	21.750[a]	35.389[a]	23.200	0.341
1409-w9	23.750	21.750	35.361[a]	23.244	0.506
1409-w10	23.875[a]	21.875[a]	35.333	23.421	0.453
1409-w11	24.000	22.000	35.358[a]	23.611	0.389
1409-w12	24.000[a]	22.000[a]	35.383[a]	23.593	0.407
1409-w13	24.000	22.000	35.408[a]	23.574	0.426
1409-w14	23.969[a]	22.000[a]	35.433[a]	23.556	0.413
1409-w15	23.938	22.000	35.458	23.572	0.366
1409-w16	24.000	22.000	35.475[a]	23.589	0.411
1409-w17	23.750	21.750	35.492[a]	23.337	0.413
1409-w18	23.750	21.750	35.508[a]	23.354	0.396
1409-w19	23.000	21.500	35.525[a]	23.102	-0.102
1409-w20	22.500	21.500	35.542	23.112	-0.612
1409-w21	22.500[a]	21.433[a]	35.594[a]	23.051	-0.551
1409-w22	22.500[a]	21.366[a]	35.646[a]	22.990	-0.490
1409-w23	22.500[a]	21.300[a]	35.698[a]	22.929	-0.429
1409-w24	22.500[a]	21.233[a]	35.750	22.869	-0.369
1409-w25	22.500	21.167	35.750[a]	22.831	-0.331
1409-w26	22.406[a]	21.062[a]	35.750	22.751	-0.345
1409-w27	22.312[a]	20.957[a]	34.625	22.671	-0.359
1409-w28	22.218[a]	20.853[a]	35.583	22.591	-0.373
1409-w29	22.125	20.750	35.583	22.479	-0.354
1409-w30	22.187[a]	20.625[a]	35.542	22.343	-0.156
1409-w31	22.250	20.500	35.500	21.509	0.741
1409-w32	22.250	20.500	35.417	22.105	0.145
1409-w33	22.149[a]	20.550[a]	35.500	22.158	-0.009
1409-w34	22.049[a]	20.600[a]	35.437[a]	22.186	-0.138
1409-w35	21.949[a]	20.650[a]	35.375	22.214	-0.265
1409-w36	21.849[a]	20.700[a]	35.500	22.216	-0.367
1409-w37	21.750	20.750	35.528[a]	22.322	-0.572
1409-w38	21.750	20.250	35.556[a]	21.746	0.004
1409-w39	21.750	20.125	35.583	21.573	0.177
1409-w40	21.750	20.250	35.667[a]	21.784	-0.034
1409-w41	21.770[b]	20.250[b]	35.750	21.801	-0.030
1409-w42	21.791[b]	20.250[b]	35.701[a]	21.818	-0.027
1409-w43	21.813[b]	20.250[b]	35.653[a]	21.835	-0.023
1409-w44	21.834[b]	20.250[b]	35.604	21.886	-0.053
1409-w45	21.855[b]	20.250[b]	35.625[a]	21.938	-0.083
1409-w46	21.875	20.250	35.646[a]	21.908	-0.033
1409-w47	21.750	20.250	35.667	21.878	-0.128

1409-w48	21.624[a]	20.017[a]	35.667	21.596	0.028
1409-w49	21.499[a]	19.786[a]	35.683[a]	21.360	0.138
1409-w50	21.374[a]	19.558[a]	35.700[a]	21.126	0.248
1409-w51	21.250	19.333	35.717[a]	20.895	0.355
1409-w52	21.124[a]	19.375[a]	35.733[a]	20.940	0.184
1410-w1	20.999[a]	19.416[a]	35.750	20.995	0.003
1410-w2	20.874[a]	19.458[a]	35.583	21.050	-0.176
1410-w3	20.750	19.500	35.604[a]	21.105	-0.355
1410-w4	21.204[a]	19.625	35.625[a]	21.250	-0.047
1410-w5	21.667	19.750	35.646[a]	21.396	0.271
1410-w6	21.333	19.667	35.667	21.207	0.126
1410-w7	21.125	19.750	35.667[a]	21.309	-0.184
1410-w8	21.229[a]	19.708[a]	35.667[a]	21.276	-0.047
1410-w9	21.333	19.667	35.667	21.244	0.089
1410-w10	21.499[a]	19.833[a]	35.667	21.435	0.064
1410-w11	21.667	20.000	35.667	21.616	0.051
1410-w12	21.500	19.875	35.750[a]	21.481	0.019
1410-w13	21.250	19.750	35.833[a]	21.346	-0.096
1410-w14	21.208[a]	19.750	35.917	21.346	-0.138
1410-w15	21.167[a]	19.498[a]	36.042	21.074	0.093
1410-w16	21.125	19.250	36.125	20.854	0.271
1410-w17	21.000	19.667	36.062[a]	21.355	-0.355
1410-w18	21.125	19.500	36.000	21.223	-0.098
1410-w19	21.062[a]	19.416[a]	35.937[a]	21.206	-0.144
1410-w20	21.000	19.333	35.875	21.164	-0.164
1410-w21	21.000[a]	19.291[a]	35.825[a]	21.082	-0.082
1410-w22	21.000	19.250	35.775[a]	21.000	0.000
1410-w23	21.062[a]	19.187[a]	35.725[a]	20.895	0.167
1410-w24	21.125	19.125	35.675[a]	20.791	0.334
1410-w25	20.998[a]	19.150[a]	35.625	20.789	0.209
1410-w26	20.873[a]	19.175[a]	35.917	20.787	0.086
1410-w27	20.748[a]	19.200[a]	35.917	20.785	-0.037
1410-w28	20.624[a]	19.225[a]	35.958[a]	20.783	-0.160
1410-w29	20.500	19.250	36.000	20.781	-0.281
1410-w30	20.500[a]	19.124[a]	36.028[a]	20.814	-0.314
1410-w31	20.500[a]	18.999[a]	36.056[a]	20.678	-0.178
1410-w32	20.500[a]	18.875	36.083	20.567	-0.067
1410-w33	20.500[a]	18.937[a]	36.083	20.659	-0.159
1410-w34	20.500	19.000	36.042[a]	20.743	-0.243
1410-w35	20.474[b]	18.971[b]	36.000	20.725	-0.253
1410-w36	20.446[b]	18.939[b]	35.958[a]	20.707	-0.263
1410-w37	20.417[b]	18.907[b]	35.917	20.673	-0.256
1410-w38	20.387[b]	18.874[b]	35.933[a]	20.615	-0.226
1410-w39	20.359[b]	18.842[b]	35.950[a]	20.557	-0.196
1410-w40	20.333	18.813	35.967[a]	20.500	-0.167

Sources: The exchange rates quoted in Venice are extracted from Medieval and Early Modern Data Bank (MEMDB): Currency exchanges (Mueller) http://www2.scc.rutgers.edu/memdb/index.html, and Bruges' exchange rates are calculated from R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968), Appendix I.
Note. The exchange rates of Venice-Paris were quoted at a variable number of Venetian grossi a oro of account per French franc, Venice-Bruges at a variable number of Venetian

grossi a oro of account per Flemish franc (33 Flemish groots), and Bruges-Paris at a variable number of Flemish groots per French franc.

The Venice-Bruges-Paris cross weekly exchange rates are calculated on the following format, $E_t^{vbrup} = \frac{E_{t-4}^{brup}}{33} * E_t^{vbru}$, where E^{vbru}, E^{brup}, and E^{vbrup} are the Venice-Bruges, Bruges-Paris, and Venice-Bruges-Paris direct-exchange rates, respectively.

Two approaches are used to interpolate the missing exchange rates: a. linear interpolation and b. cardinal spline interpolation.

Appendix 2.B The weekly exchange rates of Venice, Bruges and Barcelona in 1399-1410

Date	Venice-Barcelona	Venice-Bruges	Bruges-Barcelona	Venice-Bruges-Barcelona	The difference
1399-w14	194.000	21.500	9.625	-	-
1399-w15	194.000	21.500	9.646	-	-
1399-w16	193.500	21.500	9.792	-	-
1399-w17	191.500	21.532	9.896	-	-
1399-w18	192.000	21.563	9.813	192.830	-0.830
1399-w19	191.500	21.646	9.792	192.510	-1.010
1399-w20	192.000	21.667	9.854	195.234	-3.234
1399-w21	192.000	21.667	9.833	197.303	-5.303
1399-w22	193.652[a]	21.563	9.792	196.587	-2.934
1399-w23	195.319[a]	21.448[a]	9.802	197.231	-1.912
1399-w24	197.000	21.333	9.875	199.547	-2.547
1399-w25	197.250[a]	21.291[a]	9.781	199.510	-2.260
1399-w26	197.500	21.250	9.861	199.066	-1.566
1399-w27	198.000	21.125	9.865	200.446	-2.446
1399-w28	195.000	21.277	9.833	200.501	-5.501
1399-w29	198.000	21.000	9.792	201.217	-3.217
1399-w30	198.250	21.031	9.760	202.553	-4.303
1399-w31	200.000	21.063	9.833	202.327	-2.327
1399-w32	199.000	21.125	9.858	201.082	-2.082
1399-w33	199.000	21.830	9.875	193.777	5.223
1399-w34	196.000	21.125	9.910	199.597	-3.597
1399-w35	195.000	21.250	9.913[a]	199.899	-4.899
1399-w36	195.000	21.209	9.917	200.804	-5.804
1399-w37	194.000	21.500	9.917[a]	198.419	-4.419
1399-w38	194.500	21.229	9.917	201.664	-7.164
1399-w39	195.746[a]	21.239[a]	10.000	201.635	-5.889
1399-w40	197.000	21.250	9.986	201.607	-4.607
1399-w41	196.000	21.250	10.055[a]	201.607	-5.607
1399-w42	195.500	21.250	10.125	201.607	-6.107
1399-w43	195.000	21.125	10.083	204.497	-9.497
1399-w44	197.000	21.667	10.104	199.107	-2.107
1399-w45	196.500	21.709	10.333	200.102	-3.602
1399-w46	196.500	21.854	10.375	200.146	-3.646
1399-w47	197.250	21.750	10.417	200.276	-3.026
1399-w48	198.000	21.667	10.459	201.458	-3.458
1399-w49	199.000	21.667	10.375	206.021	-7.021
1399-w50	199.000	21.625	10.500	207.260	-8.260
1399-w51	200.000	21.646	10.375	207.891	-7.891
1399-w52	205.000	21.667	10.416[a]	208.523	-3.523
1400-w1	208.651[a]	21.667[a]	10.458	206.858	1.793
1400-w2	212.368[a]	21.667[a]	10.479	209.351	3.017
1400-w3	216.150[a]	21.667[a]	10.455[a]	206.858	9.292
1400-w4	220.000	21.667	10.431	207.684	12.316
1400-w5	200.000	21.750	10.375	207.718	-7.718
1400-w6	200.000	21.875	10.354	206.945	-6.945
1400-w7	200.500	22.000	10.403	205.294	-4.794
1400-w8	199.750	22.440	10.365	200.804	-1.054

1400-w9	200.500	22.250	10.472	201.438	-0.938
1400-w10	210.000	22.209	10.500	201.406	8.594
1400-w11	210.500	22.750	10.528	197.536	12.964
1400-w12	210.125	22.709	10.500	197.173	12.952
1400-w13	206.522[a]	22.527[a]	10.229	200.825	5.696
1400-w14	202.981[a]	22.346[a]	10.292	202.989	-0.008
1400-w15	199.500	22.167	10.271	205.174	-5.674
1400-w16	198.999[a]	22.250[a]	10.083	203.867	-4.867
1400-w17	198.500	22.333	10.542	197.865	0.635
1400-w18	199.000	22.459	10.667	197.972	1.028
1400-w19	198.750	22.750	10.667	195.036	3.714
1400-w20	198.000	22.354	10.709	194.864	3.136
1400-w21	199.250	22.333	10.750	203.913	-4.663
1400-w22	199.375[a]	22.354[a]	10.750	206.144	-6.769
1400-w23	199.500	22.375	10.709	205.951	-6.451
1400-w24	198.372[a]	22.500	10.719[a]	205.603	-7.231
1400-w25	197.250	22.584	10.729	205.637	-8.387
1400-w26	198.000	22.667	10.771	204.879	-6.879
1400-w27	198.750	22.563	10.764	205.029	-6.279
1400-w28	204.750	22.313	10.729[a]	207.529	-2.779
1400-w29	206.050[a]	22.354[b]	10.694	207.339	-1.289
1400-w30	207.358[a]	22.398[b]	10.667	207.743	-0.385
1400-w31	208.675[a]	22.444[b]	10.542	207.187	1.488
1400-w32	210.000	22.490[b]	10.333	206.091	3.909
1400-w33	204.525[a]	22.536[b]	10.167	205.000	-0.475
1400-w34	199.193[a]	22.582[b]	10.000	204.064	-4.871
1400-w35	194.000	22.626[b]	9.959	201.282	-7.282
1400-w36	190.000	22.667	9.938	196.932	-6.932
1400-w37	186.000	22.500	9.917	195.206	-9.206
1400-w38	187.500	22.250	10.083	194.157	-6.657
1400-w39	187.000	22.333	9.833	192.633	-5.633
1400-w40	191.000	22.167	10.125	193.666	-2.666
1400-w41	190.843[b]	22.246[b]	10.083	192.583	-1.740
1400-w42	190.674[b]	22.330[b]	10.146	195.074	-4.399
1400-w43	190.500[b]	22.417[b]	10.209	189.493	1.007
1400-w44	190.326[b]	22.504[b]	10.292	194.368	-4.042
1400-w45	190.157[b]	22.588[b]	10.354[a]	192.843	-2.685
1400-w46	190.000	22.667	10.417	193.368	-3.368
1400-w47	189.000	23.000	10.667	191.742	-2.742
1400-w48	191.000	23.062[a]	10.778	192.787	-1.787
1400-w49	191.000	23.125	10.750	193.430	-2.430
1400-w50	191.000	23.630	10.750	190.442	0.558
1400-w51	192.500	22.938	10.771	200.900	-8.400
1400-w52	192.750[a]	22.844[a]	10.500	203.819	-11.069
1401-w1	193.000	22.750	10.500	204.132	-11.132
1401-w2	193.000	22.979	10.333	202.098	-9.098
1401-w3	194.500	23.188	10.347[a]	200.672	-6.172
1401-w4	194.000	23.000	10.361[a]	197.217	-3.217
1401-w5	194.000	23.000	10.375	197.217	-3.217
1401-w6	193.000	23.125	10.186[a]	193.032	-0.032
1401-w7	192.500	23.167	10.000	192.942	-0.442

1401-w8	191.623[a]	23.208[a]	10.000	192.858	-1.235
1401-w9	190.750	23.250	10.083	192.774	-2.024
1401-w10	189.000	23.167	10.333	189.936	-0.936
1401-w11	189.000[a]	23.021[a]	9.917	187.659	1.341
1401-w12	189.000	22.875	9.917	188.852	0.148
1401-w13	187.494[a]	22.906[a]	9.917	190.164	-2.670
1401-w14	186.000	22.938	9.989[a]	194.605	-8.605
1401-w15	185.000	22.875	10.062	187.285	-2.285
1401-w16	185.997[a]	22.906[a]	10.083	187.028	-1.030
1401-w17	187.000	22.938	10.167	186.771	0.229
1401-w18	190.000	23.000	10.000	187.628	2.372
1401-w19	190.997[a]	22.937[a]	10.000	189.515	1.482
1401-w20	192.000	22.875	9.950	190.426	1.574
1401-w21	192.000	22.750	10.037[a]	193.061	-1.061
1401-w22	192.000	22.750	10.125	189.890	2.110
1401-w23	193.000	22.500	10.125	192.000	1.000
1401-w24	194.000	22.500	9.833	191.041	2.959
1401-w25	194.000[a]	22.500[a]	10.111	192.713	1.287
1401-w26	194.000	22.500	10.139[a]	194.400	-0.400
1401-w27	194.000	22.500	10.167	194.400	-0.400
1401-w28	195.000	22.333	10.302	190.205	4.795
1401-w29	194.000	22.333	10.279[a]	195.587	-1.587
1401-w30	194.000	22.333	10.255[a]	196.126	-2.126
1401-w31	193.000	22.354	10.232[a]	196.481	-3.481
1401-w32	193.997[a]	22.302[a]	10.208	199.560	-5.562
1401-w33	195.000	22.250	10.222	199.568	-4.568
1401-w34	197.000	22.000	10.208	201.374	-4.374
1401-w35	197.000	22.125	10.167	199.778	-2.778
1401-w36	195.000	22.333	10.194	197.465	-2.465
1401-w37	193.000	22.333	10.181[a]	197.730	-4.730
1401-w38	193.000	22.500	10.167	195.994	-2.994
1401-w39	193.000	22.125	9.979	198.509	-5.509
1401-w40	195.000	21.625	9.989[a]	203.654	-8.654
1401-w41	193.500	21.750	10.000	202.207	-8.707
1401-w42	196.000	21.500	9.917	204.280	-8.280
1401-w43	197.000	21.250	10.041[a]	202.867	-5.867
1401-w44	197.000	21.000	10.167	205.498	-8.498
1401-w45	195.000	21.250	10.292	203.294	-8.294
1401-w46	194.000	21.375[a]	10.292[a]	200.431	-6.431
1401-w47	198.000	21.500	10.292[a]	201.759	-3.759
1401-w48	198.000	21.500	10.292	204.286	-6.286
1401-w49	198.500	21.125	10.250	210.468	-11.968
1401-w50	199.000	21.500	10.291[a]	206.797	-7.797
1401-w51	200.000	21.375	10.333	208.007	-8.007
1401-w52	215.000	21.354	10.167	208.211	6.789
1402-w1	220.000	21.375	10.250[a]	207.158	12.842
1402-w2	240.000	21.250	10.333	209.218	30.782
1402-w3	210.000	21.375	10.292	208.835	1.165
1402-w4	210.000	21.333	10.292	205.885	4.115
1402-w5	210.000	21.375	10.292	207.151	2.849
1402-w6	220.000	21.375	10.292	208.835	11.165

1402-w7	220.000	21.333	10.292	208.416	11.584
1402-w8	220.000	21.333	10.250	208.416	11.584
1402-w9	224.944[a]	21.229[a]	10.167	209.440	15.505
1402-w10	230.000	21.125	10.000	210.468	19.532
1402-w11	234.947[a]	21.125[a]	10.000	210.468	24.478
1402-w12	240.000	21.125	10.042	209.609	30.391
1402-w13	270.000	21.000	10.062[a]	209.150	60.850
1402-w14	260.000	21.000	10.083	205.714	54.286
1402-w15	270.000	21.125	10.292	204.497	65.503
1402-w16	250.500	21.125	10.333	205.349	45.151
1402-w17	270.500	21.125	10.292	205.774	64.726
1402-w18	270.500	21.000	10.208[a]	207.428	63.072
1402-w19	260.000	21.125	10.125	210.468	49.532
1402-w20	280.000	21.125	10.229[a]	211.307	68.693
1402-w21	270.000	21.630	10.333	205.545	64.455
1402-w22	290.000	21.000	10.375	209.992	80.008
1402-w23	287.489[a]	20.653[a]	10.375	211.783	75.706
1402-w24	285.000	20.313	10.292	217.537	67.463
1402-w25	245.805[a]	20.125	10.271	221.807	23.998
1402-w26	212.000	20.125	10.167	222.708	-10.708
1402-w27	212.000	20.125	10.167	222.708	-10.708
1402-w28	213.000	20.000	10.139	222.307	-9.307
1402-w29	213.000	20.167	10.194[a]	220.016	-7.016
1402-w30	213.000	20.125	10.250	218.243	-5.243
1402-w31	215.000	20.000	10.250[a]	219.600	-4.600
1402-w32	216.000	19.938	10.250[a]	219.686	-3.686
1402-w33	219.000	19.750	10.250	222.986	-3.986
1402-w34	218.000	19.667	10.292	225.149	-7.149
1402-w35	214.000	20.750	10.281[a]	213.398	0.602
1402-w36	215.000	20.500	10.271[a]	216.000	-1.000
1402-w37	216.000	20.000	10.260[a]	221.400	-5.400
1402-w38	216.000	20.125	10.250	220.926	-4.926
1402-w39	210.000	20.250	10.291[a]	219.338	-9.338
1402-w40	280.000	20.250	10.333[a]	219.114	60.886
1402-w41	280.000[a]	20.291[a]	10.375[a]	218.443	61.557
1402-w42	280.000	20.333	10.417	217.774	62.226
1402-w43	280.000	20.333	10.375	218.656	61.344
1402-w44	260.000	20.250	10.389[a]	220.441	39.559
1402-w45	270.000	20.333	10.403[a]	220.430	49.570
1402-w46	280.000	20.500	10.417	219.519	60.481
1402-w47	242.487[a]	20.500[a]	10.417	218.634	23.853
1402-w48	210.000	20.500	10.458	218.929	-8.929
1402-w49	214.000	20.000	10.458	224.704	-10.704
1402-w50	216.000	20.000	10.437[a]	225.007	-9.007
1402-w51	219.000	19.750	10.417	227.855	-8.855
1402-w52	221.000	19.750	10.417	228.752	-7.752
1403-w1	220.000	19.500	10.417	231.685	-11.685
1403-w2	222.000	19.438	10.375	231.968	-9.968
1403-w3	219.000	20.125	10.333	223.610	-4.610
1403-w4	217.000	20.125	10.333	223.610	-6.610
1403-w5	216.000	20.250	10.250	222.229	-6.229

1403-w6	214.495[a]	20.291[a]	10.250	220.881	-6.386
1403-w7	213.000	20.333	10.250[a]	219.538	-6.538
1403-w8	215.485[a]	20.229[a]	10.250	220.669	-5.184
1403-w9	218.000	20.125	10.250[a]	220.025	-2.025
1403-w10	219.000	20.000	10.250[a]	221.400	-2.400
1403-w11	214.000	20.167	10.250	219.567	-5.567
1403-w12	212.000	20.333	10.125	217.774	-5.774
1403-w13	211.000	20.333	10.115[a]	217.774	-6.774
1403-w14	212.000	20.125	10.104[a]	220.025	-8.025
1403-w15	212.000	20.167	10.094[a]	219.567	-7.567
1403-w16	212.000	20.125	10.083	217.342	-5.342
1403-w17	210.998[a]	20.062[a]	10.000	217.795	-6.798
1403-w18	210.000	20.000	10.021	218.250	-8.250
1403-w19	290.000	19.833	10.000	219.861	70.139
1403-w20	280.000	19.625	9.958[a]	221.962	58.038
1403-w21	280.000	20.125	9.917	214.658	65.342
1403-w22	270.000	20.167	9.875	214.658	55.342
1403-w23	280.000	20.000	9.854[a]	216.000	64.000
1403-w24	290.000	19.875[a]	9.833[a]	216.459	73.541
1403-w25	211.000	19.750	9.813[a]	216.919	-5.919
1403-w26	213.000	19.375	9.792	220.181	-7.181
1403-w27	214.000	19.250	9.667	221.143	-7.143
1403-w28	210.000	19.333	9.667	219.730	-9.730
1403-w29	220.000	20.125	9.684[a]	210.637	9.363
1403-w30	260.000	20.000	9.701[a]	211.507	48.493
1403-w31	250.000	20.000	9.719[a]	208.807	41.193
1403-w32	230.000	19.875	9.736	210.120	19.880
1403-w33	220.000	20.000	9.792	209.179	10.821
1403-w34	210.000	20.250	9.709	206.964	3.036
1403-w35	210.000	20.667	9.667	203.149	6.851
1403-w36	207.485[a]	20.667[a]	9.667[a]	203.511	3.974
1403-w37	205.000	20.667	9.667[a]	204.681	0.319
1403-w38	210.000	20.500	9.667	204.589	5.411
1403-w39	210.000	20.750	9.730	201.260	8.740
1403-w40	210.000	20.750	9.823[a]	201.260	8.740
1403-w41	210.000	20.667	9.917	202.068	7.932
1403-w42	230.000	20.667	10.000	202.068	27.932
1403-w43	230.000	20.500	10.125	205.031	24.969
1403-w44	210.000	20.333	10.250	208.698	1.302
1403-w45	214.942[a]	20.664[a]	10.458	207.326	7.616
1403-w46	220.000	21.000	10.308	205.716	14.284
1403-w47	240.000	21.000	10.042	208.286	31.714
1403-w48	260.000	21.750	10.083	203.586	56.414
1403-w49	260.500	21.000	9.979[a]	215.136	45.364
1403-w50	240.000	21.000	9.875	212.059	27.941
1403-w51	240.000	20.667	9.917	209.900	30.100
1403-w52	230.000	20.500	9.917	212.487	17.513
1404-w1	220.000	20.500	10.125	210.281	9.719
1404-w2	210.000	20.667	10.021	206.416	3.584
1404-w3	230.000	20.667	10.042	207.294	22.706
1404-w4	230.000	20.500	10.021[a]	208.983	21.017

1404-w5	230.000	20.500	10.000	213.366	16.634
1404-w6	240.000	20.375	9.917	212.466	27.534
1404-w7	220.500	20.333	9.729	213.348	7.152
1404-w8	230.000	20.667	9.760[a]	209.464	20.536
1404-w9	230.000	20.667	9.792	209.029	20.971
1404-w10	240.000	20.500	9.750	208.983	31.017
1404-w11	240.000	20.333	9.792	206.705	33.295
1404-w12	240.000	20.333	9.792	207.373	32.627
1404-w13	240.000	20.500	9.833	206.348	33.652
1404-w14	240.000	20.500	9.792	205.463	34.537
1404-w15	230.000	20.667	9.917	204.681	25.319
1404-w16	210.000	20.667	10.000	204.681	5.319
1404-w17	199.500	20.750	10.000[a]	204.716	-5.216
1404-w18	200.000	20.667	10.000	204.681	-4.681
1404-w19	210.000	20.667	10.000	207.294	2.706
1404-w20	200.000	20.667	9.875	209.029	-9.029
1404-w21	198.000	20.750	9.917[a]	208.193	-10.193
1404-w22	194.000	20.938	9.959	206.323	-12.323
1404-w23	192.000	20.875	9.927[a]	206.946	-14.946
1404-w24	192.000	21.000	9.896	203.143	-11.143
1404-w25	193.500	21.000	10.000	204.000	-10.500
1404-w26	199.000	20.750	9.889	207.329	-8.329
1404-w27	198.000	20.750	9.833[a]	206.677	-8.677
1404-w28	197.500	21.000	9.778	203.575	-6.075
1404-w29	196.000	21.000	9.771	205.714	-9.714
1404-w30	196.000	21.000	9.760[a]	203.424	-7.424
1404-w31	197.000	21.000	9.750	202.279	-5.279
1404-w32	197.000	20.875	9.750	202.345	-5.345
1404-w33	198.000	20.750	9.750	203.425	-5.425
1404-w34	197.000	21.000	9.875	200.787	-3.787
1404-w35	198.000	21.000	9.833	200.571	-2.571
1404-w36	198.000	20.833	9.750	202.176	-4.176
1404-w37	198.333[a]	21.012[a]	9.708	200.454	-2.121
1404-w38	198.666[a]	21.193[a]	9.750	201.294	-2.628
1404-w39	199.000	21.375	9.750[a]	198.730	0.270
1404-w40	210.000	20.500	9.750	205.463	4.537
1404-w41	206.612[a]	20.583[a]	9.792	203.753	2.859
1404-w42	203.279[a]	20.666[a]	9.833	203.810	-0.531
1404-w43	200.000	20.750	9.750	202.988	-2.988
1404-w44	199.000	21.000	9.750	200.571	-1.571
1404-w45	198.498[a]	21.125	9.667	200.244	-1.745
1404-w46	197.997[a]	21.083[a]	9.708	201.480	-3.483
1404-w47	197.498[a]	21.042[a]	9.729[a]	200.175	-2.677
1404-w48	197.000	21.000	9.750	200.571	-3.571
1404-w49	197.499[a]	21.313[a]	9.750	195.947	1.553
1404-w50	198.000	21.630	9.625	193.891	4.109
1404-w51	196.000	21.250	9.417	197.784	-1.784
1404-w52	196.250[a]	21.250[a]	9.439[b]	198.212	-1.962
1405-w1	196.499[a]	21.250	9.463[b]	198.212	-1.712
1405-w2	196.750[a]	21.250[a]	9.488[b]	195.671	1.079
1405-w3	197.000	20.500	9.512[b]	198.446	-1.446

1405-w4	197.000	20.875	9.537[b]	195.369	1.631
1405-w5	195.997[a]	21.000[a]	9.561[b]	194.696	1.301
1405-w6	195.000	21.125	9.583	194.025	0.975
1405-w7	196.000	21.125	9.576[a]	194.511	1.489
1405-w8	194.997[a]	21.062[a]	9.569[a]	195.578	-0.580
1405-w9	194.000	21.000	9.562[a]	196.650	-2.650
1405-w10	194.000	20.937[a]	9.556	197.732	-3.732
1405-w11	194.000	20.875	9.542	198.179	-4.179
1405-w12	192.000	20.875	9.458	198.036	-6.036
1405-w13	191.499[a]	20.875[a]	9.479[a]	197.892	-6.393
1405-w14	191.000	20.875	9.500	197.749	-6.749
1405-w15	190.000	21.630	9.521	190.569	-0.569
1405-w16	189.499[a]	21.439[a]	9.535[a]	190.586	-1.087
1405-w17	189.000	21.250	9.549[a]	192.705	-3.705
1405-w18	187.000	21.500	9.563	190.884	-3.884
1405-w19	187.000	21.500	9.750	191.302	-4.302
1405-w20	187.000[a]	21.542[a]	9.750	191.211	-4.211
1405-w21	187.000[a]	21.583[a]	9.729[a]	191.119	-4.119
1405-w22	187.000[a]	21.625[a]	9.708	191.028	-4.028
1405-w23	187.000	21.667	9.708	194.397	-7.397
1405-w24	187.000	21.667	9.750	194.397	-7.397
1405-w25	187.500	21.438	9.625	196.053	-8.553
1405-w26	187.000	21.375	9.583	196.211	-9.211
1405-w27	187.500	21.250	9.597[a]	197.365	-9.865
1405-w28	192.000	21.124[a]	9.611[a]	199.392	-7.392
1405-w29	193.000	20.999[a]	9.625	198.007	-5.007
1405-w30	193.000	20.875	9.625	198.323	-5.323
1405-w31	195.000	20.875	9.583	198.610	-3.610
1405-w32	194.250	20.813	9.583[a]	199.495	-5.245
1405-w33	195.123[a]	20.740[a]	9.583	200.486	-5.363
1405-w34	196.000	20.667	9.583[a]	201.190	-5.190
1405-w35	194.000	20.875	9.583[a]	198.323	-4.323
1405-w36	194.000[a]	20.812[a]	9.583	198.920	-4.920
1405-w37	194.000	20.750	9.583[a]	199.518	-5.518
1405-w38	197.000	20.667	9.583	200.319	-3.319
1405-w39	197.333[a]	20.555[a]	9.583[a]	201.410	-4.077
1405-w40	197.666[a]	20.444[a]	9.583	202.507	-4.841
1405-w41	198.000	20.333	9.625	203.610	-5.610
1405-w42	195.484[a]	20.664[a]	9.625[a]	200.350	-4.866
1405-w43	193.000	21.000	9.625[a]	197.143	-4.143
1405-w44	192.499[a]	21.000[a]	9.625[a]	197.143	-4.644
1405-w45	192.000	21.000	9.625	198.000	-6.000
1405-w46	194.000	21.220[a]	9.625	195.947	-1.947
1405-w47	193.499[a]	21.442[a]	9.667[a]	193.915	-0.416
1405-w48	193.000	21.667	9.708	191.905	1.095
1405-w49	193.499[a]	21.267[a]	9.750	195.511	-2.012
1405-w50	194.000	20.875	9.719[a]	199.186	-5.186
1405-w51	192.000	20.875	9.688	200.046	-8.046
1405-w52	192.000[a]	20.937[a]	9.681[a]	200.311	-8.311
1406-w1	192.000	21.000	9.674[a]	200.571	-8.571
1406-w2	190.997[a]	21.062[a]	9.667	199.335	-8.338

1406-w3	190.000	21.125	9.667	198.107	-8.107
1406-w4	189.000	21.167	9.708	197.572	-8.572
1406-w5	189.000	21.250	9.667	196.659	-7.659
1406-w6	188.000	21.250	9.625	196.518	-8.518
1406-w7	188.000	21.333	9.604	195.753	-7.753
1406-w8	188.000[a]	21.333[a]	9.604[a]	196.597	-8.597
1406-w9	188.000[a]	21.333[a]	9.604[a]	195.753	-7.753
1406-w10	188.000	21.333	9.604	194.909	-6.909
1406-w11	187.499[a]	21.385[a]	9.583	194.011	-6.511
1406-w12	187.000	21.438	9.594[a]	193.535	-6.535
1406-w13	187.000	21.500	9.604	192.977	-5.977
1406-w14	186.000	21.500	9.604[a]	192.977	-6.977
1406-w15	186.000	21.500	9.604	192.558	-6.558
1406-w16	186.500	21.667	9.618	191.282	-4.782
1406-w17	186.750[a]	21.583	9.622[a]	192.232	-5.482
1406-w18	187.000	21.500	9.625	192.977	-5.977
1406-w19	187.000[a]	21.531	9.667	192.695	-5.695
1406-w20	187.000	21.563	9.625	192.691	-5.691
1406-w21	186.500	21.667	9.604[a]	191.835	-5.335
1406-w22	186.600[a]	21.600[a]	9.583	192.502	-5.902
1406-w23	186.700[a]	21.533[a]	9.583	193.937	-7.237
1406-w24	186.800[a]	21.466[a]	9.667	193.702	-6.902
1406-w25	186.900[a]	21.399[a]	9.667	193.884	-6.984
1406-w26	187.000	21.333	9.708	194.066	-7.066
1406-w27	187.997[a]	21.250[a]	9.750	194.825	-6.828
1406-w28	189.000	21.167	9.874[a]	197.288	-8.288
1406-w29	192.000	21.250	10.000	196.518	-4.518
1406-w30	191.666[a]	21.208[a]	9.833	197.753	-6.087
1406-w31	191.333[a]	21.167[a]	9.833	198.993	-7.660
1406-w32	191.000	21.125	9.916[a]	201.925	-10.925
1406-w33	192.000	21.125	10.000	204.497	-12.497
1406-w34	192.000	21.500	9.792	197.581	-5.581
1406-w35	193.000	21.125	9.750	201.089	-8.089
1406-w36	190.484[a]	21.187[a]	9.771[a]	202.188	-11.705
1406-w37	188.000	21.250	9.792	203.294	-15.294
1406-w38	188.499[a]	21.187[a]	9.875	199.647	-11.148
1406-w39	189.000	21.125	9.833	199.385	-10.385
1406-w40	191.000	21.000	9.854[a]	201.000	-10.000
1406-w41	192.000	21.125	9.875	200.237	-8.237
1406-w42	191.750[a]	21.062[a]	9.792	202.541	-10.791
1406-w43	191.500	21.000	9.833	202.286	-10.786
1406-w44	191.750[a]	21.000a	9.812[a]	202.714	-10.964
1406-w45	192.000	21.000	9.792	203.143	-11.143
1406-w46	192.000[a]	21.000a	9.833	201.429	-9.429
1406-w47	192.000	21.000	9.802[a]	202.286	-10.286
1406-w48	191.499[a]	21.000[a]	9.771	201.857	-10.357
1406-w49	191.000	21.000	9.771	201.429	-10.429
1406-w50	189.995[a]	21.110[a]	9.667	201.228	-11.233
1406-w51	188.995[a]	21.221[a]	9.625	199.538	-10.543
1406-w52	188.000	21.333	9.625	197.862	-9.862
1407-w1	188.000	21.250	9.750	198.635	-10.635

1407-w2	185.483[a]	21.560[a]	9.708	193.690	-8.207
1407-w3	183.000	21.875	9.625	190.080	-7.080
1407-w4	184.494[a]	21.812[a]	9.625[a]	190.625	-6.132
1407-w5	186.000	21.750	9.625[a]	193.655	-7.655
1407-w6	183.000	21.750	9.625	192.828	-9.828
1407-w7	183.000[a]	21.812[a]	9.542	190.625	-7.625
1407-w8	183.000	21.875	9.542	190.080	-7.080
1407-w9	185.000	21.333	9.542	194.909	-9.909
1407-w10	185.000	21.500	9.542	193.395	-8.395
1407-w11	184.499[a]	21.583[a]	9.542	190.981	-6.481
1407-w12	184.000	21.667	9.495[a]	190.243	-6.243
1407-w13	184.000	21.750	9.448	189.517	-5.517
1407-w14	184.000	21.875	9.432[a]	188.434	-4.434
1407-w15	184.250[a]	21.812[a]	9.417	188.975	-4.725
1407-w16	184.500	21.750	9.250	188.584	-4.084
1407-w17	183.000	22.000	9.292	185.523	-2.523
1407-w18	184.000	21.500	9.229	189.523	-5.523
1407-w19	183.000	21.500	9.258[a]	189.209	-6.209
1407-w20	182.000	21.750	9.287[a]	183.724	-1.724
1407-w21	182.250[a]	21.750[a]	9.316[a]	184.552	-2.302
1407-w22	182.500	21.750	9.346[a]	183.310	-0.810
1407-w23	183.000	21.750	9.375	183.886	-0.886
1407-w24	183.997[a]	21.708[a]	9.333	184.816	-0.819
1407-w25	185.000	21.667	9.333	185.752	-0.752
1407-w26	185.000	21.500	9.375	187.782	-2.782
1407-w27	185.500	21.563	9.583	187.822	-2.322
1407-w28	185.667[a]	21.625[a]	9.500[a]	186.450	-0.783
1407-w29	185.833[a]	21.687[a]	9.417	185.914	-0.080
1407-w30	186.000	21.750	9.397[a]	186.207	-0.207
1407-w31	186.000[a]	21.812[a]	9.376[a]	189.800	-3.800
1407-w32	186.000	21.875	9.355[a]	187.604	-1.604
1407-w33	185.000	22.000	9.333[a]	184.909	0.091
1407-w34	185.000[a]	22.000[a]	9.312[a]	184.498	0.502
1407-w35	185.000	22.000	9.292	184.087	0.913
1407-w36	184.248[a]	22.000[a]	9.292[a]	183.678	0.571
1407-w37	183.500	22.000	9.292	183.269	0.231
1407-w38	184.500	22.000	9.333	182.861	1.639
1407-w39	183.000	22.000	9.333	182.455	0.545
1407-w40	190.500	21.000	9.327[b]	191.143	-0.643
1407-w41	191.000	21.124[a]	9.320[b]	190.022	0.978
1407-w42	189.319[a]	21.249[a]	9.313[b]	189.754	-0.436
1407-w43	187.652[a]	21.374[a]	9.305[b]	188.641	-0.989
1407-w44	186.000	21.500	9.298[b]	187.395	-1.395
1407-w45	186.499[a]	21.416[a]	9.292	187.987	-1.488
1407-w46	187.000	21.333	9.292	188.581	-1.581
1407-w47	187.499[a]	21.389[a]	9.500	187.951	-0.452
1407-w48	188.000	21.444[a]	9.500	187.323	0.677
1407-w49	189.500	21.500	9.750	186.698	2.802
1407-w50	191.000	21.416[a]	9.750	187.430	3.570
1407-w51	191.498[a]	21.332[a]	9.792	192.383	-0.885
1407-w52	191.997[a]	21.249[a]	9.833	193.137	-1.140

1408-w1	192.498[a]	21.166[a]	9.583	198.997	-6.499
1408-w2	193.000	21.084	9.583[a]	199.777	-6.777
1408-w3	190.000	21.279[a]	9.583	198.791	-8.791
1408-w4	190.664[a]	21.476[a]	9.625[a]	197.806	-7.142
1408-w5	191.331[a]	21.674[a]	9.667	191.009	0.322
1408-w6	192.000	21.875	9.750	189.257	2.743
1408-w7	192.000[a]	21.771[a]	9.722[a]	190.163	1.837
1408-w8	192.000	21.667	9.694[a]	191.903	0.097
1408-w9	191.499[a]	21.771[a]	9.667	191.817	-0.318
1408-w10	191.000	21.875	9.667	192.549	-1.549
1408-w11	191.000	22.000	9.687[a]	190.908	0.092
1408-w12	189.000	21.750	9.708	192.550	-3.550
1408-w13	190.000	21.750	9.792	192.000	-2.000
1408-w14	189.933[b]	21.767[b]	9.820[b]	191.843	-1.914
1408-w15	189.862[b]	21.785[b]	9.850[b]	192.099	-2.242
1408-w16	189.787[b]	21.803[b]	9.880[b]	192.355	-2.569
1408-w17	189.713[b]	21.822[b]	9.912[b]	193.847	-4.133
1408-w18	189.638[b]	21.840[b]	9.942[b]	194.272	-4.629
1408-w19	189.567[b]	21.858[b]	9.972[b]	194.697	-5.126
1408-w20	189.500	21.875	10.000	195.124	-5.624
1408-w21	190.000	21.875	10.000[a]	195.712	-5.712
1408-w22	188.500	21.750	10.000	197.430	-8.930
1408-w23	190.000	21.500	10.028[a]	200.327	-10.327
1408-w24	190.000	21.750	10.055[a]	198.621	-8.621
1408-w25	190.997[a]	21.499[a]	10.083	200.944	-9.946
1408-w26	192.000	21.250	10.083	203.294	-11.294
1408-w27	192.000[a]	21.375[a]	10.083[a]	202.669	-10.669
1408-w28	192.000	21.500	10.083	202.045	-10.045
1408-w29	192.000	21.333	9.833	204.191	-12.191
1408-w30	193.000	21.250	9.833[b]	204.988	-11.988
1408-w31	193.333[a]	21.333[a]	9.833[b]	204.191	-10.858
1408-w32	193.666[a]	21.416[a]	9.833[b]	203.396	-9.730
1408-w33	194.000	21.500	9.833[b]	197.581	-3.581
1408-w34	192.494[a]	21.375[a]	9.833	198.740	-6.246
1408-w35	191.000	21.250	9.750	199.906	-8.906
1408-w36	191.498[a]	21.267[a]	9.764[a]	199.750	-8.252
1408-w37	191.997[a]	21.283[a]	9.778[a]	199.594	-7.597
1408-w38	192.498[a]	21.300[a]	9.792	199.439	-6.941
1408-w39	193.000	21.316[a]	9.792	197.595	-4.595
1408-w40	191.000	21.333	9.917	197.721	-6.721
1408-w41	191.000	21.500	9.917	196.465	-5.465
1408-w42	191.000	21.375	9.958[a]	197.895	-6.895
1408-w43	191.000	21.333	10.000[a]	198.284	-7.284
1408-w44	190.833[a]	21.333[a]	10.041[a]	200.816	-9.982
1408-w45	190.667[a]	21.333[a]	10.083	200.816	-10.149
1408-w46	190.500	21.333	10.167	201.654	-11.154
1408-w47	191.000	21.421[a]	10.167	201.662	-10.662
1408-w48	189.995[a]	21.510[a]	10.208[a]	201.671	-11.676
1408-w49	188.995[a]	21.599[a]	10.250	201.679	-12.684
1408-w50	188.000	21.688	10.083	202.508	-14.508
1408-w51	187.497[a]	21.725[a]	9.971[a]	202.161	-14.664

1408-w52	186.996[a]	21.763[a]	9.860[a]	202.639	-15.643
1409-w1	186.496[a]	21.800[a]	9.750	203.119	-16.623
1409-w2	185.997[a]	21.837[a]	9.767[a]	199.474	-13.476
1409-w3	185.500	21.875	9.783[a]	196.913	-11.413
1409-w4	185.000	21.688	9.800[a]	196.397	-11.397
1409-w5	185.000	22.000	9.817[a]	191.455	-6.455
1409-w6	184.499[a]	21.875[a]	9.833	192.880	-8.380
1409-w7	184.000	21.750	9.792	194.316	-10.316
1409-w8	185.494[a]	21.750[a]	9.806[a]	194.647	-9.153
1409-w9	187.000	21.750	9.819[a]	194.978	-7.978
1409-w10	186.499[a]	21.875[a]	9.833	194.197	-7.698
1409-w11	186.000	22.000	9.823[a]	192.273	-6.273
1409-w12	185.499[a]	22.000[a]	9.812[a]	192.545	-7.046
1409-w13	185.000	22.000	9.802[a]	192.818	-7.818
1409-w14	185.000[a]	22.000[a]	9.792[a]	193.091	-8.091
1409-w15	185.000	22.000	9.781	192.886	-7.886
1409-w16	185.000	22.000	9.771[a]	192.681	-7.681
1409-w17	186.000	21.750	9.760[a]	194.689	-8.689
1409-w18	186.997[a]	21.750	9.750[a]	194.482	-7.485
1409-w19	188.000	21.500	9.740[a]	196.535	-8.535
1409-w20	192.000	21.500	9.729	196.325	-4.325
1409-w21	192.997[a]	21.433[a]	9.707[a]	196.729	-3.731
1409-w22	194.000	21.366[a]	9.684[a]	197.133	-3.133
1409-w23	194.000	21.300[a]	9.661[a]	197.539	-3.539
1409-w24	194.000[a]	21.233[a]	9.639	197.945	-3.945
1409-w25	194.000	21.167	9.632[a]	198.102	-4.102
1409-w26	197.882[a]	21.062[a]	9.625	198.626	-0.744
1409-w27	201.842[a]	20.957[a]	9.667	199.152	2.690
1409-w28	205.880[a]	20.853[a]	9.833	199.679	6.201
1409-w29	210.000	20.750	9.875	200.530	9.470
1409-w30	210.000[a]	20.625[a]	9.875	201.604	8.396
1409-w31	210.000	20.500	9.958	203.707	6.293
1409-w32	210.000	20.500	9.972	207.220	2.780
1409-w33	222.437[a]	20.550[a]	10.000	207.594	14.843
1409-w34	235.611[a]	20.600[a]	10.000[a]	207.091	28.520
1409-w35	249.564[a]	20.650[a]	10.000	208.333	41.231
1409-w36	264.345[a]	20.700[a]	10.083	208.118	56.226
1409-w37	280.000	20.750	10.069[a]	208.193	71.807
1409-w38	290.000	20.250	10.056[a]	213.333	76.667
1409-w39	280.500	20.125	10.042	214.658	65.842
1409-w40	270.000	20.250	10.021[a]	215.111	54.889
1409-w41	270.000[b]	20.250[b]	10.000	214.814	55.186
1409-w42	270.000[b]	20.250[b]	10.028[a]	214.518	55.482
1409-w43	270.000[b]	20.250[b]	10.055[a]	214.222	55.778
1409-w44	270.000[b]	20.250[b]	10.083	213.777	56.223
1409-w45	270.000[b]	20.250[b]	10.125[a]	213.333	56.667
1409-w46	270.000	20.250	10.167	213.924	56.076
1409-w47	260.500	20.250	10.167	214.517	45.983
1409-w48	262.843[a]	20.017[a]	10.167	217.618	45.225
1409-w49	265.207[a]	19.786[a]	10.083[a]	221.061	44.146
1409-w50	267.593[a]	19.558[a]	10.000	224.560	43.033

1409-w51	270.000	19.333	10.000[a]	227.176	42.824
1409-w52	270.000[a]	19.375[a]	10.000[a]	226.688	43.312
1410-w1	270.000[a]	19.416[a]	10.000	224.340	45.660
1410-w2	270.000[a]	19.458[a]	10.000	222.015	47.985
1410-w3	270.000	19.500	9.979[a]	221.538	48.462
1410-w4	238.118[a]	19.625[a]	9.958[a]	220.132	17.986
1410-w5	210.000	19.750	9.937[a]	218.734	-8.734
1410-w6	290.500	19.667	9.917	219.657	70.843
1410-w7	290.500	19.750	9.889[a]	218.277	72.223
1410-w8	247.872[a]	19.708[a]	9.861[a]	218.280	29.592
1410-w9	211.500	19.667	9.833	218.283	-6.783
1410-w10	243.569[a]	19.833[a]	9.667	216.006	27.563
1410-w11	280.500	20.000	9.667	213.598	66.902
1410-w12	280.000	19.875	9.611[a]	214.338	65.662
1410-w13	260.000	19.750	9.555[a]	215.089	44.911
1410-w14	230.000	19.750	9.500	211.443	18.557
1410-w15	253.772[a]	19.498[a]	9.438	214.171	39.600
1410-w16	280.000	19.250	9.333	215.681	64.319
1410-w17	260.000	19.667	9.333[a]	209.888	50.112
1410-w18	270.500	19.500	9.333	210.462	60.038
1410-w19	275.455[a]	19.416[a]	9.354[a]	209.978	65.477
1410-w20	280.500	19.333	9.375	208.555	71.945
1410-w21	264.811[a]	19.291[a]	9.383[a]	209.004	55.807
1410-w22	250.000	19.250	9.392[a]	209.455	40.545
1410-w23	264.575[a]	19.187[a]	9.400[a]	210.606	53.969
1410-w24	280.000	19.125	9.408[a]	211.765	68.235
1410-w25	290.500	19.150[a]	9.417	211.677	78.823
1410-w26	268.500[a]	19.175[a]	9.417	211.589	56.911
1410-w27	248.165[a]	19.200[a]	9.333	211.501	36.665
1410-w28	229.371[a]	19.225[a]	9.333[a]	211.413	17.958
1410-w29	212.000	19.250	9.333	211.325	0.675
1410-w30	212.000[a]	19.124[a]	9.319[a]	212.715	-0.715
1410-w31	212.000[a]	18.999[a]	9.306[a]	212.220	-0.220
1410-w32	212.000	18.875	9.292	213.616	-1.616
1410-w33	210.998[a]	18.937[a]	9.438	212.912	-1.914
1410-w34	210.000	19.000	9.385[a]	211.894	-1.894
1410-w35	217.870[b]	18.971[b]	9.333	211.928	5.682
1410-w36	226.296[b]	18.939[b]	9.354[a]	211.961	13.534
1410-w37	235.000[b]	18.907[b]	9.375	215.643	18.024
1410-w38	243.704[b]	18.874[b]	9.350[a]	214.803	27.331
1410-w39	252.130[b]	18.842[b]	9.325[a]	213.967	36.941
1410-w40	260.000	18.813	9.300[a]	214.798	45.202

Sources: The exchange rates quoted in Venice are extracted from Medieval and Early Modern Data Bank (MEMDB): Currency exchanges (Mueller) http://www2.scc.rutgers.edu/memdb/index.html, and Bruges-Barcelona exchange rates are calculated from R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968), Appendix I.

Note. The exchange rates of Venice-Barcelona were quoted at a variable number of Barcelonese denari for one Venetian ducat, Venice-Bruges at a variable number of Venetian grossi a oro of account per Flemish franc (33 Flemish groots), and Bruges-Barcelona at a variable number of Barcelona denari per Flemish écu (of 22 Flemish groots).

The Venice-Bruges-Barcelona cross weekly exchange rates are calculated on the following format, $E_t^{vbrubar} = \frac{24}{E_t^{vbru}} * 1.5 * E_{t-4}^{brubar}$ where E^{vbru}, E^{brubar}, and $E^{vbrubar}$ are the Venice-Bruges, Bruges-Barcelona, and Venice-Bruges-Barcelona direct-exchange rates, respectively.

a. The missing exchange rates are estimated by linear interpolation.

Appendix 2.C The semi-monthly exchange rates of Venice, Bruges and Barcelona in 1399-1405

Date	Bruges-Barcelona	Barcelona-Venice	Bruges-Venice	Bruges-Barcelona-Venice	The difference
1399-Jan-1	120.833	185.496	35.667	-	
1399-Jan-2	120.250	183.996	35.719	-	
1399-Feb-1	120.000	180.996	35.667	34.008	1.659
1399-Feb-2	118.743[a]	183.996	35.802[a]	34.090	1.712
1399-Mar-1	117.500	186.996	35.938	33.889	2.049
1399-Mar-2	115.500	188.004	35.708	35.047	0.661
1399-Apr-1	115.667	189.996	36.097	35.567	0.530
1399-Apr-2	118.286	190.500	35.905	34.967	0.938
1399-May-1	117.500	190.752[a]	36.104	35.574	0.530
1399-May-2	118.000	191.004	36.323	35.517	0.806
1399-June-1	118.250	192.996	36.444	35.489	0.956
1399-June-2	117.875	191.500	36.500	35.649	0.851
1399-July-1	118.250	189.996	36.167	35.906	0.260
1399-July-2	117.550	191.250	35.847	35.840	0.007
1399-Aug-1	118.286	191.004	35.488	35.337	0.151
1399-Aug-2	118.813	190.248	35.458	35.413	0.045
1399-Sep-1	119.000	188.748	35.333	35.312	0.022
1399-Sep-2	119.500	185.496	35.167	35.025	0.142
1399-Oct-1	119.833	186.996	35.000	34.652	0.348
1399-Oct-2	121.167	186.000	34.597	33.680	0.917
1399-Nov-1	122.750	188.976[a]	34.375	33.515	0.860
1399-Nov-2	125.083	192.000	34.021	32.714	1.307
1399-Dec-1	124.500	190.668	34.667	33.393	1.273
1399-Dec-2	124.875	189.996	34.656	33.826	0.830
1400-Jan-1	125.700	192.000	34.500	33.371	1.129
1400-Jan-2	124.900	192.000	34.625	33.466	1.159
1400-Feb-1	124.600	193.374	34.817	33.900	0.916
1400-Feb-2	124.938	193.836	35.083	33.809	1.274
1400-Mar-1	126.167	194.496	35.139	33.719	1.420
1400-Mar-2	125.083	195.504	35.321	34.092	1.229
1400-Apr-1	123.333	196.668	35.347	34.694	0.653
1400-Apr-2	125.125	197.496	34.750	34.374	0.376
1400-May-1	128.000	197.748	34.083	33.802	0.281
1400-May-2	129.000	193.832	33.833	33.681	0.152
1400-June-1	128.750	193.832	34.042	33.790	0.252
1400-June-2	128.750	193.832	33.917	33.121	0.796
1400-July-1	129.188	190.998	33.906	33.009	0.898
1400-July-2	127.600	186.504	33.783	33.419	0.364
1400-Aug-1	125.333	183.996	33.958	33.526	0.432
1400-Aug-2	120.250	183.000	34.156	34.121	0.035
1400-Sep-1	119.375	180.498	34.031	33.909	0.122
1400-Sep-2	119.500	177.000	33.583	33.690	-0.107
1400-Oct-1	121.333	181.002	33.667	32.728	0.939
1400-Oct-2	122.125	181.500	33.500	31.885	1.615
1400-Nov-1	124.250	180.996	33.417	32.049	1.368
1400-Nov-2	129.333	180.330[a]	32.708	30.874	1.835

1400-Dec-1	128.750	179.666[a]	32.656	30.927	1.729
1400-Dec-2	127.083	179.004	33.042	31.218	1.824
1401-Jan-1	125.000	179.004	33.625	31.621	2.004
1401-Jan-2	124.750[a]	180.000	33.479[a]	31.568	1.911
1401-Feb-1	124.500	180.000	33.333	31.631	1.702
1401-Feb-2	120.333	179.502	34.639	32.909	1.730
1401-Mar-1	124.000	181.642[a]	34.667	31.935	2.731
1401-Mar-2	119.000	183.808[a]	34.722	33.185	1.537
1401-Apr-1	120.750	186.000	34.260	33.094	1.166
1401-Apr-2	121.000	188.496	34.300	33.420	0.880
1401-May-1	120.000	188.004	34.542	34.100	0.442
1401-May-2	119.700	188.750[a]	34.688	34.644	0.043
1401-June-1	119.750	189.498	34.528	34.539	-0.012
1401-June-2	121.333	189.000	34.556	34.224	0.332
1401-July-1	123.300	191.668	34.067	33.811	0.255
1401-July-2	122.983[a]	191.004	34.075[a]	33.810	0.265
1401-Aug-1	122.667	188.004	34.083	34.375	-0.292
1401-Aug-2	122.375	186.750	34.073	34.338	-0.265
1401-Sep-1	122.333	188.668	34.097	33.810	0.287
1401-Sep-2	120.200	189.000	35.000	34.181	0.819
1401-Oct-1	120.000	188.004	35.236	34.589	0.647
1401-Oct-2	120.500	187.749	35.958	34.506	1.452
1401-Nov-1	123.500	189.000	35.250	33.491	1.759
1401-Nov-2	123.375[a]	190.494[a]	35.571[a]	33.479	2.092
1401-Dec-1	123.250	192.000	35.896	33.736	2.160
1401-Dec-2	123.000	192.996	36.063	34.072	1.990
1402-Jan-1	124.000	194.004	36.167	34.065	2.102
1402-Jan-2	123.500	195.000	36.542	34.380	2.162
1402-Feb-1	123.500	195.750	36.625	34.559	2.066
1402-Feb-2	122.833	198.504	36.833	34.925	1.908
1402-Mar-1	120.000	198.996	36.958	35.888	1.071
1402-Mar-2	120.500	201.000	37.063	36.241	0.821
1402-Apr-1	121.833	200.004	36.833	35.934	0.900
1402-Apr-2	123.667	200.004	36.528	35.757	0.770
1402-May-1	121.500	197.496	37.167	36.215	0.952
1402-May-2	124.250	198.000	36.542	35.413	1.128
1402-June-1	124.000	198.504	36.292	35.040	1.252
1402-June-2	122.833	198.996	36.083	35.463	0.621
1402-July-1	121.800	199.500	36.217	35.855	0.362
1402-July-2	123.000	199.500	36.208	35.593	0.616
1402-Aug-1	123.125[a]	199.500	36.602[a]	35.647	0.955
1402-Aug-2	123.250	199.500	37.000	35.611	1.389
1402-Sep-1	123.125[a]	198.996	37.249[a]	35.647	1.602
1402-Sep-2	123.000	198.996	37.500	35.683	1.817
1402-Oct-1	123.872[a]	198.750	37.479[a]	35.342	2.137
1402-Oct-2	124.750	198.000	37.458	35.093	2.365
1402-Nov-1	125.000	198.000	37.583	34.980	2.603
1402-Nov-2	125.000	199.142[b]	37.667	34.848	2.819
1402-Dec-1	125.500	200.371[b]	37.667	34.709	2.958
1402-Dec-2	125.000	201.629[b]	37.722	35.049	2.673
1403-Jan-1	124.750	202.858[b]	37.792	35.336	2.456

1403-Jan-2	123.750	204.000	37.833	35.845	1.988
1403-Feb-1	123.000	207.996	38.167	36.283	1.883
1403-Feb-2	123.000	207.252	38.583	36.488	2.096
1403-Mar-1	123.000	207.996	38.833	37.203	1.631
1403-Mar-2	121.500	208.500	38.667	37.527	1.140
1403-Apr-1	121.083[a]	206.004	38.167	37.792	0.375
1403-Apr-2	120.667	207.000	38.306	38.014	0.292
1403-May-1	120.167	205.500	38.722	37.715	1.007
1403-May-2	118.833	204.000	38.875	38.323	0.552
1403-June-1	118.165[a]	201.498	38.799[a]	38.260	0.538
1403-June-2	117.500	200.754	38.722	38.196	0.526
1403-July-1	116.000	199.248	38.875	38.215	0.660
1403-July-2	116.000	198.504	38.583	38.074	0.509
1403-Aug-1	117.000	198.996	38.458	37.465	0.993
1403-Aug-2	116.400	196.336	38.067	37.518	0.549
1403-Sep-1	116.762[a]	192.000	37.782[a]	37.494	0.288
1403-Sep-2	117.125	191.004	37.500	36.878	0.622
1403-Oct-1	119.000	188.004	36.667	35.496	1.171
1403-Oct-2	120.833	192.332	36.167	34.776	1.391
1403-Nov-1	124.400	189.000	35.400	33.248	2.152
1403-Nov-2	121.625	189.996	36.542	34.790	1.752
1403-Dec-1	118.500	188.004	37.833	35.089	2.745
1403-Dec-2	119.000	192.996	37.500	35.125	2.375
1404-Jan-1	120.667	190.332	37.250	34.277	2.973
1404-Jan-2	120.500	195.996	37.333	35.236	2.098
1404-Feb-1	119.500	195.996	37.542	35.040	2.501
1404-Feb-2	116.750	196.248	37.646	36.933	0.713
1404-Mar-1	117.250	196.500	37.833	36.775	1.058
1404-Mar-2	117.800	197.249[a]	37.842	36.651	1.191
1404-Apr-1	118.250	198.000	37.625	36.558	1.067
1404-Apr-2	120.000	193.998	37.000	36.162	0.838
1404-May-1	119.500	189.504	36.556	36.452	0.104
1404-May-2	119.500	191.502	36.125	35.715	0.410
1404-June-1	118.750	189.996	36.167	35.108	1.059
1404-June-2	119.000	189.000	35.917	35.404	0.513
1404-July-1	117.333	186.000	36.111	35.624	0.487
1404-July-2	117.167	188.004	35.806	35.488	0.318
1404-Aug-1	117.000	186.000	36.333	34.974	1.359
1404-Aug-2	117.750	184.664	36.208	35.126	1.082
1404-Sep-1	117.167	186.252	35.625	34.925	0.700
1404-Sep-2	117.000	184.002	36.000	34.723	1.277
1404-Oct-1	117.250	185.004	36.083	34.947	1.136
1404-Oct-2	117.333	186.000	36.333	34.500	1.833
1404-Nov-1	116.000	182.496	36.750	35.087	1.663
1404-Nov-2	116.750	184.002	36.917	35.049	1.867
1404-Dec-1	116.000	184.998	37.000	34.611	2.389
1404-Dec-2	113.000	185.746[a]	37.250	35.823	1.427
1405-Jan-1	113.663[a]	186.498	37.083[a]	35.807	1.275
1405-Jan-2	114.329[a]	186.000	36.916[a]	35.743	1.173
1405-Feb-1	115.000	186.999[a]	36.750	35.678	1.072
1405-Feb-2	114.812[a]	188.004	37.185[a]	35.641	1.544

1405-Mar-1	114.625	186.244[a]	37.625	35.891	1.734
1405-Mar-2	113.500	184.500	37.000	36.441	0.559
1405-Apr-1	114.167	186.000	37.500	35.889	1.611
1405-Apr-2	114.750	183.996	37.000	35.373	1.627
1405-May-1	117.000	182.004	36.500	34.974	1.526
1405-May-2	116.750	176.004	36.083	34.672	1.412
1405-June-1	116.750	179.748	36.167	34.296	1.870
1405-June-2	115.000	180.000	36.000	33.670	2.330
1405-July-1	115.500	180.498	35.917	34.238	1.679
1405-July-2	115.500	181.332	35.708	34.286	1.423
1405-Aug-1	115.000	183.996	36.000	34.530	1.470
1405-Aug-2	115.000	183.496[a]	36.125	34.690	1.435
1405-Sep-1	115.000	182.997[a]	36.167	35.199	0.967
1405-Sep-2	115.000	182.500[a]	36.250	35.104	1.146
1405-Oct-1	115.250	182.004	36.333	34.932	1.401
1405-Oct-2	115.375[a]	183.991[a]	36.458[a]	34.800	1.659
1405-Nov-1	115.500	186.000	36.583	34.667	1.916
1405-Nov-2	116.082[a]	184.500	36.736[a]	34.870	1.866

Source: R. de Roover, *The Bruges Money Market around 1400* (Brussels, 1968), Appendix I and II.

Note. The exchange rates of Barcelona-Venice were quoted at a variable number of Barcelona denari per Venetian ducat, Barcelona-Bruges at a variable number of Barcelona denari per Flemish écu (of 22 Flemish groots), and Bruges-Venice at a variable Flemish groots per Venetian ducat. The Barcelona-Bruges-Venice cross semi-monthly exchange rates are calculated on the following format, $E_t^{BruBarV} = \frac{E_{t-3}^{BarV}}{E_t^{BruBar}} * 22$, where E^{BarV}, E^{BruBar}, and $E^{BruBarV}$ are the Barcelona-Venice, Bruges-Barcelona, and Bruges-Barcelona-Venice direct-exchange rates, respectively.

The missing exchange rates are estimated by a. linear interpolation and b. cardinal spline interpolation.

Appendices to Chapter Three

Appendix 3.A: The Data

Quotation Types: A=account book, E=bill of exchange, H=secondary sources.

1 Pound sterling = 20 shillings = 240 pence

1 Pound Flemish =20 Shillings = 240 groots

£ = pound, s = shilling, d = penny/groot

Exchange rates were quoted at a variable number of Flemish shillings for one Pound sterling.

Cold mart =31st January-10th February, Pascha mart =1st -10th May, Sinxon = 1st -10th August, Bamas mart = 31st October-10th November

Candlemas = February 2, Hallowtide = October 31

Date	original 1	original 2	Exchange rate	Place	Type	Term of payment	Source
Cold Mart, 1511	£100 st	£140 Fl	28.000	London	E	unknown	Mucklowe Accoount
Cold Mart, 1511	£100 st	£165 Fl	29.000	London	E	sight	Mucklowe Accoount
Cold Mart, 1511	£80 st	£114 Fl	28.500	London	E	Sept-30	Mucklowe Accoount
Pascha Mart, 1514	£66 13s 4d st		29.583	London	E	usance	Kitson's account
Sinxon Mart, 1514	£100st		30.000	London	E	usance	Kitson's account
	£400 st		30.000	London		unknown	Kitson's account
	£19 3s 2d t		30.500	London		unknown	Kitson's account
Cold Mart, 1514-5	£80 st		30.500	London		unknown	Kitson's account
Bamas Mart, 1515	£40 st		30.750	London		unknown	Kitson's account
	£100 st		30.500	London		unknown	Kitson's account
Cold Mart, 1515-6	£248 st		30.625	London		unknown	Kitson's account

12-April,	£100 st	30.250	London	E	12 days after sight	Kitson's account
Sinxon Mart, 1516	£400 st	30.500	London		unknown	Kitson's account
Bamas Mart, 1516	£286 st	30.250	London		unknown	Kitson's account
		29.875	London		unknown	Kitson's account
		30.000	London		unknown	Kitson's account
Pascha Mart, 1517	£35 st	32.500	London		unknown	Kitson's account
	£6 13s 4d st	30.000	London		unknown	Kitson's account
Sinxon Mart, 1517	£66 13s 4d st	29.500	London	E	usance	Kitson's account
	£66 13s 4d st	29.500	London	E	usance	Kitson's account
	£66 13s 4d st	29.500	London		unknown	Kitson's account
Cold Mart, 1517-8	£26 st	30.000	London		unknown	Kitson's account
	£179 st	30.000	London	E	sight	Kitson's account
	£120 st	30.000	London	E	sight	Kitson's account
Pascha Mart, 1520	£100 st	30.667	London		unknown	Kitson's account
Bamas Mart, 1520	£49 11s 6d st	30.500	London		unknown	Kitson's account
Cold Mart, 1521-2	£40 st	29.000	Antwerp	E	usance	Kitson's account
	£100 st	28.000	Antwerp	E	£50 at Easter, £50 at Midsummer	Kitson's account
	£60 st	28.000	Antwerp	E	1522-03-31	Kitson's account
	£30 st	28.667	Antwerp	E	1522-03-14	Kitson's account
	£30 st	28.667	Antwerp	E	1522-03-14	Kitson's account
	£12 st	29.000	Antwerp	E	1522-02-22	Kitson's account
	£10 st	29.333	Antwerp	E	1522-02-24	Kitson's account
	£84 st	29.500	Antwerp	E	1522-03-11	Kitson's account
Pascha Mart, 1522	£40 st	29.000	Antwerp	E	usance	Kitson's account
	£40 st	29.167	Antwerp	E	sight	Kitson's account
	£40 st	29.167	Antwerp	E	sight	Kitson's account
Sinxon Mart, 1522	£100 st	30.208	London		unknown	Kitson's account
Sinxon Mart, 1522	£50 st	29.167	Antwerp	E	usance	Kitson's account
	£60 st	29.333	Antwerp	E	usance	Kitson's account
	£60 st	29.500	Antwerp	E	usance	Kitson's account
	£20 st	29.333	Antwerp	E	usance	Kitson's account
	£30 st	29.500	Antwerp	E	usance	Kitson's account
	£26 13s 4d st	29.000	Antwerp	E	1522-09-29	Kitson's account
	£13 st	29.500	Antwerp	E	sight	Kitson's account
Bamas Mart, 1522	£50 st	29.500	Antwerp	E	usance	Kitson's account

	£20 st		29.667	Antwerp		unknown	Kitson's account
Cold Mart, 1522-3	£80 st		30.500	Antwerp	E	sight	Kitson's account
	£60 st		30.000	Antwerp	E	1523-02-28	Kitson's account
	£40 st		30.000	Antwerp	E	1523-02-16	Kitson's account
	£10 st		30.000	Antwerp	E	1523-02-20	Kitson's account
	£100 st		30.000	Antwerp	E	1523-03-16	Kitson's account
	£18 13s 4d st		30.000	Antwerp	E	sight	Kitson's account
	£20 st		29.667	Antwerp	E	1523-04-06	Kitson's account
Pascha Mart, 1523	£100 st		30.250	Antwerp	E	usance	Kitson's account
	£80 st		20.917	Antwerp	E	sight	Kitson's account
	£40 st		30.000	Antwerp	E	1523-06-01	Kitson's account
	£80 st		30.083	Antwerp	E	sight	Kitson's account
Sinxon Mart, 1523	£100 st		30.000	Antwerp	E	1523-10-20	Kitson's account
	£60 st		29.500	Antwerp	E	Hallowtide	Kitson's account
Bamas Mart, 1523	£120 st		29.667	Antwerp	E	£60 at "shorstyd", £60 at mid-Lent	Kitson's account
	£30 st		30.000	Antwerp	E	Candlemas	Kitson's account
	£40 st		30.000	Antwerp	E	Candlemas	Kitson's account
	£100 st		30.000	Antwerp	E	£50 on 15 Jan, £50 on 15 April	Kitson's account
Cold Mart, 1523-4	£68 st		30.083	London		unknown	Kitson's account
Cold Mart, 1526-7	£30 st		33.081	London		unknown	Kitson's account
1532-06-29	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	Brulez (1958)
1532-07-20	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	Brulez (1958)
1532-08-10	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	Brulez (1958)
1532-09-18	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	Brulez (1958)
1532-11-02	1 English noble	8s 8d Fl	26.000	Antwerp	E	usance	Brulez (1958)
1532-12-14	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	Brulez (1958)
1533-03-08	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	Brulez (1958)
1535-01-10	1 English noble	8s 11 1/8d Fl	26.781	Antwerp	E	usance	Brulez (1958)
1537-03-13	£100 st		26.500	London	E	1537-03-20	Kitson's account
1537-03-16	£200 st		26.667	London	E	Half payable 7 days after sight, and half payable on 16 April	Kitson's account
1537-03-21	£100 st		26.583	London	E	1537-04-06	Kitson's account
1537-04-06	£200 st		26.500	London	E	4 days after sight	Kitson's account
1537-05-08	£200 st		26.750	London	E	in the Pascha Mart	Kitson's account
1537-05-15	£100 st		26.667	London	E	1537-05-31	Kitson's account

1537-05-15	£50 st		26.667	London	E	1537-05-31	Kitson's account
1537-06-09	£80 st		26.583	London	E	3 days after sight	Kitson's account
1537-06-09	£50 st		26.583	London	E	3 days after sight	Kitson's account
1537-06-21	£60 st		26.833	London	E	3 days after sight	Kitson's account
1537-06-23	£40 st		26.875	London	E	3 days after sight	Kitson's account
1537-06-25	£100 st		26.875	London	E	sight	Kitson's account
1537-07-10	£100 st		26.917	London	E	sight	Kitson's account
1537-09-10	£30 st		26.833	London	E	sight	Kitson's account
1537-10-09	£100 st		27.500	London	E	sight	Kitson's account
1537-10-24	£40 st		27.000	London	E	sight	Kitson's account
1538-03-09	1 English noble	9s 1/3d Fl	27.083	Antwerp	E	usance	van der Molen letter book, f. 2v
1538-03-09	1 English noble	9s 1/3d Fl	27.083	Antwerp	E	usance	van der Molen letter book, f. 3v
1538-03-30	1 English noble	9s 1/3d Fl	27.083	Antwerp	E	usance	van der Molen letter book, f. 4
1538-03-30	1 English noble	9s 1/3d Fl	27.083	Antwerp	E	usance	van der Molen letter book, f. 4
1538-03-30	1 English noble	9s 1/3d Fl	27.083	Antwerp	E	usance	van der Molen letter book, f. 5
1538-04-17	1 English noble	9s Fl	27.000	Antwerp	E	usance	van der Molen letter book, f. 7
1538-04-17	1 English noble	9s Fl	27.000	Antwerp	E	usance	van der Molen letter book, f. 8
1538-04-17	1 English noble	9s Fl	27.000	Antwerp	E	usance	van der Molen letter book, f. 8
1538-05-11	1 English noble	9s 1d Fl	27.250	Antwerp	E	usance	van der Molen letter book, f. 10
1538-05-11	1 English noble	9s 1d Fl	27.250	Antwerp	E	usance	van der Molen letter book, f. 10v
1538-05-11	1 English noble	9s 1d Fl	27.250	Antwerp	E	usance	van der Molen letter book, f. 11v
1538-05-11	1 English noble	9s 1d Fl	27.250	Antwerp	E	usance	van der Molen letter book, f. 12
1538-06-01	1 English noble	9s 1 3/4d Fl	27.438	Antwerp	E	usance	van der Molen letter book, f. 14
1538-06-01	1 English noble	9s 1 3/4d Fl	27.438	Antwerp	E	usance	van der Molen letter book, f. 14v
1538-06-01	1 English noble	9s 1 3/4d Fl	27.438	Antwerp	E	usance	van der Molen letter book, f. 15
1538-06-01	1 English noble	9s 1 3/4d Fl	27.438	Antwerp	E	usance	van der Molen letter book, f. 15
1538-06-01	1 English noble	9s 1 3/4d Fl	27.438	Antwerp	E	usance	van der Molen letter book, f. 15v
1538-06-01	1 English noble	9s 1 3/4d Fl	27.438	Antwerp	E	usance	van der Molen letter book, f. 16
1538-06-01	1 English noble	9s 1 3/4d Fl	27.438	Antwerp	E	usance	van der Molen letter book, f. 16v
1538-06-22	1 English noble	9s 2d Fl	27.500	Antwerp	E	usance	van der Molen letter book, f. 18
1538-06-22	1 English noble	9s 2d Fl	27.500	Antwerp	E	usance	van der Molen letter book, f. 18v
1538-06-22	1 English noble	9s 2d Fl	27.500	Antwerp	E	usance	van der Molen letter book, f. 19
1538-06-22	1 English noble	9s 2d Fl	27.500	Antwerp	E	usance	van der Molen letter book, f. 19v
1538-07-13	1 English noble	9s 2 1/2d Fl	27.625	Antwerp	E	usance	van der Molen letter book, f. 21v
1358-07-13	1 English noble	9s 2 1/4d Fl	27.563	Antwerp	E	usance	van der Molen letter book, f. 22

1358-07-13	1 English noble	9s 2 1/4d Fl	27.563	Antwerp	E	usance	van der Molen letter book, f. 22v
1538-07-13	1 English noble	9s 2 1/2d Fl	27.625	Antwerp	E	usance	van der Molen letter book ,f. 23
1538-07-13	1 English noble	9s 2 1/2d Fl	27.625	Antwerp	E	usance	van der Molen letter book, f. 23v
1358-07-13	1 English noble	9s 2 1/4d Fl	27.563	Antwerp	E	usance	van der Molen letter book, f. 24
1538-08-03	1 English noble	9s 3 1/8d Fl	27.781	Antwerp	E	usance	van der Molen letter book, f. 25v
1538-08-24	1 English noble	9s Fl	27.000	Antwerp	E	usance	van der Molen letter book, f. 28v
1538-08-24	1 English noble	9s Fl	27.000	Antwerp	E	usance	van der Molen letter book, f. 29v
1538-08-24	1 English noble	9s Fl	27.000	Antwerp	E	usance	van der Molen letter book,f. 29v
1538-09-14	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 32v
1538-09-14	1 English noble	9s 4d Fl	28.000	Antwerp	E	usance	van der Molen letter book,f. 33
1538-09-14	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 33v
1538-09-14	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 35
1538-09-14	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 36
1538-10-05	1 English noble	9s 4 2/3d Fl	28.167	Antwerp	E	usance	van der Molen letter book,f. 37v
1538-10-05	1 English noble	9s 4 2/3d Fl	28.167	Antwerp	E	usance	van der Molen letter book,f. 38
1538-10-05	1 English noble	9s 4 2/3d Fl	28.167	Antwerp	E	usance	van der Molen letter book,f. 39
1538-10-26	1 English noble	9s 7 1/2d Fl	28.875	Antwerp	E	usance	van der Molen letter book,f. 39v
1538-11-16	1 English noble	9s 6 1/4d Fl	28.563	Antwerp	E	usance	van der Molen letter book,f. 42
1538-11-23	1 English noble	9s 6 1/4d Fl	28.563	Antwerp	E	usance	van der Molen letter book,f. 44
1538-11-23	1 English noble	9s 6 1/4d Fl	28.563	Antwerp	E	usance	van der Molen letter book,f. 45
1538-12-14	1 English noble	9s 5d Fl	28.250	Antwerp	E	usance	van der Molen letter book,f. 46
1538-12-14	1 English noble	9s 5d Fl	28.250	Antwerp	E	usance	van der Molen letter book,f. 48v
1538-12-14	1 English noble	9s 5d Fl	28.250	Antwerp	E	usance	van der Molen letter book,f. 48v
1538-12-14	1 English noble	9s 5d Fl	28.250	Antwerp	E	usance	van der Molen letter book,f. 49v
1539-01-11	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 52v
1539-01-11	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 53
1539-01-11	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 53v
1539-01-11	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 53v
1539-02-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 54v
1539-02-01	1 English noble	9s 4d Fl	28.000	Antwerp	E	usance	van der Molen letter book,f. 56
1539-02-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 57
1539-02-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 57v
1539-02-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 58
1539-03-01	1 English noble	9s 4 7/8d Fl	28.219	Antwerp	E	usance	van der Molen letter book,f. 60v
1539-03-01	1 English noble	9s 5d Fl	28.250	Antwerp	E	usance	van der Molen letter book,f. 61

1539-03-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 61v
1539-03-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 62
1539-03-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 62v
1539-03-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 63
1539-03-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 64v
1539-03-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 65
1539-03-01	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 65v
1539-03-03	1 English noble	9s 4 3/4d Fl	28.188	Antwerp	E	usance	van der Molen letter book,f. 59v
1539-03-23	1 English noble	9s 5 1/4d Fl	28.313	Antwerp	E	usance	van der Molen letter book,f. 66v
1539-03-29	1 English noble	9s 4 1/4d Fl	28.063	Antwerp	E	usance	van der Molen letter book,f. 67
1539-03-29	1 English noble	9s 4d Fl	28.000	Antwerp	E	usance	van der Molen letter book,f. 68
1539-03-29	1 English noble	9s 4 1/4d Fl	28.063	Antwerp	E	usance	van der Molen letter book,f. 68v
1539-03-29	1 English noble	9s 4 1/4d Fl	28.063	Antwerp	E	usance	van der Molen letter book,f. 69
1539-03-29	1 English noble	9s 4 1/4d Fl	28.063	Antwerp	E	usance	van der Molen letter book,f. 69
1539-03-29	1 English noble	9s 4 1/4d Fl	28.063	Antwerp	E	usance	van der Molen letter book,f. 70
1539-03-29	1 English noble	9s 4 1/4d Fl	28.063	Antwerp	E	usance	van der Molen letter book,f. 71v
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 73
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 73v
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 74
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 74
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 75
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 75
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 75v
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 76
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 76v
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 77
1539-04-26	1 English noble	9s 4 1/8d Fl	28.031	Antwerp	E	usance	van der Molen letter book,f. 77v
1539-05-10	1 English noble	9s 3 3/4d Fl	27.938	Antwerp	E	usance	van der Molen letter book,f. 79
1539-05-24	1 English noble	9s 2d Fl	27.500	Antwerp	E	usance	van der Molen letter book,f. 81
1539-05-24	1 English noble	9s 1 1/2d Fl	27.375	Antwerp	E	usance	van der Molen letter book,f. 79v
1539-05-24	1 English noble	9s 1 1/2d Fl	27.375	Antwerp	E	usance	van der Molen letter book,f. 80
1539-05-24	1 English noble	9s 1 1/2d Fl	27.375	Antwerp	E	usance	van der Molen letter book,f. 80v
1539-05-24	1 English noble	9s 1 1/2d Fl	27.375	Antwerp	E	usance	van der Molen letter book,f. 82
1539-05-24	1 English noble	9s 1 1/2d Fl	27.375	Antwerp	E	usance	van der Molen letter book,f. 82v
1539-05-24	1 English noble	9s 1 1/2d Fl	27.375	Antwerp	E	usance	van der Molen letter book,f. 83v

1539-05-24	1 English noble	9s 2d Fl	27.500	Antwerp	E	usance	van der Molen letter book,f. 84
1539-05-24	1 English noble	9s 1 1/2d Fl	27.375	Antwerp	E	usance	van der Molen letter book,f. 84v
1539-05-24	1 English noble	9s 1 1/2d Fl	27.375	Antwerp	E	usance	van der Molen letter book,f. 85
1539-06-14	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 87v
1539-06-14	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 88
1539-06-14	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 88v
1539-06-14	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 89
1539-06-14	1 English noble	8s 11 1/2d Fl	26.875??	Antwerp	E	usance	van der Molen letter book,f. 89v
1539-06-21	1 English noble	8s 8d Fl	26.000	Antwerp	E	usance	van der Molen letter book,f. 90
1539-06-21	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 90v
1539-06-21	1 English noble	8s 8d Fl	26.000	Antwerp	E	usance	van der Molen letter book,f. 91
1539-06-21	1 English noble	8s 8d Fl	26.000	Antwerp	E	usance	van der Molen letter book,f. 91v
1539-06-21	1 English noble	8s 8d Fl	26.000	Antwerp	E	usance	van der Molen letter book,f. 92v
1539-07-05	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. ??
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 96v
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 97
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 97
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 97v
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 98
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 98v
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 98v
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 99
1539-07-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book,f. 100
1539-08-17	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 102
1539-08-17	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 102v
1539-08-17	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 103
1539-08-17	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 103v
1539-08-17	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 105v
1539-09-13	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 106
1539-09-13	1 English noble	8s 8 1/4d Fl	26.063	Antwerp	E	usance	van der Molen letter book,f. 106v
1539-09-13	1 English noble	8s 8 1/4d Fl	26.063	Antwerp	E	usance	van der Molen letter book,f. 107
1539-09-13	1 English noble	8s 8 1/4d Fl	26.063	Antwerp	E	usance	van der Molen letter book,f. 107v
1539-09-13	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 108
1539-09-13	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book,f. 108
1539-09-13	1 English noble	8s 8 1/4d Fl	26.063	Antwerp	E	usance	van der Molen letter book, f. 108v

1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 110v
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 111
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 111v
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 111v
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 112v
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 113
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 113v
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 113v
1539-10-11	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 114
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 115
1539-10-12	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 116
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 117
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 117v
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 118
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 118
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 119
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 120
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 120v
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 121
1539-11-08	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 121v
1539-12-06	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 124
1539-12-07	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 123
1539-12-07	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 125
1539-12-07	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 125
1539-12-07	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 125v
1540-01-04	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 128v
1540-01-04	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 129
1540-01-04	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 130v
1540-01-04	1 English noble	8s 3 3/4d Fl	24.938	Antwerp	E	usance	van der Molen letter book, f. 132
1540-02-01	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 136
1540-02-01	1 English noble	8s 4 1/4d Fl	25.063	Antwerp	E	usance	van der Molen letter book, f. 134
1540-02-01	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 136
1540-02-01	1 English noble	8s 4 1/4d Fl	25.063	Antwerp	E	usance	van der Molen letter book, f. 136v
1540-02-01	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 137v
1540-02-01	1 English noble	8s 4 1/4d Fl	25.063	Antwerp	E	usance	van der Molen letter book, f. 138

1540-02-29	1 English noble	8s 5d Fl	25.250	Antwerp	E	usance	van der Molen letter book, f. 138v
1540-02-29	1 English noble	8s 5d Fl	25.250	Antwerp	E	usance	van der Molen letter book, f. 139v
1540-02-29	1 English noble	8s 5d Fl	25.250	Antwerp	E	usance	van der Molen letter book, f. 140
1540-02-29	1 English noble	8s 5d Fl	25.250	Antwerp	E	usance	van der Molen letter book, f. 140v
1540-02-29	1 English noble	8s 5d Fl	25.250	Antwerp	E	usance	van der Molen letter book, f. 141
1540-02-29	1 English noble	8s 5d Fl	25.250	Antwerp	E	usance	van der Molen letter book, f. 141
1540-02-29	1 English noble	8s 5d Fl	25.250	Antwerp	E	usance	van der Molen letter book, f. 142v
1540-03-13	1 English noble	8s 6 1/4d Fl	25.563	Antwerp	E	usance	van der Molen letter book, f. 143
1540-04-04	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. 143
1540-04-04	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. 146v
1540-04-04	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. 149
1540-05-02	1 English noble	8s 6 3/4d Fl	25.688	Antwerp	E	usance	van der Molen letter book, f. 147
1540-05-02	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 150v
1540-05-02	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 151
1540-05-02	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 152
1540-05-02	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 152v
1540-05-30	1 English noble	8s 7 1/4d Fl	25.813	Antwerp	E	usance	van der Molen letter book, f. 155
1540-05-30	1 English noble	8s 7 1/4d Fl	25.813	Antwerp	E	usance	van der Molen letter book, f. 157
1540-05-30	1 English noble	8s 7 1/4d Fl	25.813	Antwerp	E	usance	van der Molen letter book, f. 157v
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 160
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 160
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 160v
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 161
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 161v
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 161v
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 162
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 162
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 162
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 162v
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 163
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 163
1540-06-27	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 163v
1540-07-25	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book, f. 164
1540-07-25	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book, f. 164
1540-07-25	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book, f. 167

1540-07-25	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book, f. 167v
1540-07-25	1 English noble	8s 8 1/2d Fl	26.125	Antwerp	E	usance	van der Molen letter book, f. 167v
1540-07-25	1 English noble	8s 8d Fl	26.000	Antwerp	E	usance	van der Molen letter book, f. 168
1540-08-22	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 170v
1540-08-22	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 172
1540-09-18	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 174
1540-09-18	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 174v
1540-09-18	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 175
1540-09-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 172v
1540-09-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 173
1540-09-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 173
1540-09-18	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 175
1540-09-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 176
1540-09-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 176
1540-09-24	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 176v
1540-10-17	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 176v
1540-10-17	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 177
1540-10-17	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 179
1540-10-17	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 181
1540-11-14	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 182
1540-11-14	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 182v
1540-11-14	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 184
1540-11-14	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 186
1540-11-27	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 186v
1541-01-09	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 189
1541-01-09	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 189
1541-01-09	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 191
1541-02-06	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 193
1541-02-06	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 193
1541-02-06	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 194
1541-02-06	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 194v
1541-02-06	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 195
1541-02-06	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 195
1541-02-06	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 195v
1541-02-06	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 196

1541-02-13	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 196v
1541-03-06	1 English noble	8s 10 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 197v
1541-03-06	1 English noble	8s 10 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 197v
1541-03-06	1 English noble	8s 10 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 198v
1541-04-03	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 200v
1541-04-03	1 English noble	8s 11 1/4d Fl	26.813	Antwerp	E	usance	van der Molen letter book, f. 201
1541-04-03	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 201
1541-04-03	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 201v
1541-05-01	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 202
1541-05-01	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 202v
1541-05-01	1 English noble	8s 11 2/3d Fl	26.917	Antwerp	E	usance	van der Molen letter book, f. 203
1541-05-01	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 203
1541-05-01	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 203v
1541-05-01	1 English noble	8s 11 1/2d Fl	26.875	Antwerp	E	usance	van der Molen letter book, f. 203v
1541-05-01	1 English noble	8s 11 2/3d Fl	26.917	Antwerp	E	usance	van der Molen letter book, f. 204
1541-05-01	1 English noble	8s 11 3/4d Fl	26.938	Antwerp	E	usance	van der Molen letter book, f. 205
1541-05-29	1 English noble	8s 10 1/2d Fl	26.625	Antwerp	E	usance	van der Molen letter book, f. 205
1541-05-29	1 English noble	8s 10 1/2d Fl	26.625	Antwerp	E	usance	van der Molen letter book, f. 206
1541-05-29	1 English noble	8s 10 1/2d Fl	26.625	Antwerp	E	usance	van der Molen letter book, f. 207
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 207
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 207v
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 207v
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 208
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 208
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 208v
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 209
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 209
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 209v
1541-06-26	1 English noble	8s 8 3/4d Fl	26.188	Antwerp	E	usance	van der Molen letter book, f. 210
1541-07-24	1 English noble	8s 10 3/4d Fl	26.688	Antwerp	E	usance	van der Molen letter book, f. 211
1541-07-24	1 English noble	8s 10 3/4d Fl	26.688	Antwerp	E	usance	van der Molen letter book, f. 211
1541-07-24	1 English noble	8s 10 3/4d Fl	26.688	Antwerp	E	usance	van der Molen letter book, f. 211v
1541-07-24	1 English noble	8s 10 3/4d Fl	26.688	Antwerp	E	usance	van der Molen letter book, f. 211v
1541-07-24	1 English noble	8s 10 3/4d Fl	26.688	Antwerp	E	usance	van der Molen letter book, f. 212
1541-08-21	1 English noble	8s 11 1/4d Fl	26.813	Antwerp	E	usance	van der Molen letter book, f. 212v

1541-08-21	1 English noble	8s 11 1/4d Fl	26.813	Antwerp	E	usance	van der Molen letter book, f. 213v
1541-08-21	1 English noble	8s 11 1/4d Fl	26.813	Antwerp	E	usance	van der Molen letter book, f. 214
1541-08-21	1 English noble	8s 11 1/4d Fl	26.813	Antwerp	E	usance	van der Molen letter book, f. 214
1541-08-28	1 English noble	8s 11d Fl	26.750	Antwerp	E	usance	van der Molen letter book, f. 214v
1541-08-31	1 English noble	8s 10 3/4d Fl	26.688	Antwerp	E	usance	van der Molen letter book, f. 214v
1541-09-18	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 214v
1541-09-18	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 215
1541-09-18	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 215v
1541-09-18	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 215v
1541-09-18	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 215v
1541-09-18	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 216
1541-09-18	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 216
1541-09-18	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 216
1541-10-16	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 217
1541-10-16	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 217
1541-10-16	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 217v
1541-10-16	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 218v
1541-10-16	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 218v
1541-10-28	1 English noble	8s 11d Fl	26.750	Antwerp	E	usance	van der Molen letter book, f. 214v
1541-11-13	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 219
1541-11-13	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 219v
1541-11-13	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 219v
1541-11-13	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 219v
1541-11-13	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 220v
1541-11-13	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 220v
1541-11-13	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 221
1541-11-13	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 221
1541-11-13	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 221v
1541-11-13	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 221v
1541-11-23	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 221v
1541-12-11	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 220v
1541-12-11	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 222
1541-12-11	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 223
1541-12-11	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 224
1542-01-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 224v

1542-01-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 224v
1542-01-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 225
1542-01-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 225
1542-01-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 225v
1542-01-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 226
1542-01-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 226
1542-01-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 226v
1542-02-04	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 227
1542-02-05	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	Brulez (1958)
1542-02-05	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 227
1542-02-05	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 227v
1542-02-05	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 227v
1542-02-05	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 227v
1542-02-05	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 228
1542-02-05	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 228
1542-03-11	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 228v
1542-03-11	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 229
1542-03-11	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 229
1542-03-11	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 229v
1542-03-12	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 228v
1542-03-12	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 229v
1542-03-12	1 English noble	8s 7 2/3d Fl	25.917	Antwerp	E	usance	van der Molen letter book, f. 230v
1542-04-16	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 230v
1542-04-16	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 231
1542-04-16	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 231v
1542-04-16	1 English noble	8s 4d Fl	25.000	Antwerp	E	usance	van der Molen letter book, f. 231v
1542-05-14	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 233
1542-05-14	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 233
1542-05-14	1 English noble	8s 7d Fl	25.833	Antwerp	E	usance	van der Molen letter book, f. 233
1542-05-14	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 233v
1542-05-14	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 233v
1542-05-14	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 234
1542-05-14	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 234
1542-06-10	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 235
1542-06-10	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 235v

1542-06-10	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 236
1542-06-10	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 236
1542-06-10	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 236v
1542-06-10	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 237
1542-06-11	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 235
1542-06-11	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 235
1542-06-11	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 235v
1542-06-11	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 235v
1542-06-26			27.667	London	E	double usance	SP 1/244/5
1542-06-27	£60 st		28.000	London	E	double usance	SP 46/7/194
1542-07-01			28.000	London	E	1542-09-01	SP 1/244/8
1542-07-08	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 237v
1542-07-09	1 English noble	8s 10 1/8d Fl	26.531	Antwerp	E	usance	van der Molen letter book, f. 237
1542-07-09	1 English noble	8s 10 1/8d Fl	26.531	Antwerp	E	usance	van der Molen letter book, f. 237
1542-07-09	1 English noble	8s 10 1/8d Fl	26.531	Antwerp	E	usance	van der Molen letter book, f. 238
1542-08-05	1 English noble	8s 9 2/3d Fl	26.417	Antwerp	E	usance	van der Molen letter book, f. 240v
1542-08-05	1 English noble	8s 9 2/3d Fl	26.417	Antwerp	E	usance	van der Molen letter book, f. 241
1542-08-05	1 English noble	8s 9 2/3d Fl	26.417	Antwerp	E	usance	van der Molen letter book, f. 241
1542-09-03	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 241v
1542-09-03	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 242v
1542-09-03	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 242v
1542-09-03	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 242v
1542-09-03	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 243
1542-09-03	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 243
1542-09-03	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 243
1542-10-01	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 243v
1542-10-01	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 243v
1542-10-01	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 244
1542-10-01	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 244
1542-10-01	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 244v
1542-10-01	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 245
1542-10-01	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 245
1542-10-01	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 245v
1542-10-29	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 246
1542-10-29	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 246

1542-10-29	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 246
1542-10-29	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 246v
1542-10-29	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 247
1542-10-29	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 247v
1542-10-29	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 247v
1542-10-29	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 247v
1542-10-29	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 248
1542-10-29	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 248
1542-11-25	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 248v
1542-11-25	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 249
1542-11-25	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 249
1542-11-25	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 249
1542-11-25	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 249
1542-11-25	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 249v
1542-11-25	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 249v
1542-11-25	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 250
1542-11-25	1 English noble	8s 10 1/3d Fl	26.583	Antwerp	E	usance	van der Molen letter book, f. 250v
1542-11-26	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	Brulez (1958)
1542-12-23	1 English noble	8s 10 1/8d Fl	26.531	Antwerp	E	usance	van der Molen letter book, f. 251
1542-12-23	1 English noble	8s 10 1/8d Fl	26.531	Antwerp	E	usance	van der Molen letter book, f. 252
1542-12-23	1 English noble	8s 10 1/8d Fl	26.531	Antwerp	E	usance	van der Molen letter book, f. 252v
1542-12-23	1 English noble	8s 10 1/8d Fl	26.531	Antwerp	E	usance	van der Molen letter book, f. 253
1543-01-06	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 253
1543-01-20	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 253v
1543-01-20	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 254
1543-01-20	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 254
1543-01-20	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	van der Molen letter book, f. 255
1543-02-05	1 English noble	8s 10 1/2d Fl	26.625	Antwerp	E	usance	van der Molen letter book, f. 255v
1543-02-18	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 255v
1543-02-24	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 255v
1543-02-24	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 256
1543-02-24	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 256v
1543-02-24	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 256v
1543-02-24	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 257
1543-02-24	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 257

1543-02-24	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 257v
1543-02-24	1 English noble	8s 9 3/4d Fl	26.438	Antwerp	E	usance	van der Molen letter book, f. 258
1543-04-01	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 258
1543-04-01	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 258v
1543-04-01	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 259
1543-04-01	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 259
1543-04-01	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 259
1543-04-01	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 259
1543-04-01	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 259v
1543-04-29	1 English noble	8s 10 1/4d Fl	26.563	Antwerp	E	usance	Brulez (1958)
1543-04-29	1 English noble	8s 10 1/2d Fl	26.625	Antwerp	E	usance	van der Molen letter book, f. 260v
1543-04-29	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 261
1543-04-29	1 English noble	8s 10 2/3d Fl	26.667	Antwerp	E	usance	van der Molen letter book, f. 262
1543-05-06	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 262v
1543-05-26	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 263v
1543-05-26	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 263v
1543-05-26	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 263v
1543-05-26	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 264v
1543-06-23	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 265v
1543-06-23	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 265v
1543-06-23	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 266
1543-06-23	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 266
1543-07-21	1 English noble	8s 8 2/3d Fl	26.167	Antwerp	E	usance	van der Molen letter book, f. 266v
1543-07-21	1 English noble	8s 8 2/3d Fl	26.167	Antwerp	E	usance	van der Molen letter book, f. 267
1543-07-21	1 English noble	8s 8 2/3d Fl	26.167	Antwerp	E	usance	van der Molen letter book, f. 267
1543-07-21	1 English noble	8s 8 2/3d Fl	26.167	Antwerp	E	usance	van der Molen letter book, f. 268
1543-07-21	1 English noble	8s 8 2/3d Fl	26.167	Antwerp	E	usance	van der Molen letter book, f. 268v
1543-08-18	1 English noble	8s 7 3/4d Fl	25.938	Antwerp	E	usance	van der Molen letter book, f. 269
1543-08-18	1 English noble	8s 7 3/4d Fl	25.938	Antwerp	E	usance	van der Molen letter book, f. 269
1543-08-18	1 English noble	8s 7 3/4d Fl	25.938	Antwerp	E	usance	van der Molen letter book, f. 270v
1543-09-00			26.000	London	A	unknown	SP 46/5/6v
1543-09-15	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f.??
1543-09-16	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. ??
1543-09-17	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. ??
1543-09-25	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. 271

1543-09-25	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. 271
1543-09-25	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. 271v
1543-09-25	1 English noble	8s 5 1/4d Fl	25.313	Antwerp	E	usance	van der Molen letter book, f. 272v
1543-10-14	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 273
1543-10-14	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 274
1543-10-14	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 274
1543-10-23	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 274
1543-10-23	1 English noble	8s 7d Fl	25.750	Antwerp	E	usance	van der Molen letter book, f. 274
1543-10-26			26.000	London	E	sight	SP 46/5/6v
1543-11-10	1 English noble	8s 7 1/2d Fl	25.875	Antwerp	E	usance	van der Molen letter book, f. 276v
1543-11-30	£40 Fl		26.167	Calais	E	1543-12-06	SP 1/244/157
1543-12-06	£80 st		26.667	London	E	sight	SP1/182/148
1543-12-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 277
1543-12-08	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 278
1544-01-00			26.667	London	H	sight	Gould (1970)
1544-01-22	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 280v
1544-02-00			27.167	London	H	sight	Gould (1970)
1544-02-09	1 English noble	8s 11 1/3d Fl	26.833	Antwerp	E	usance	van der Molen letter book, f. 282v
1544-03-00			26.917	London	H	sight	Gould (1970)
1544-03-02			26.750	London	E	sight	SP1/183/162
1544-03-02			27.500	London	E	Double usance	SP1/183/162
1544-03-15	1 English noble	8s 10 1/2d Fl	26.625	Antwerp	E	usance	van der Molen letter book, f. 284v
1544-04-00			26.667	London	H	sight	Gould (1970)
1544-04-02	£100 st	£266 13s 4d Fl	26.667	London	E	sight	SP 46/5 14v
1544-04-12	£100 st		26.667	London	E	sight	SP 46/5/15v
1544-04-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 285
1544-04-19	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 285v
1544-04-29	1 English noble	8s 9 1/2d Fl	26.375	Antwerp	E	usance	van der Molen letter book, f. 285v
1544-05-00			26.625	London	H	sight	Gould (1970)
1544-05-17	1 English noble	8s 9 1/4d Fl	26.313	Antwerp	E	usance	van der Molen letter book, f. 288
1544-06-00			25.792	London	H	sight	Gould (1970)
1544-06-14	1 English noble	8s 6d Fl	25.500	Antwerp	E	usance	van der Molen letter book, f. 289v
1544-06-14	1 English noble	8s 6d Fl	25.500	Antwerp	E	usance	van der Molen letter book, f. 291
1544-06-14	1 English noble	8s 6d Fl	25.500	Antwerp	E	usance	van der Molen letter book, f. 291v
1544-07-00			25.667	London	H	sight	Gould (1970)

1544-07-12	1 English noble	8s 5 1/2d Fl	25.375	Antwerp	E	usance	van der Molen letter book, f. 292
1544-07-18	£80 st		26.667	London	E	the Sinxon Mart	SP 46/5/31
1544-08-00			26.458	London	H	sight	Gould (1970)
1544-08-09	1 English noble	8s 8 2/3d Fl	26.167	Antwerp	E	usance	van der Molen letter book, f. 294
1544-08-26	£60 st	£80 10s Fl	26.833	London	E	usance	SP 1/191/176
1544-08-26			27.000	London	E	usance	SP 1/191/176
1544-08-26			26.667	London	E	sight	SP 1/191/176
1544-09-00			26.542	London	H	sight	Gould (1970)
1544-09-13	1 English noble	8s 9d Fl	26.250	Antwerp	E	usance	van der Molen letter book, f. 295
1544-10-00			26.792	London	H	sight	Gould (1970)
1544-10-04	1 English noble	8s 10d Fl	26.500	Antwerp	E	usance	van der Molen letter book, f. 295v
1544-10-31			26.500	London	E	unknown	SP1/194/177
1544-11-00			26.792	London	H	sight	Gould (1970)
1544-11-25			26.833	London	E	usance	SP46/5/39
1544-12-00			25.292	London	H	sight	Gould (1970)
1544-12-03	£110 st		27.000	London	E	usance	SP 46/5/47, 48
1544-12-09	£32 9s st		26.500	Antwerp	E	unknown	SP1/195/212
1544-12-09			27.000	Antwerp	E	sight	SP1/195/212
1545-01-30		£177 5s st	26.500	Antwerp	E	unknown	SP1/197/212
1545-02-28			26.500	London	E	sight	SP1/198/182
1545-03-29			26.333	London	E	usance	SP46/5/70v
1545-03-31			26.667	London	E	usance	SP46/5/70v, 82r
1545-04-10			26.667	Calais	E	unknown	SP46/5/82v
1545-05-08			26.000	London	E	sight	SP1/200/210
1545-05-08			26.333	London	E	sight	SP1/200/210
1545-05-08	£100 st		26.000	London	E	unknown	SP1/200/210
1545-05-15			26.500	London	E	sight	SP1/201/58
1545-05-18			26.000	Antwerp	E	usance	SP46/5/71r, 71v
1545-05-19	£100 st		26.417	London	E	3 days after sight	SP1/201/89
1545-05-25	£50 st		26.000	Antwerp	E	usance	SP46/5/71v, 90r
1545-05-27	£100 st		26.417	London	E	sight	SP1/201/147
1545-05-27	£60 st		26.667	London	E	in Pascha Mart	SP1/201/147
1545-05-29	£100 st		26.250	London	E	sight	SP1/201/162
1545-05-31	£40 st		26.000	Antwerp	E	1545-06-30	SP46/5/81r
1545-05-31	£60 st		25.333	Antwerp	E	sight	SP46/5/81r

1545-05-31	£100 st		25.500	Antwerp	E	sight	SP46/5/81r
1545-09-07	£80 st	£104 13s 4d Fl	26.167	Antwerp	E	unknown	SP1/212/218r
1545-09-12	£40 st		25.667	London	E	sight	SP1/212/220v, 221r, 221v, 222r
1545-09-12	£60 st		25.833	London	E	in Sinxon Mart	SP1/212/220v, 221r, 221v, 222r
1545-09-28	£30 st		26.333	London	E	1545-11-10	SP1/208/91
1545-10-00			25.375	London	H	sight	Gould (1970)
1545-11-04			26.000	London	E	Double usance	SP1/210/1
1545-11-28	£40 st		26.000	London	E	1546-01-20	SP1/211/93
1545-12-05			26.083	London	E	Double usance	SP1/211/176
1545-12-05			26.667	London	E	1546-03-31	SP1/211/176
1545-12-19	£250 st		25.000	London	E	unknown	SP46/5/75r
1546-04-00			26.250	London	H	sight	Gould (1970)
1546-04-05	£100 st		25.000	London	E	1546-04-20	SP46/5/89v, 78r, 78v
1546-04-09	£100 st		25.000	London	E	1546-05-02	SP46/5/85v, 86r
1546-04-09			25.333	London	E	1546-05-31	SP46/5/85v, 86r
1546-05-00			25.417	London	H	sight	Gould (1970)
1546-05-07	£500 st		24.667	London	E	sight	SP46/5/96v
1546-05-07	£300 st		25.000	London	E	in the sinxon Mart	SP46/5/96v
1546-05-07	£1809 3s 7d Fl	£1720 st	26.667		A	unknown	Gresham daybook, 141
1546-05-07	£6006 Fl	£4504 2s 4d st	26.667		A	unknown	Gresham daybook, 142
1546-05-07			24.750	Antwerp	E	half-usance	SP 46/5/98v
1546-05-13			25.000	London	K	in the Pascha Mart	SP46/5/158
1546-05-18	£200 st		24.833	London	E	3 days after sight	SP46/5/157
1546-05-18		£200 st	25.000		E	1546-06-30	Gresham daybook, 220
1546-05-19			26.667		A	unknown	Gresham daybook, 232
1546-05-23			24.333	Antwerp	E	unknown	SP46/5/162
1546-05-30		£7 17s 6d st	26.667		A	unknown	Gresham daybook, 294
1546-06-11		£2 5s st	26.667		A	unknown	Gresham daybook, 372
1546-06-17	£7 12s 4d Fl	£5 15s st	26.667		A	unknown	Gresham daybook, 412
1546-07-00			24.500	London	H	sight	Gould (1970)
1546-07-02			24.333	London	E	sight	SP46/5/165
1546-07-02			24.667	London	E	1546-09-15	SP46/5/165
1546-07-02			24.833	London	E	1546-09-15	SP46/5/165
1546-07-02			25.000	London	E	1546-09-30	SP46/5/165, 168
1546-07-30	£1180 6s Fl	£908 0s 9d st	26.000	London	A	unknown	Gresham daybook, 570

1546-09-00			25.000	London	H	sight	Gould (1970)
1546-09-00	£11 3s 2 1/2d Fl	£9 6s st	24.000	Antwerp	A	unknown	SP 46/5/182r
1546-09-00	£81 1s 10d Fl	£67 11s 6 3/4 st	24.000	Antwerp	A	unknown	SP 46/5/182r
1546-09-00	£84 13s 1d Fl	£78 17s 7 1/2 st	24.000	Antwerp	A	unknown	SP 46/5/183r
1546-09-00	£13 12s 1d Fl	£11s 6s 9d st	24.000	Antwerp	A	unknown	SP 46/5/183r
1546-09-01	£60 st		23.667	London	E	1546-09-08	SP 46/5/113r
1546-09-01			24.167	London	E	usance	SP 46/5/113r
1546-09-01	£100 st		25.167	London	E	in the Bamas Mart	SP 46/5/113r
1546-09-24	£100 st		24.333	London	E	1546-11-23	SP 1/225/44
1546-09-24	£100 st		23.917	London	E	4 days after sight	SP 1/225/44
1546-10-26	£500 Fl	£384 12s st	26.000		A	unknown	Gresham daybook, 753
1546-10-26	£45 Fl	£34 12s 4d st	26.000		A	unknown	Gresham daybook, 754
1546-11-08			24.000	London	E	sight	SP 46/5/117
1547-01-00			23.292	London	H	sight	Gould (1970)
1547-01-28			23.000	Antwerp	E	sight	Gresham daybook, 1176
1547-02-00			23.375	London	H	sight	Gould (1970)
1547-02-15	£250 st		23.000	London	E	usance	SP 46/5/122r, 122v
1547-03-00			22.042	London	H	sight	Gould (1970)
1547-03-01			23.000	Calais	E	unknown	SP 46/5/125r, 125v, 318v, 318r, 126r
1547-03-05	£421 6s 8d st		22.750		A	unknown	Gresham daybook, 1328
1547-03-22	£200 st		22.500	London	E	usance	SP 46/5/196
1547-03-26	£10 Fl	£8 15s st	23.000	Antwerp	E	sight	Gresham daybook, 1426
1547-04-00			22.000	London	H	sight	Gould (1970)
1547-04-05	£100 st		21.917	London	E	sight	SP 46/5/197
1547-04-05	£23 3s 7d Fl	£18s 10d st	25.000		A	unknown	Gresham daybook, 1477
1547-04-05	£14 8s 1d Fl	£13 8s st	22.000		A	unknown	Gresham daybook, 1478
1547-04-18	£50 Fl		26.667	Antwerp	A	unknown	Gresham daybook, 1498
1547-04-30	£200 st		22.000	London	E	1547-07-16	Gresham daybook, 1532
1547-05-00			22.208	London	H	sight	Gould (1970)
1547-05-06			22.667	London	E	1547-08-08	SP 46/5/200
1547-05-06	£60 st		22.000	London	E	in Pascha mart	SP 46/5/205
1547-05-10	£100 st		22.167	London	E	in Pascha mart	SP 46/5/205
1547-05-10	£100 st		22.750	London	E	1547-08-15	SP 46/5/205
1547-05-10			22.000		A	unknown	Gresham daybook, 1565
1547-05-28	£200 st		23.500	London	E	in Sinxon mart	SP 46/5/207

1547-05-28		22.167	London	E	usance	SP 46/5/207
1547-05-28		22.250	London	E	usance	SP 46/5/207
1547-05-28		22.417	London	E	usance	SP 46/5/207
1547-05-28		22.500	London	E	usance	SP 46/5/207
1547-06-00		22.083	London	H	sight	Gould (1970)
1547-06-07	£100 st	23.000	London	E	in Sinxon mart	SP 46/5/208
1547-06-08	£80 st	22.333	London	E	1547-08-08	Gresham daybook, 1751
1547-06-20		22.083	Antwerp	E	usance	SP46/5/212, SP46/6/167
1547-06-20		22.333	London	E	sight	SP46/5/212, SP46/6/167
1547-06-23		22.667	London	E	sight	SP 46/5/213
1547-06-23		23.500	London	E	1547-08-31	SP 46/5/213
1547-06-23		24.000	London	E	mid-Sept, 1547	SP 46/5/213
1547-06-26	£200 st	23.167	London	E	usance	Gresham daybook, 1785
1547-07-18		22.000		A	unknown	Gresham daybook, 1806
1547-07-21		22.000		A	unknown	Gresham daybook, 1807
1547-07-21		25.000		A	unknown	Gresham daybook, 1808
1547-07-21		25.000	Antwerp	A	unknown	Gresham daybook, 1809
1547-07-28		21.500		E	unknown	Gresham daybook, 1833
1547-08-00		22.500	London	H	sight	Gould (1970)
1547-08-03		26.667		A	unknown	Gresham daybook, 1857
1547-08-03		26.667		A	unknown	Gresham daybook, 1858
1547-08-05	£50 st	22.083	Antwerp	E	unknown	Gresham daybook, 1877
1547-08-22		22.500	Antwerp	E	usance	SP 46/5/221
1547-08-24		22.375	Antwerp	E	8 days after sight	Gresham daybook, 1934
1547-08-24		23.000		A	unknown	Gresham daybook, 1935
1547-09-00		22.833	London	H	sight	Gould (1970)
1547-09-17		22.500		A	unknown	Gresham daybook, 1977
1547-09-17		22.500		A	unknown	Gresham daybook, 1984
1547-09-29	£44 st	22.833	London	E	usance	Gresham daybook, 2015
1547-10-00		22.708	London	H	sight	Gould (1970)
1547-10-30	£200 st	23.250	London	E	1548-01-31	Gresham daybook, 2087
1547-10-30	£100 st	23.000	London	E	1547-11-28	Gresham daybook, 2088
1547-11-00		23.042	London	H	sight	Gould (1970)
1547-11-05	£100 st	23.250	London	E	1548-01-31	Gresham daybook, 2118
1547-11-15	£100 st	23.167	London	E	1548-01-17	Gresham daybook, 2151

1547-11-21		26.583	Antwerp	E	sight	SP 46/5/235, 236
1547-11-21		26.667	Antwerp	E	usance	SP 46/5/235, 236
1547-11-26	£150 st	23.000	London	E	1548-01-26	Gresham daybook, 2196
1547-12-00		22.750	London	H	sight	Gould (1970)
1547-12-15	£100 st	22.250	London	E	sight	Gresham daybook, 2275
1547-12-15	£100 st	23.000	London	E	usance	Gresham daybook, 2276
1548-02-00		22.042	London	H	sight	Gould (1970)
1548-02-04	£200 st	22.333	London	E	1548-03-01	Gresham daybook, 2390
1548-02-04	£100 st	22.250	London	E	sight	Gresham daybook, 2391
1548-02-08	£100 st	22.167	London	E	sight	Gresham daybook, 2394
1548-02-09	£100 st	22.250	London	E	sight	Gresham daybook, 2397
1548-02-09	£100 st	22.167	London	E	sight	Gresham daybook, 2403
1548-02-09	£100 st	22.250	London	E	1548-03-01	Gresham daybook, 2406
1548-02-09	£100 st	22.250	London	E	1548-03-01	Gresham daybook, 2408
1548-02-22	£50 st	22.083	London	E	sight	Gresham daybook, 2454
1548-03-00		21.875	London	H	sight	Gould (1970)
1548-03-08	£200 st	22.167	London	E	Double usance	Gresham daybook, 2519
1548-03-08		22.250	Antwerp	A	unknown	Gresham daybook, 2497
1548-03-24	£200 st	22.000	London	E	usance	Gresham daybook, 2625
1548-03-24	£200 st	21.792	Antwerp	E	unknown	Gresham daybook, 2628
1548-03-25		21.750		E	in the Bamas mart	Gresham daybook, 2538
1548-03-30	£200 st	21.792	Antwerp	E	sight	Gresham daybook, 2660
1548-03-31		21.417	Antwerp	E	unknown	SP 46/5/246
1548-04-01		21.583	Antwerp	E	usance	SP 46/5/246
1548-04-18	£80 st	22.000	London	E	1548-04-30	SP 46/5/252
1548-04-18	£100 st	22.333	London	E	1548-06-30	SP 46/5/252
1548-04-26		21.700		E	sight	Gresham daybook, 2772
1548-05-01		21.917	London	E	sight	SP 46/5/261
1548-05-01		22.083	London	E	usance	SP 46/5/261
1548-05-01		22.333	London	E	Double usance	SP 46/5/261
1548-05-04	£100 st	22.167	London	E	usance	SP 46/5/262
1548-05-05		22.083	London	E	sight	SP 46/5/262
1548-05-05		22.333	London	E	usance	SP 46/5/262
1548-05-05		22.667	London	E	Double usance	SP 46/5/262
1548-05-05		23.000	London	E	3 moths	SP 46/5/262

1548-05-15			22.333	London	E	usance	SP 46/5/266
1548-05-15			22.417	London	E	usance	SP 46/5/266
1548-05-15			22.667	London	E	Double usance	SP 46/5/266
1548-05-20			26.667			unknown	Gresham daybook, 2923
1548-06-00			22.292	London	H	sight	Gould (1970)
1548-06-02	£100 st		22.250	London	E	1548-06-30	SP 46/5/270
1548-06-04	£100 st		22.333	London	E	usance	SP 46/5/271
1548-06-19			22.500		A	unknown	Gresham daybook, 3052
1548-06-20			22.500		A	unknown	Gresham daybook, 3052
1548-06-20			22.500		A	unknown	Gresham daybook, 3054
1548-06-20			22.500		A	unknown	Gresham daybook, 3055
1548-06-30			23.000	London	E	1548-09	SP 46/5/275
1548-07-00			22.250	London	H	sight	Gould (1970)
1548-07-04	£100 st		23.083	London	E	3 months	SP 46/5/276
1548-07-12	£100 st		22.917	London	E	1548-09-30	SP 46/5/277
1548-07-28	£100 st		22.667	London	E	Double usance	SP46/5/279, 281, SP46/6/169
1548-07-28	£60 st		22.333	London	E	usance	Gresham daybook, 3251
1548-07-28	£100 st		22.500	London	E	usance	Gresham daybook, 3252
1548-08-00			22.083	London	H	sight	Gould (1970)
1548-08-24			22.000		A	unknown	Gresham daybook, 3355
1548-08-27	£130 st		22.417	London	E	Double usance	Gresham daybook, 3426
1548-08-27	£200 st		22.500	London	E	Double usance	Gresham daybook, 3439
1548-09-00			22.000	London	H	sight	Gould (1970)
1548-09-07			22.000		A	unknown	Gresham daybook, 3485
1548-09-07	£100 st		22.125	London	E	usance	Gresham daybook, 3457
1548-09-07	£100 st		22.417	London	E	Double usance	Gresham daybook, 3458
1548-09-16	£80 st		22.417	London	E	Double usance	Gresham daybook, 3530
1548-09-16	£100 st		22.333	London	E	Double usance	Gresham daybook, 3531
1548-09-20	£100 st		22.250	London	E	1548-10-31	SP 46/5/295
1548-09-20			22.167	London	E	usance	SP 46/5/295
1548-09-21	£100 st		22.333	London	E	usance	Gresham daybook, 3553
1548-09-21	£50 st		22.333	London	E	usance	Gresham daybook, 3554
1548-10-00			22.167	London	H	sight	Gould (1970)
1548-10-09	£280 st		22.000	London	E	10 days after sight	Gresham daybook, 3585
1548-10-15	£100 st	£111 5s Fl	22.250	London	E	unknown	SP 46/5/297, 298

1548-10-27			22.333		E	unknown	Gresham daybook, 3630
1548-10-28	£50 st		22.000	London	E	sight	Gresham daybook, 3638
1548-11-00			22.042	London	H	sight	Gould (1970)
1548-11-02	£200 st		22.000	London	E	6 days after sight	Gresham daybook, 3667
1548-11-02	£150 st		22.000	London	E	4 days after sight	Gresham daybook, 3668
1548-11-08	£90 st	£101 5s Fl	22.500	London	E	Double usance	SP 46/5/306
1548-11-13	£100 st	£110 Fl	22.000	London	E	1548-12-15	SP 46/5/306
1548-11-16	£100 st	£110 8s 4d Fl	22.083	London	E	one and half usance	SP 46/5/314
1548-11-17			22.000		A	unknown	Gresham daybook, 3731
1548-11-17			22.000			unknown	Gresham daybook, 3738
1548-11-20	£100 st		22.500	Antwerp	E	1548-11-30	Gresham daybook, 3768
1548-11-20	£100 st		21.500	London	E	usance	Gresham daybook, 3769
1548-12-00			21.292	London	H	sight	Gould (1970)
1548-12-01	£200 st		22.000		E	Double usance	Gresham daybook, 3796
1548-12-01			21.600		E	unknown	Gresham daybook, 3804
1548-12-11			22.000		A	unknown	Gresham daybook, 3873
1548-12-22	£60 st		21.500	London	E	Double usance	SP 46/5/314
1548-12-30	£50 st		20.500	Antwerp	E	1548-01-20	Gresham daybook, 3953
1548-12-31			21.000		A	unknown	Gresham daybook, 3961
1549-01-00			21.500	London	H	sight	Gould (1970)
1549-01-09			21.000			unknown	Gresham daybook, 3995
1549-01-13	£200 st		21.667	London	E	usance	Gresham daybook, 4021
1549-01-14	£100 st		21.667	London	E	usance	Gresham daybook, 4033
1549-02-00			21.208	London	H	sight	Gould (1970)
1549-02-16			22.333	London	E	sight	Gresham daybook, 4182
1549-03-00			20.167	London	H	sight	Gould (1970)
1549-03-16	£100 st		20.333	London	E	1549-04-19	Gresham daybook, 4278
1549-03-16			21.000		A	unknown	Gresham daybook, 4283
1549-04-00			20.375	London	H	sight	Gould (1970)
1549-04-04	£100 st		20.500	London		1549-05-07	Gresham daybook, 4342
1549-04-09	£500 st		20.083	Antwerp	E	sight	Gresham daybook, 4352
1549-04-26	£100 st		20.000	Antwerp		1549-05-29	Gresham daybook, 4370
1549-04-26	£283 6s 8d st		20.000	Antwerp		1549-05-05	Gresham daybook, 4372
1549-04-26	£200 st		20.000	Antwerp		1549-05-28	Gresham daybook, 4375
1549-05-00			20.500	London	H	sight	Gould (1970)

1549-05-19	£100 st		20.083	Antwerp	E	1549-06-15	Gresham daybook, 4405
1549-05-22	£452 10s Fl	£395 18s 9d st	22.500	Antwerp	A	unknown	Gresham daybook, 4426
1549-05-22	£342 18s Fl		22.500	Antwerp	A	unknown	Gresham daybook, 4427
1549-05-24	£200 st		20.500	London		1549-06-26	Gresham daybook, 4433
1549-05-24	£207 11s 3d st		20.125	Antwerp		1549-06-22	Gresham daybook, 4443
1549-05-24	£100 st		20.000	Antwerp	E	1549-06-20	Gresham daybook, 4444
1549-05-24	£93 16s Fl		22.500	Antwerp	A	unknown	Gresham daybook, 4447
1549-06-00			20.292	London	H	sight	Gould (1970)
1549-06-01	£100 st		20.333	London	E	1549-06-30	Gresham daybook, 4459
1549-06-02	£100 st		20.417	London	E	1549-06-30	Gresham daybook, 4472
1549-06-02	£100 st		20.417	London		unknown	Gresham daybook, 4476
1549-06-02			20.417	London	E	1549-06-09	Gresham daybook, 4485
1549-06-08	£200 st		20.458	London	E	usance	Gresham daybook, 4489
1549-06-10	£60 st		20.417	London	E	usance	Gresham daybook, 4504
1549-06-10			20.000	Antwerp	A	unknown	Gresham daybook, 4507
1549-06-16	£300 st		20.417	London	E	usance	Gresham daybook, 4522
1549-06-16	£100 st		20.375	London	E	usance	Gresham daybook, 4525
1549-06-16	£50 st		20.375	London	E	usance	Gresham daybook, 4529
1549-06-16	£200 st		20.417	London	E	usance	Gresham daybook, 4533
1549-06-16	£75 st		20.375	London	E	usance	Gresham daybook, 4535
1549-06-19			20.500		E	unknown	Gresham daybook, 4550
1549-06-19	£200 st		20.833	London	E	Double usance	Gresham daybook, 4553
1549-06-19			20.375	London	E	usance	Gresham daybook, 4560
1549-06-26	£300 st		20.833	London	E	Double usance	Gresham daybook, 4579
1549-06-26	£100 st		20.417	London	E	usance	Gresham daybook, 4584
1549-07-00			20.375	London	H	sight	Gould (1970)
1549-07-02			19.750		E	1549-07-28	Gresham daybook, 4606
1549-07-02	£100 st		20.583	London	E	usance	Gresham daybook, 4610
1549-07-02	£100 st		20.667	London	E	usance	Gresham daybook, 4612
1549-07-02	£100 st		20.667	London	E	usance	Gresham daybook, 4613
1549-07-02			20.583	London	E	usance	Gresham daybook, 4611
1549-07-02	£100 st		19.917	Antwerp	E	1549-07-28	Gresham daybook, 4608
1549-07-02	£100 st		19.917	Antwerp	E	1549-07-28	Gresham daybook, 4609
1549-07-12	£500 st		21.167	London	E	Double usance	SP 46/6/9
1549-07-13			21.000		A	unknown	Gresham daybook, 4643

1549-07-13	£100 st	20.083	Antwerp	E	usance	Gresham daybook, 4644
1549-07-13		22.000		A	unknown	Gresham daybook, 4645
1549-07-16		21.000		A	unknown	Gresham daybook, 4654
1549-07-16		21.000		A	unknown	Gresham daybook, 4655
1549-08-00		20.208	London	H	sight	Gould (1970)
1549-08-12		20.333	London	E	1549-09-14	Gresham daybook, 4796
1549-08-12		20.333	London	E	usance	Gresham daybook, 4807
1549-08-18		20.042	London	E	sight	Gresham daybook, 4822
1549-08-18		20.000	London	E	sight	Gresham daybook, 4823
1549-08-29		20.833	London	E	Double usance	Gresham daybook, 4866
1549-08-29		20.833	London	E	Double usance	Gresham daybook, 4875
1549-08-29		20.375	London	E	usance	Gresham daybook, 4877
1549-08-29		20.750	London	E	sight	Gresham daybook, 4879
1549-08-29		20.417	London	E	usance	Gresham daybook, 4882
1549-08-29		20.417	London	E	usance	Gresham daybook, 4883
1549-08-29		20.417	London	E	usance	Gresham daybook, 4884
1549-09-00		20.292	London	H	sight	Gould (1970)
1549-09-06		21.000	London	E	Triple usance	Gresham daybook, 4918
1549-09-06		20.667	London	E	Double usance	Gresham daybook, 4920
1549-09-06		20.667	London	E	Double usance	Gresham daybook, 4924
1549-09-10		20.500	London	E	one and half usance	Gresham daybook, 4928
1549-09-10		20.667	London	E	Double usance	Gresham daybook, 4930
1549-09-10		20.667	London	E	Double usance	Gresham daybook, 4931
1549-09-10		20.167	London	E	sight	Gresham daybook, 4932
1549-09-10		20.125	London	E	sight	Gresham daybook, 4934
1549-09-10		20.167	London	E	sight	Gresham daybook, 4935
1549-09-10		20.167	London	E	sight	Gresham daybook, 4940
1549-09-18		20.500	London	E	sight	Gresham daybook, 4953
1549-09-26	£177 4s 6d st	19.917	Antwerp	E	1549-10-15	Gresham daybook, 4956
1549-09-26	£55 4s st	19.813	Antwerp	E	1549-10-09	Gresham daybook, 4057
1549-09-26	£183 7s st	19.813	Antwerp	E	1549-10-09	Gresham daybook, 4958
1549-09-26	£100 st	19.771	Antwerp	E	1549-10-09	Gresham daybook, 4960
1549-10-00		20.125	London	H	sight	Gould (1970)
1549-10-02		20.167	London	E	sight	Gresham daybook, 4965
1549-10-16		20.125	London	E	sight	Gresham daybook, 5010

1549-10-16			20.333	London	E	usance	Gresham daybook, 5012
1549-10-16			20.083	London	E	sight	Gresham daybook, 5019
1549-10-21			20.125	London	E	sight	Gresham daybook, 5028
1549-10-21			20.333	London	E	usance	Gresham daybook, 5024
1549-10-21			20.292	London	E	usance	Gresham daybook, 5030
1549-10-21			20.083	London	E	sight	Gresham daybook, 5031
1549-10-21			20.375	London	E	usance	Gresham daybook, 5032
1549-10-24			20.333	London	E	usance	Gresham daybook, 5037
1549-10-24			20.250	London	E	usance	Gresham daybook, 5038
1549-10-24			20.083	London	E	sight	Gresham daybook, 5039
1549-10-24			20.083	London	E	usance	Gresham daybook, 5053
1549-11-00			20.083	London	H	sight	Gould (1970)
1549-11-12	£100 st		19.583	Antwerp	E	usance	Gresham daybook, 5129
1549-11-12	£200 st		19.917	Antwerp	E	1549-11-26	Gresham daybook, 5130
1549-11-21			20.000	London	E	sight	Gresham daybook, 5136
1549-11-21			20.083	London	E	sight	Gresham daybook, 5138
1549-12-00			19.625	London	H	sight	Gould (1970)
1549-12-31	£91 1s 7d st		19.250	Antwerp	E	half-usance	Gresham daybook, 5301
1550-04-00			19.375	London	H	sight	Gould (1970)
1550-04-15	£200 st		18.938	Antwerp	E	half-usance	Gresham daybook, 5491
1550-04-18			19.583	London	E	usance	Gresham daybook, 5502
1550-04-18			19.667	London	E	unknown	Gresham daybook, 5503
1550-05-00			20.042	London	H	sight	Gould (1970)
1550-05-01	£60 st		20.167	London	E	Double usance	SP 46/6/14
1550-05-01	£70 st	£70 11s 8d Fl	20.167	London	E	Double usance	SP 46/6/14
1550-05-16	£200 st		19.750	Antwerp	E	2 days after sight	Gresham daybook, 5549
1550-05-29			19.917	London	E	usance	SP 46/6/17
1550-05-29			19.667	London	E	sight	SP 46/6/17
1550-05-31			19.833	London	E	unknown	SP 46/6/17
1550-06-00			19.458	London	H	sight	Gould (1970)
1550-06-27			19.625	London	E	usance	Gresham daybook, 5670
1550-07-00			19.542	London	H	sight	Gould (1970)
1550-07-15	£100 st		19.250	Antwerp	E	sight	Gresham daybook, 5769
1550-07-23	£50 st		19.417	Antwerp	E	unknown	Gresham daybook, 5774
1550-07-23			19.333	London	E	sight	Gresham daybook, 5775

1550-07-30	£117 st	19.333	Antwerp	E	sight	Gresham daybook, 5791
1550-08-00		18.958	London	H	sight	Gould (1970)
1550-08-06	£100 st	19.250	London	E	1550-09-04	SP 46/6/18
1550-08-06		19.000		A	unknown	Gresham daybook, 5809
1550-08-06		19.000		A	unknown	Gresham daybook, 5820
1550-08-06		19.000		A	unknown	Gresham daybook, 5821
1550-08-08		19.500	London	E	Double usance	SP 46/6/18
1550-08-11	£400 st	18.750	Antwerp	E	3 days after sight	Gresham daybook, 5825
1550-08-11	£57 5s st	18.500	Antwerp	E	1550-08-20	Gresham daybook, 5830
1550-08-11	£50 st	18.833	Antwerp	E	1550-08-20	Gresham daybook, 5831
1550-08-17		18.500		A	unknown	Gresham daybook, 5838
1550-08-17	£109 14s 7d st	18.500	Antwerp	E	2 days after sight	Gresham daybook, 5847
1550-08-17	£100 st	19.000	London	E	usance	Gresham daybook, 5849
1550-08-17	£100 st	19.000	London	E	usance	Gresham daybook, 5850
1550-08-17		18.833	London	E	sight	Gresham daybook, 5851
1550-08-17	£50 st	19.333	London	E	Double usance	Gresham daybook, 5851
1550-08-26		18.417	Antwerp	E	unknown	Gresham daybook, 5874
1550-09-00		18.375	London	H	sight	Gould (1970)
1550-09-01	£60 st	18.000	Antwerp	E	3 days after sight	Gresham daybook, 5885
1550-09-01	£100 st	18.167	Antwerp	E	1550-09-28	Gresham daybook, 5891
1550-09-01	£155 10s st	18.000	Antwerp	E	1550-10-06	Gresham daybook, 5892
1550-09-24	£112 2s 11d st	17.833	Antwerp	E	1550-10-18	Gresham daybook, 5910
1550-09-24		17.833	Antwerp	E	sight	Gresham daybook, 5911
1550-10-00		18.000	London	H	sight	Gould (1970)
1550-10-09	£100 st	17.583	Antwerp	E	1550-11-04	Gresham daybook, 5979
1550-10-23	£100 st	17.583	Antwerp	E	1550-11-12	Gresham daybook, 6006
1550-11-00		18.000	London	H	sight	Gould (1970)
1550-11-10	£120 st	18.000	London	E	5 days after sight	Gresham daybook, 6048
1550-11-10	£150 st	18.000	London	E	1 day after sight	Gresham daybook, 6049
1550-11-15		18.333	London	E	Double usance	SP 46/5/30
1550-11-25		18.167		E	unknown	Gresham daybook, 6072
1551-01-04		17.000		A	unknown	Gresham daybook, 6091
1551-01-18		16.667	London	E	sight	SP 46/6/83
1551-02-00		16.875	London	H	sight	Gould (1970)
1551-02-14		17.000		A	unknown	Gresham daybook, 6117

1551-02-18	£141 15s st		16.583	Antwerp	E	sight	Gresham daybook, 6127
1551-02-21			16.500		A	unknown	Gresham daybook, 6149
1551-02-21			16.000		A	unknown	Gresham daybook, 6150
1551-03-10			16.833	London	E	sight	Gresham daybook, 6179
1551-03-24			16.000		A	unknown	Gresham daybook, 6210
1551-04-00			15.250	London	H	sight	Gould (1970)
1551-04-06			16.250	London	E	Double usance	SP 46/6/98
1551-04-06			15.500	London	E	usance	SP 46/6/98
1551-05-04	£200 st		16.167	London	E	3 moths	SP 46/6/100
1551-05-06			15.333	London	E	sight	SP 46/6/100
1551-05-22			13.583	London	E	usance	SP 46/6/143
1551-05-25	£200 st		13.750	London	E	Double usance	SP 46/6/143
1551-05-29			14.000	London	E	usance	SP 46/6/145
1551-05-30	£100 st		13.917	London	E	Double usance	SP 46/6/147
1551-05-31			13.917	London	E	Double usance	SP 46/6/149
1551-06-00			13.125	London	H	sight	Gould (1970)
1551-06-03			17.500	Calais	E	1551-10-31	SP 46/6/106r
1551-06-04			13.500	London	E	Double usance	SP 46/6/151
1551-06-09			13.000	London	E	sight	SP 46/6/153
1551-06-29			16.333	Antwerp	E	unknown	Gresham daybook, 6337
1551-07-00			12.750	London	H	sight	Gould (1970)
1551-07-04	£100 st	£66 13s 4d Fl	13.333	London	E	1551-08-04	SP46/6/173, 174
1551-07-12			13.000			unknown	Gresham daybook, 6395
1551-07-19	£100 st		12.083	London	E	sight	SP46/7/5
1551-07-20			13.500		A	unknown	Gresham daybook, 6408
1551-07-21	£133 6s 8d st		13.333	Antwerp	E	sight	Gresham daybook, 6413
1551-07-23	£50 st		12.083	London	E	unknown	SP 46/7/8
1551-08-00			17.833	London	H	sight	Gould (1970)
1551-09-00			18.583	London	H	sight	Gould (1970)
1551-09-00			15.417	Antwerp	H	sight	Gould (1970)
1551-09-08			18.583	London	E	usance	SP 46/7/19
1551-09-09			18.333	London	E	sight	SP 46/7/19
1551-09-12			19.000	London	E	usance	SP 46/7/25
1551-09-27	£227 2s 7d st		18.000	London	E	1551-11-08	SP46/7/32, 33
1551-09-30			18.667	London	E	half usance	Gresham daybook, 6444

1551-10-00			19.167	London	H	sight	Gould (1970)
1551-10-21			18.500	Antwerp	E	unknown	SP46/7/125r, 125v
1551-10-21			19.167	London	E	unknown	SP46/7/125r, 125v
1551-11-00			18.667	London	H	sight	Gould (1970)
1551-11-00			16.292	Antwerp	H	sight	Gould (1970)
1551-11-01			18.833	London	E	sight	SP46/7/60
1551-11-06	£100 st		19.000	London	E	unknown	Gresham daybook, 6490
1551-11-26			17.750	Antwerp	E	unknown	SP46/7/85
1551-11-29			17.333	Antwerp	E	unknown	SP46/7/88, 89
1551-12-00			18.583	London	H	sight	Gould (1970)
1551-12-05			15.000			unknown	Gresham daybook, 6554
1551-12-29	£100 st		18.250	London	E	1552-02-22	SP46/7/111
1552-01-00			17.667	London	H	sight	Gould (1970)
1552-01-15			16.417	Antwerp	E	unknown	SP46/7/123, 123A
1552-01-30			15.000	Antwerp	E	usance	SP46/7/128, 129
1552-02-08			16.167	London	E	unknown	SP 46/7/141
1552-02-08			16.833	London	E	double usance	SP 46/7/141
1552-02-10	£100 st		16.667	London	E	double usance	SP 46/7/143
1552-03-01	£100 st		15.750	Antwerp	E	usance	SP46/7/168, 169
1552-06-00			17.583	London	H	sight	Gould (1970)
1552-07-00			19.292	London	H	sight	Gould (1970)
1552-08-00			19.500	London	H	sight	Gould (1970)
1552-12-00			19.458	London	H	sight	Gould (1970)
1553-01-00			19.458	London	H	sight	Gould (1970)
1553-02-00			19.958	London	H	sight	Gould (1970)
1553-03-17			19.750	Antwerp	H		CSPF, Edward VI, No. 634
1553-04-00			20.167	London	H	sight	Gould (1970)
1553-04-12	£1837 8s st	£1756 2s 3d Fl	19.115	Antwerp	E		CSPF, Edward VI, No. 653
1553-04-16			19.667	Antwerp	E		CSPF, Edward VI, No. 655
1553-04-28			20.000	Antwerp	E		CSPF, Edward VI, No. 670
1553-08-00			22.458	London	H	sight	Gould (1970)
1553-11-25	£15426 19s 1d st	£16969 12s 11d Fl	22.000	London	E	sight	CSPF, Mary, No. 81
1553-12-06			25.667	Antwerp	E	usance	CSPF, Mary, No. 98
1553-12-20			22.750	Antwerp	E		CSPF, Mary, No. 104
1553-12-28			22.000	Antwerp	E		CSPF, Mary, No. 113

1554-01-00			20.958	London	H	sight	Gould (1970)
1554-01-01			21.667	Antwerp	E		CSPF, Mary, No. 123
1554-01-08			22.333	Antwerp	E		CSPF, Mary, No. 130
1554-02-00			22.458	London	H	sight	Gould (1970)
1554-02-15			22.000	Antwerp	E		CSPF, Mary, No. 150
1554-12-00			21.625	London	H	sight	Gould (1970)
1555-07-00			21.458	London	H	sight	Gould (1970)
1555-10-00			21.292	London	H	sight	Gould (1970)
1555-10-05			20.833	Antwerp	E	usance	CSPF, Mary, No. 420
1555-10-05			21.000	Antwerp	E	double usance	CSPF, Mary, No. 420
1555-12-00			21.792	London	H	sight	Gould (1970)
1555-12-23	£2000 st		21.500	Antwerp	E		CSPF, Mary, No. 442
1556-03-00			21.625	London	H	sight	Gould (1970)
1556-06-00			22.500	London	H	sight	Gould (1970)
1557-01-00			20.250	London	H	sight	Gould (1970)
1558-03-00			21.542	London	H	sight	Gould (1970)
1558-04-00			21.708	London	H	sight	Gould (1970)
1558-04-03	£56 16s 4d st	£62 10s fl	22.000	London	E	Usance[1]	Ramsay (1962), p.61
1558-04-03	£50 st	£55 4s 2d fl	22.083	London	E	1558-05-03	Ramsay (1962), p.61
1558-04-10	£40 st	£44 6s 8d fl	22.167	London	E	1558-04-26	Ramsay (1962), p.61
1558-04-11	£54 5s st	£60 2s 6d fl	22.167	London	E	1558-04-30	Ramsay (1962), p.61
1558-04-12	£100 st	£111 5s fl	22.167	London	E	1558-05-12	Ramsay (1962), p.61
1558-06-00			22.000	London	H	sight	Gould (1970)
1558-11-00			22.292	London	H	sight	Gould (1970)
1558-12-00			21.667			unknown	CSPF, 1558, No. 178
1558-12-23			21.667	London	E	usance	Lloyd (2000)
1558-12-27			21.167	Antwerp	E	usance	Lloyd (2000)
1559-01-02			21.750	Antwerp	E	usance	Lloyd (2000)
1559-01-19	£50 st	£54 11s 8d fl	21.917	London	E	1559-02-19	Ramsay (1962), p.62
1559-01-21	£100 st	£108 15s fl	21.750	London	E	at sight	Ramsay (1962), p.60
1559-01-27	£60 st	£65 10s fl	21.833	London	E	usance	Ramsay (1962), p.60
1559-01-28	£50 st	£54 13s 9d fl	21.875	London	E	half usance	Ramsay (1962), p.60
1559-02-01	£150 st	£163 15s fl	21.833	London	E	1559-02-16	Ramsay (1962), p.61
1559-02-01	£50 st	£55 fl	22.000	London	E	1559-03-01	Ramsay (1962), p.61
1559-02-01	£5000 st	£5479 15s 10d FL	21.919	London	E	unknown	CSPF, 1558-9, No. 295, 296

1559-02-01			21.917	Antwerp	E	usance	Lloyd (2000)
1559-02-04	£100 st	£109 15s 10d fl	21.958	London	E	1559-03-04	Ramsay (1962), p.60
1559-02-13	£200 st	£223 6s 8d fl	22.333	London	E	1559-04-01	Ramsay (1962), p.61
1559-02-23	£100 st	£112 1s 8d fl	22.417	London	E	1559-04-23	Ramsay (1962), p.61
1559-03-00			21.833	London	H	sight	Gould (1970)
1559-03-01			22.000	Antwerp	E	usance	Lloyd (2000)
1559-03-18	£39 1s 6d st	£42 fl	21.500	London	E	unknown	Ramsay (1962), p.61
1559-07-19			21.875	Antwerp	E	usance	Lloyd (2000)
1559-07-20			21.875	Antwerp	E	usance	Lloyd (2000)
1559-07-20			21.917	Antwerp	E	usance	Lloyd (2000)
1559-07-22			21.833	Antwerp	E	usance	Lloyd (2000)
1559-07-22			21.875	Antwerp	E	usance	Lloyd (2000)
1559-07-28			21.750	Antwerp	E	usance	Lloyd (2000)
1559-07-28			21.792	Antwerp	E	usance	Lloyd (2000)
1559-08-02			21.750	Antwerp	E	usance	Lloyd (2000)
1559-08-03			21.708	Antwerp	E	usance	Lloyd (2000)
1559-08-03			21.750	Antwerp	E	usance	Lloyd (20000
1559-08-04			21.708	Antwerp	E	usance	Lloyd (2000)
1559-08-04			21.750	Antwerp	E	usance	Lloyd (2000)
1559-08-16			21.792	Antwerp	E	usance	Lloyd (2000)
1559-09-00			22.250	London	H	sight	Gould (1970)
1559-10-00			22.250	London	H	sight	Gould (1970)
1559-10-23			22.000	Antwerp	E	usance	CSPF, 1559-60, No. 126
1559-10-29			22.250	Antwerp	E	usance	CSPF, 1559-60, No. 156
1559-11-02			22.250	Antwerp	E	usance	Lloyd (2000)
1560-01-00			22.208	London	H	sight	Gould (1970)
1560-01-22			22.333	Antwerp	E	usance	CSPF, 1559-60, No. 617
1560-01-24			22.333	Antwerp	E	usance	Lloyd (2000)
1560-02-13			22.333	Antwerp	E	usance	CSPF, 1559-60, No. 790
1560-02-13			22.417	Antwerp	E	usance	CSPF, 1559-60, No. 790
1560-02-25			22.667	Antwerp	E	usance	CSPF, 1559-60, No. 771
1560-02-28			22.667	Antwerp	E	usance	CSPF, 1559-60, No. 789
1560-03-00			22.500	London	H	sight	Gould (1970)
1560-03-08			22.750	Antwerp	E	usance	CSPF, 1559-60, No. 841
1560-04-00			23.042	London	H	sight	Gould (1970)

1560-04-10			22.583	Antwerp	E	usance	Lloyd (2000)
1560-04-12			23.000	London	E	usance	CSPF, 1559-60, No. 999
1560-04-12	£2501 6s 8d st	£2826 13s 7d FL	22.601	Antwerp	E	unknown	CSPF, 1559-60, No. 999
1560-04-30			23.333	London	E	usance	CSPF, 1559-60, No. 1102
1560-05-00			23.208	London	H	sight	Gould (1970)
1560-05-12			23.000	London	E	usance	CSPF, 1560-1, No. 84
1560-05-12			22.500	Antwerp	E	usance	CSPF, 1560-1, No. 84
1560-07-00			22.500	London	H	sight	Gould (1970)
1560-07-04			21.500	London	E	usance	Lloyd (2000)
1560-10-00			23.208	London	H	sight	Gould (1970)
1560-11-00			23.000	London	H	sight	Gould (1970)
1560-12-00			22.333	London	H	sight	Gould (1970)
1561-01-00			20.542	London	H	sight	Gould (1970)
1561-03-00			22.167	London	H	sight	Gould (1970)
1561-04-00			22.083	London	H	sight	Gould (1970)
1561-05-00			21.958	London	H	sight	Gould (1970)
1561-05-09			22.125	Antwerp	E	usance	SP 46/13/112
1561-07-00			23.083	London	H	sight	Gould (1970)
1561-07-05			22.167	Antwerp	E	usance	SP 46/13/113
1561-07-21			22.250	Antwerp	E	usance	Lloyd (2000)
1561-07-25			22.250	Antwerp	E	usance	SP 46/13/115
1561-07-25			25.292	Antwerp	E	usance	SP 46/13/115
1561-07-27			22.292	Antwerp	E	usance	SP 46/13/116
1561-08-00			22.750	London	H	sight	Gould (1970)
1561-08-02			22.000	Antwerp	E	usance	Lloyd (2000)
1561-08-04			22.000	Antwerp	E	usance	CSPF, 1561-2, No. 375
1561-08-07	£39802 17s 4d st	£44784 6s Fl	22.500		A	unknown	CSPF, 1561-2, No. 388
1561-08-19			22.000	Antwerp	E	usance	CSPF, 1561-2, No. 425
1561-08-19			22.000	Antwerp	E	usance	Lloyd (2000)
1561-08-30			22.333	Antwerp	E	usance	CSPF, 1561-2, No. 463
1561-08-30			22.333	Antwerp	E	usance	Lloyd (2000)
1561-09-06	£2542 16s st	£2821 15s Fl	22.194	Antwerp	E	usance	CSPF, 1561-2, No. 480
1561-10-01			22.167	Antwerp	E	usance	SP 46/13/118, 119
1561-11-16			22.417	Antwerp	E	usance	SP 46/13/123
1561-11-30			22.458	Antwerp	E	usance	SP 46/13/124

1562-01-14			22.500	Antwerp	E	usance	SP 46/13/128
1562-01-14			22.542	Antwerp	E	usance	SP 46/13/128
1562-01-28			23.250	Antwerp	E	usance	Lloyd (2000)
1562-01-31			23.083	Antwerp	E	usance	SP 46/13/131
1562-02-00			23.417	London	H	sight	Gould (1970)
1562-03-00			22.625	London	H	sight	Gould (1970)
1562-03-01			23.250	Antwerp	E	usance	Lloyd (2000)
1562-03-01			22.833	Antwerp	E	usance	CSPF, 1561-2, No. 918
1562-03-01			22.917	Antwerp	E	double usance	CSPF, 1561-2, No. 918
1562-03-01			22.833	Barowe	E	usance	CSPF, 1561-2, No. 918
1562-03-01			23.000	Barowe	E	double usance	CSPF, 1561-2, No. 918
1562-03-01			23.083	Barowe	E	double usance	CSPF, 1561-2, No. 918
1562-04-24			22.167	Antwerp	E	usance	SP 46/13/134
1562-07-27	£400 st	£448 15s Fl	22.438	London	E	unknown	CSPF, 1562, No. 378
1562-08-00			22.292	London	H	sight	Gould (1970)
1562-08-01			20.417	Antwerp	E	usance	Lloyd (2000)
1562-08-01			20.500	Antwerp	E	usance	Lloyd (2000)
1562-09-20			22.792	Antwerp	E	Usance	SP 46/13/136
1562-09-20			22.833	Antwerp	E	usance	SP 46/13/136
1562-10-17			21.854	Antwerp	E	usance	SP46/13/142
1562-10-24			22.042	Antwerp	E	usance	SP 46/13/137
1562-12-00			22.000	London	H	sight	Gould (1970)
1563-01-00			21.833	London	H	sight	Gould (1970)
1563-02-28			23.000	Barowe	E	usance	SP 46/13/141
1563-03-07			21.500	Antwerp	E	usance	Lloyd (2000)
1563-06-20	£10000 st	£10836 8s 6d Fl	21.673	Antwerp	E	usance	CSPF, 1563, No. 936
1563-10-03			21.000	Antwerp	E	usance	CSPF, 1563, No. 1263
1563-11-10			21.000	Antwerp	E	usance	CSPF, 1563, No. 1388
1564-01-08			21.333	Antwerp	E	usance	Lloyd (2000)
1564-01-09			21.500	Antwerp	E	usance	Lloyd (2000)
1564-02-11	£100 st	£109 3s 4d fl	21.833	London		Double usance[4]	Ramsay (1962), p.105
1564-02-11	£100 st	£108 19s 2d fl	21.792	London	E	double usance	Ramsay (1962), p.105
1564-02-17	£100 st	£108 6s 8d fl	21.667	London	E	double usance	Ramsay (1962), p.105
1564-02-18	£100 st	£108 10s 10d fl	21.708	London	E	double usance	Ramsay (1962), p.105
1564-02-18	£50 st	£54 3s 4d fl	21.667	London	E	double usance	Ramsay (1962), p.105

1564-03-10			19.667	Antwerp	E	usance	CSPF, 1564-5, No. 232
1564-03-18[3]	£106 17s 6d fl	£100 st	21.333	Flanders	E	usance	Ramsay (1962), p.104
1564-03-18[3]	£100 st	£106 13s 4d fl	21.333	London	E	usance	Ramsay (1962), p.107
1564-03-20	£50 st	£57 10s fl	23.000	London	E	treble usance	Ramsay (1962), p.107
1564-04-11	£100 st	£108 19s 2d fl	21.792	London	E	usance	Ramsay (1962), p.105
1564-04-13	£133 5s fl	£121 16s st	20.500	Emden	E	unknown	Ramsay (1962), p.104
1564-04-21	£100 st	£106 5s fl	21.250	London	E	usance	Ramsay (1962), p.105
1564-04-21	£100 st	£107 10s fl	21.500	London	E	one and half usance	Ramsay (1962), p.105
1564-04-27	£53 15s fl	£53 1s 9d st	20.250	Flanders	E	usance	Ramsay (1962), p.104
1564-04-28	£70 17s 6d fl	£70 st	20.250	Flanders	E	unknown	Ramsay (1962), p.104
1564-05-04	£53 6s 8d fl	£52 13s 6d st	20.250	Flanders	E	usance	Ramsay (1962), p.104
1564-05-10	£50 st	£52 1s 8d fl	20.833	London	E	half usance	Ramsay (1962), p.103
1564-05-19	£105 4s st	£109 11s 8d fl	20.833	London	E	unknown	Ramsay (1962), p.103
1564-05-27	£100 st	£112 10s fl	22.500	London	E	double usance	Ramsay (1962), p.105
1564-06-03	£100 st	£112 18s 4d fl	22.583	London	E	double usance	Ramsay (1962), p.105
1564-06-03	£50 st	£54 15s 10d fl	21.917	London	E	double usance	Ramsay (1962), p.105
1564-07-04	£100 st	£112 10s fl	22.500	London	E	usance	Ramsay (1962), p.104
1564-07-05	£51 7s 6d st	£54 15s 10d fl	21.333	London	E	unknown	Ramsay (1962), p.104
1564-08-05	£60 st	£67 10s fl	22.500	London	E	usance	Ramsay (1962), p.106
1564-08-10	£50 st	£56 5s fl	22.500	London	E	1564-09-18	Ramsay (1962), p.106
1564-08-30	£50 st	£56 0s 10d fl	22.417	London	E	usance	Ramsay (1962), p.106
1564-09-01	£50 st	£55 8s 4d fl	22.167	London	E	half usance	Ramsay (1962), p.106
1564-09-01	£50 st	£53 19s 2d fl	21.583	London	E	unknown	Ramsay (1962), p.107
1564-09-05	£40 st	£43 3s 4d fl	21.583	London	E	usance	Ramsay (1962), p.107
1564-09-07	£102 10s fl	£100 st	20.500	Emden	E	usance	Ramsay (1962), p.104
1564-09-17	£50 st	£54 5s 5d fl	21.708	Flanders	E	unknown	Ramsay (1962), p.107
1564-09-29	£100 st	£109 11s 8d fl	21.917	Flanders	E	unknown	Ramsay (1962), p.107
1564-10-07	£108 19s 2d fl	£100 st	21.750	Emden	E	usance	Ramsay (1962), p.104
1564-10-10	£100 st	£115 12s 6d fl	23.125	London	E	double usance	Ramsay (1962), p.106
1564-10-12	£100 st	£115 12s 6d fl	23.125	London	E	double usance	Ramsay (1962), p.106
1564-10-14	£25 st	£28 15s fl	23.000	London	E	usance	Ramsay (1962), p.104
1564-10-14	£50 st	£57 10s fl	23.000	London	E	usance	Ramsay (1962), p.106
1564-10-14	£50 st	£58 6s 8d fl	23.333	London	E	unknown	Ramsay (1962), p.106
1564-10-27	£100 st	£115 8s 4d fl	23.083	London	E	double usance	Ramsay (1962), p.106
1564-10-27	£60 st	£69 fl	23.000	London	E	1564-12-23	Ramsay (1962), p.106

1564-11-08	£100 st	£115 16s 8d fl	23.167	London	E	double usance	Ramsay (1962), p.106
1564-11-10	£100 st	£120 fl	24.000	London	E	1565-02-28	Ramsay (1962), p.107
1564-12-02	£100 st	£118 15s fl	23.750	London	E	1565-02-27	Ramsay (1962), p.107
1564-12-11	£113 15s fl	£100 st	22.750	Flanders	E	unknown	Ramsay (1962), p.104
1564-12-15	£102 4s 4d st	£115 8s 4d fl	22.583	London	E	half usance	Ramsay (1962), p.104
1564-12-16	£50 st	£55 15s fl	23.000	London	E	usance	Ramsay (1962), p.107
1564-12-22	£101 9s 1d st	£115 16s 8d fl	22.833[2]	London	E	half usance	Ramsay (1962), p.104
1564-12-28			23.000	London		unknown	Ramsay (1962), p.28
1565-01-09	£100 st	£117 10s fl	23.500	London	E	double usance	Ramsay (1962), p.105
1565-01-17	£100 st	£116 13s 4d fl	23.333	London	E	One and half usance[5]	Ramsay (1962), p.113
1565-01-17	£50 st	£58 6s 8d fl	23.333	London	E	1565-02-27	Ramsay (1962), p.113
1565-01-17	£100 st	£116 13s 4d fl	23.333	London	E	1565-02-28	Ramsay (1962), p.113
1565-01-27	£100 st	£116 9s 2d fl	23.292	London	E	1565-02-28	Ramsay (1962), p.113
1565-02-03	£100 st	£118 15s fl	23.750	London	E	double usance	Ramsay (1962), p.113
1565-02-10	£100 st	£117 10s fl	23.500	London	E	usance	Ramsay (1962), p.113
1565-02-12	£100 st	£117 10s fl	23.500	London	E	usance	Ramsay (1962), p.113
1565-02-12	£100 st	£118 6s 8d fl	23.667	London	E	usance	Ramsay (1962), p.113
1565-02-15	£100 st	£117 18s 4d fl	23.583	London	E	1565-03-15	Ramsay (1962), p.113
1565-02-16	£114 15s 10d fl	£100 st	22.875	Flanders	E	unknown	Ramsay (1962), p.113
1565-02-17	£93 6s 4d st	£109 13s 2d fl	23.500	London	E	usance	Ramsay (1962), p.113
1565-02-28	£58 6s 8d fl	£51 5s 8d st	22.750	Flanders	E	usance	Ramsay (1962), p.112
1565-03-03	£100 st	£116 17s 6d fl	23.375	London	E	1565-04-03	Ramsay (1962), p.113
1565-03-11	£114 11s 8d fl	£100 st	22.917	Flanders	E	1565-04-11	Ramsay (1962), p.112
1565-03-20			23.333	Antwerp		unknown	Ramsay (1962), p.119
1565-12-19			24.083	London	E	double usance	PRO, E 101/520/25 f.13
1566-03-09			23.917	London	E	double usance	PRO, E 101/520/25 f.3
1566-05-12	£60 st	£70 7s 6d fl	23.458	London	E	usance	PRO, E 101/520/24 f.14
1566-07-02	£80 st	£93 6s 8d fl	23.333	London	E	usance	PRO, E 101/520/24 f.19
1566-07-22			23.250	Antwerp	E	usance	Lloyd (2000)
1566-08-04			22.917	Antwerp	E	usance	Lloyd (2000)
1566-08-14			23.042	Antwerp	E	half usance	PRO, E 101/520/24 f.26
1566-08-14			22.917	Antwerp	E	usance	PRO, E 101/520/24 f.26
1566-09-04	£60 st	£70 5s Fl	23.417	London	E	Usance and 5 days	PRO, E 101/520/24 f.34
1566-09-04	£60 st	£70 5s Fl	23.417	London	E	1566-09-25	PRO, E 101/520/24 f.34
1566-09-14			23.333	London	E	usance	PRO, E 101/520/24 f.111

1566-09-29			22.667	Antwerp	E	usance	Lloyd (2000)
1566-10-20			22.792	Antwerp	E	usance	Lloyd (2000)
1566-11-02			23.500	London	E	usance	PRO, E 101/520/24 f.110
1566-11-10			22.875	Antwerp	E	usance	Lloyd (2000)
1566-11-16			23.000	Antwerp	E	usance	PRO, E 101/520/24 f. 112
1566-12-01			22.667	Antwerp	E	usance	Lloyd (2000)
1567-02-19			22.667	Antwerp	E	usance	PRO, E 101/520/24 f.53
1567-02-20			22.667	Antwerp	E	usance	PRO, E 101/520/24 f.52
1567-03-26	£50 st	£57 5s 10d fl	22.917	London	E	usance	PRO, E 101/520/24 f.60
1567-03-29			22.417	Antwerp	E	usance	Lloyd (2000)
1567-04-07	£60 st	£68 15s fl	22.917	London	E	usance	PRO, E 101/520/24 f.62
1567-04-18			22.625	Antwerp	E	usance	Lloyd (2000)
1567-04-19	£10 st	£10 16s 1d fl	22.750	London	E	sight	PRO, E 101/520/24 f.61
1567-04-27			22.625	Antwerp	E	usance	Lloyd (2000)
1567-05-31			22.792	London	E	usance	Lloyd (2000)
1567-05-31	£200 fl	£112 18s 4d st	22.583	Antwerp	E	1567-07-02	PRO, E 101/520/24 f.64
1567-06-05	£50 st	£56 17s 9d fl	22.750	London	E	usance	PRO, E 101/520/24 f.69
1567-07-01	£50 st	£56 19s 7d fl	22.792	London	E	usance	PRO, E 101/520/24 f.68
1567-07-09	£114 5s 1d st	£134 fl	23.458	London	E	usance	PRO, E 101/520/24 f.74
1567-07-12	£74 st	£87 7s 6d fl	23.750	London	E	double usance	PRO, E 101/520/24 f.79
1567-07-14	£50 st	£60 4s 2d fl	24.083	London	E	double usance	PRO, E 101/520/24 f.98
1567-07-19			23.333	Antwerp	E	usance	PRO, E 101/520/24 f.71
1567-07-26	£60 st	£71 fl	23.667	London	E	Usance and 5 days	PRO, E 101/520/24 f.77
1567-08-02	£50 st	£56 19s 7d fl	23.292	Antwerp	E	usance	PRO, E 101/520/24 f.72
1567-08-02			23.292	Antwerp	E	usance	PRO, E 101/520/24 f.72
1567-08-02			23.292	Antwerp	E	usance	PRO, E 101/520/24 f.72
1567-08-02			23.292	Antwerp	E	usance	PRO, E 101/520/24 f.72
1567-08-13			23.333	Antwerp	E	half usance	PRO, E 101/520/24 f.74
1567-08-30			23.375	Antwerp	E	usance	Lloyd (2000)
1567-09-04	£50 st	£59 2s 3d fl	23.625	London	E	usance	PRO, E 101/520/24 f.81
1567-09-05	£50 st	£59 13s 4d fl	23.667	London	E	usance	PRO, E 101/520/24 f.81
1567-09-06	£60 st	£69 7s 6d fl	23.125	Antwerp	E	usance	PRO, E 101/520/24 f.77
1567-09-07			23.333	Antwerp	E	usance	Lloyd (2000)
1567-09-20	£100 st	£117 18s 4d fl	23.583	London	E	usance	PRO, E 101/520/24 f.85
1567-09-28			23.417	Antwerp	E	usance	Lloyd (2000)

1567-10-02	£100 st	£117 18s 4d fl	23.833	Antwerp	E	usance	PRO, E 101/520/24 f.86
1567-10-02			23.333	London	E	usance	PRO, E 101/520/21
1567-10-04	£40 st	£47 11s 8d fl	23.792	London	E	sight	PRO, E 101/520/24 f.83
1567-10-11			23.333	Antwerp	E	1567-11-01	PRO, E 101/520/24 f.83
1567-10-17			23.458	Antwerp	E	usance	PRO, E 101/520/24 f.84
1567-11-07			24.000	London	E	usance	Lloyd (2000)
1567-11-15			23.500	Antwerp	E	usance	PRO, E 101/520/24 f.87
1567-11-22			23.500	Antwerp	E	usance	PRO, E 101/520/24 f.88
1567-12-05			23.333	Antwerp	E	4 days after sight	PRO, E 101/520/24 f.89
1567-12-12			23.000	Antwerp	E	usance	PRO, E 101/520/24 f.89
1567-12-24			23.250	Antwerp	E	usance	PRO, E 101/520/24 f.92
1567-12-24			23.250	Antwerp	E	20 days after sight	PRO, E 101/520/24 f.92
1568-01-14			24.083	London	E	double usance	PRO, E 101/520/21
1568-02-02			22.833	Antwerp	E	usance	Lloyd (2000)
1568-02-09			23.583	London	E	usance	PRO, E 101/520/24 f.98
1568-02-18			23.542	London	E	usance	PRO, E 101/520/24 f.99
1568-02-28			22.833	Antwerp	E	usance	PRO, E 101/520/24 f.94
1568-02-29			23.417	London	E	usance	PRO, E 101/520/24 f.101
1568-03-06			22.833	Antwerp	E	usance	PRO, E 101/520/24 f.97
1569-03-12			23.000	Antwerp	E	half usance	PRO, E 101/520/24 f.97
1568-03-16			23.083	Antwerp	E	half usance	PRO, E 101/520/24 f.98
1568-03-23	£113 8s 6d st	£132 6s 6d fl	23.333	London	E	usance	PRO, E 101/520/24 f.126
1568-03-29			23.417	London	E	usance	Lloyd (2000)
1568-04-01			23.375	London	E	usance	Lloyd (2000)
1568-04-08			22.917	Antwerp	E	usance	Lloyd (2000)
1568-04-30	£50 st	£58 8s 9d fl	23.375	London	E	usance	PRO, E 101/520/24 f. 122
1568-05-14			23.333	Antwerp	E	half usance	PRO, E 101/520/24 f.124
1568-05-14			23.250	Antwerp	E	usance	PRO, E 101/520/24 f.124
1568-06-22			23.500	London	E	usance	PRO, E 101/520/24 f.130
1568-07-02			23.500	London	E	usance and 2 days	PRO, E 101/520/24 f.130
1568-07-07			23.021	Antwerp	E	1568-08-12	PRO, E 101/520/24 f.129
1568-07-07			23.000	Antwerp	E	1568-08-12	PRO, E 101/520/24 f.129
1568-07-26			23.500	London	E	usance and 2 days	PRO, E 101/520/21
1568-07-27			23.500	London	E	usance	PRO, E 101/520/24 f.134
1568-07-30			23.417	Antwerp	E	4 days after sight	PRO, E 101/520/24 f.131

1568-08-12	23.333	London	E	3 days after sight	PRO, E 101/520/24 f.133
1568-08-27	23.417	Antwerp	E	half usance	PRO, E 101/520/24 f.134
1568-08-28	23.500	London	E	usance	PRO, E 101/520/24 f.135
1568-09-24	22.500	Antwerp	E	1568-11-27	PRO, E 101/520/24 f.136
1568-09-24	22.500	Antwerp	E	1568-11-30	PRO, E 101/520/24 f.136
1568-09-24	23.000	Antwerp	E	6 days after sight	PRO, E 101/520/24 f.136
1568-10-02	23.000	Antwerp	E	half usance	PRO, E 101/520/24 f.137
1568-10-08	22.833	Antwerp	E	usance	PRO, E 101/520/24 f.137
1568-10-16	23.083	Antwerp	E	half usance	PRO, E 101/520/24 f.137
1568-10-30	23.250	Antwerp	E	usance	PRO, E 101/520/24 f.138

Note: 1. There was not specifying the term of payment, but compared with the exchange rate of the other bill due on the 3rd of May enrolled on the same day, this bill was likely to be payable at usance. 2. The exchange rate was written at 22s 1d on the document, however, according to the amount of money delivered (£101 9s 1d st) and received (£115 16s 8d fl), the actual exchange rates shall be 22s 10d fl for £1 sterling. 3. In sixteenth-century England, the year began on 25 March. This exchange dated on 18 March 1564 shall be regarded on 18 March 1565 in Julian calendar. Compared with other exchange rates in early 1564 and 1565, however, the exchange rate is more in accordance with those in early 1564. Therefore, it is likely that the date was mistaken and shall have been 18 March 1564 in Julian calendar. 4. There was not specifying the term of payment, but compared with the exchange rate of the other bill enrolled on the same day, this bill was likely to be payable at double usance. 5. There was not specifying the term of payment, but compared with the exchange rate of the other bill enrolled on the same day, this bill was likely to be payable at 1.5 usance.

Appendix 3.B. The monthly average exchange rates quoted in van der Molen's letters: London, Venice, Lyon and Rouen, 1538-44

Date	London	Venice	Lyon	Rouen
1538-03	9.028	70.833	74.734	79.854
1538-04	9.000	71.500	75.667	80.333
1538-05	9.083	71.500	76.250	80.667
1538-06	9.156	71.500	75.292	80.646
1538-07	9.198	71.750	75.896	81.000
1538-08	9.139	72.000	75.233	80.917
1538-09	9.365	71.750	74.667	80.500
1538-10	9.507	71.156	74.563	79.958
1538-11	9.521	71.500	74.000	80.000
1538-12	9.417	70.750	73.500	78.250
1539-01	9.396	70.875	74.750	79.250
1539-02	9.365	70.417	74.804	79.219
1539-03	9.405	68.853	73.193	77.813
1539-04	9.344	67.667	72.977	76.667
1539-05	9.201	67.125	71.117	76.046
1539-06	8.778	64.137	68.202	73.368
1539-07	8.792	65.052	69.750	74.417
1539-08	8.708	65.512	70.470	74.700
1539-09	8.698	64.500	67.500	75.575
1539-10	8.521	64.333	67.250	76.000
1539-11	8.333	62.500	66.250	73.250
1539-12	8.333	63.938	66.531	71.639
1540-01	8.323	63.550	67.330	70.500
1540-02	8.368	64.217	68.054	71.673
1540-03	8.521	64.750	68.500	72.000
1540-04	8.438	64.750	68.500	71.750
1540-05	8.583	64.619	67.365	72.042
1540-06	8.639	64.635	68.875	72.333
1540-07	8.688	65.000	70.054	73.319
1540-08	8.750	65.417	71.333	73.667
1540-09	8.792	65.838	70.150	74.344
1540-10	8.792	65.600	70.733	74.317
1540-11	8.958	66.667	71.900	75.100
1540-12	-	66.875	71.292	75.875
1541-01	8.958	66.208	71.196	75.000
1541-02	8.951	66.448	70.238	75.266
1541-03	8.944	65.875	69.292	74.444
1541-04	8.958	65.167	69.000	73.167
1541-05	8.946	65.500	68.635	73.656
1541-06	8.729	65.250	67.523	72.792
1541-07	8.896	66.417	70.201	74.733

1541-08	8.917	66.083	70.917	74.917
1541-09	8.847	66.323	68.250	74.786
1541-10	8.917	66.107	68.393	74.125
1541-11	8.813	64.620	68.000	72.604
1541-12	8.792	64.750	67.000	73.000
1542-01	8.792	65.250	68.750	73.333
1542-02	8.771	65.125	70.469	72.571
1542-03	8.632	63.804	67.667	71.000
1542-04	8.333	61.500	66.500	68.313
1542-05	8.618	63.479	68.708	70.880
1542-06	9.278	64.813	68.889	72.750
1542-07	9.333	64.125	69.094	72.219
1542-08	8.806	63.500	69.500	71.500
1542-09	8.833	64.151	70.292	72.196
1542-10	8.819	63.539	72.750	72.544
1542-11	8.850	63.350	74.083	72.563
1542-12	8.844	63.333	71.200	73.000
1543-01	8.854	63.321	72.131	73.173
1543-02	8.844	63.439	71.658	73.181
1543-03	-	63.333	71.250	73.500
1543-04	8.803	64.897	71.387	73.708
1543-05	8.767	63.870	71.375	73.719
1543-06	8.750	63.160	70.250	72.000
1543-07	8.722	63.125	70.250	71.250
1543-08	8.646	61.750	69.333	70.333
1543-09	8.438	61.783	67.533	69.750
1543-10	8.583	61.250	68.125	69.500
1543-11	8.625	61.979	69.000	69.750
1543-12	8.792	61.667	67.000	69.750
1544-01	8.792	62.000	68.333	69.250
1544-02	8.944	62.500	69.500	69.750
1544-03	8.875	63.250	69.500	71.250
1544-04	8.792	63.100	68.750	71.319
1544-05	8.771	63.250	69.875	71.500
1544-06	8.500	63.250	67.750	71.700
1544-07	8.458	62.333	67.750	70.750
1544-08	8.722	62.250	67.750	71.125
1544-09	8.750	62.333	67.625	70.750
1544-10	8.833	64.000	70.000	-

Source: van der Molen's Letters, Insolvente Boedelskamer, Stadsarchief, Antwerpen, IB2039
Note. The figures reported here are the monthly averages. The Antwerp-London exchange rate was quoted as a variable number of Flemish groots for one English noble (6s 8d st.); the Antwerp-Venice exchange rate is a variable number of Flemish groots for one Venetian ducat; the Antwerp-Lyon, a variable number of Flemish groots for one ècu de marc; the Antwerp-Rouen, a variable number of Flemish groots for one French crown.

Appendix 3.C. The shadow interest rates implicit in London exchange rates and those of Antwerp and Lyon

Date	The shadow rate of interest (%)		The annual rate of interest (%)	
	monthly	annually	Antwerp**	Lyon**
1544-03	1.24	14.90		
1544-08	1.33	15.99		
1544-11	0.15	1.84		
1545-09	1.73	20.76		
1545-12	1.11	13.43		
1546-04	1.33	15.98	8.5-13	12
1546-07	1.37	16.45	8.5-13	12
1546-09	1.49	17.89	8.5-13	12
1547-03	2.08	24.93		
1547-05	0.56	6.75		
1547-06	1.84	22.05		
1547-10	0.54	6.52		
1547-11	0.72	8.66		
1547-12	2.22	26.67		
1548-02	0.53	6.38	10	10-12
1548-03	0.76	9.11	10	10-12
1548-04	0.76	9.08	10	10-12
1548-05	1.08	12.98	10	10-12
1548-06	1.49	17.92	10	10-12
1548-07	1.12	13.41	10	10-12
1548-09	0.66	7.95	10	10-12
1548-10	0.52*	6.24	10	10-12
1548-11	2.27	27.27	10	10-12
1548-12	1.08	12.91	10	10-12
1549-01	0.78	9.32		
1549-03	0.82	9.88		
1549-04	0.61	7.36		
1549-06	2.13	25.51		
1549-07	2.63	31.53		
1549-08	1.43	17.19		
1549-09	1.06	12.77		
1549-10	1.09	13.14		
1550-04	1.07	12.88		11
1550-05	1.27	15.25		11
1550-06	0.86	10.30		11
1550-08	1.37	16.44		11
1550-11	0.92	11.10		11
1551-04	4.84	58.06		8-10
1551-05	0.51	6.08		8-10
1551-06	1.67	20.10		8-10
1551-07	7.38	88.58		8-10
1551-09	1.36	16.36		8-10
1559-01	0.57	6.90		

1559-02	1.99	23.91	
1560-04	0.54	6.48	7-8
1564-03	3.91	46.88	
1564-05	5.33	64.01	
1564-10	0.36	4.34	
1564-11	2.40	28.77	
1565-01	0.89	10.72	
1565-02	0.85	10.19	
1567-04	0.73	8.81	
1567-07	2.62	31.45	
1567-10	0.17	2.07	
1568-08	0.72	8.59	

Note: *SP 46/5/298

** The figures in column 4 and 5 are extracted from S. Homer and R. E. Sylla, *A History of Interest Rates* (Hoboken, 2005), p. 116

Appendix 3.D. The structural difference of exchange rates between London and Antwerp

Date	London	Antwerp	The difference
1542-06	27.213	26.249	0.964
1542-07	27.376	26.299	1.077
1543-10	26.000	25.532	0.468
1543-12	26.667	26.152	0.515
1544-01	26.667	26.152	0.515
1544-02	27.167	26.606	0.561
1544-03	26.851	26.400	0.451
1544-04	26.667	26.152	0.515
1544-05	26.625	26.091	0.534
1544-06	25.792	25.285	0.507
1544-07	25.667	25.161	0.506
1544-08	26.588	25.946	0.642
1544-09	26.542	26.059	0.483
1544-10	26.792	26.276	0.516
1545-05	26.350	25.780	0.570
1546-05	24.972	24.665	0.308
1547-01	23.292	23.000	0.292
1547-06	22.591	21.896	0.694
1547-08	22.500	22.342	0.158
1548-04	21.763	21.401	0.362
1548-12	21.274	20.413	0.861
1549-04	20.322	19.915	0.407
1549-05	20.384	19.900	0.485
1549-07	20.440	19.748	0.692
1549-09	20.225	19.744	0.481
1549-11	20.055	19.418	0.638
1549-12	19.625	19.168	0.457
1550-04	19.369	18.858	0.511
1550-05	19.780	19.750	0.030
1550-07	19.438	19.292	0.146
1550-08	18.909	18.646	0.263
1550-09	18.375	17.848	0.527
1550-10	18.000	17.434	0.566
1551-02	16.875	16.583	0.292
1558-12	21.423	20.988	0.435
1559-01	21.689	21.566	0.123
1559-02	21.809	21.732	0.077
1559-03	21.833	21.814	0.019
1559-10	22.250	21.938	0.312
1560-01	22.208	22.144	0.064
1560-04	22.951	22.392	0.559
1560-05	22.974	22.310	0.664
1561-05	21.958	21.938	0.020
1561-07	23.083	22.057	1.026
1561-08	22.750	21.924	0.826
1566-07	23.070	23.054	0.016
1566-09	23.125	22.717	0.409
1566-11	23.235	22.744	0.491

1567-03	22.659	22.228	0.431
1567-04	22.704	22.434	0.270
1567-05	22.535	22.392	0.143
1567-07	23.179	22.568	0.611
1567-09	23.359	23.095	0.264
1567-10	23.678	23.210	0.468
1567-11	23.729	23.301	0.428
1568-02	23.249	22.640	0.609
1568-03	23.112	22.843	0.269
1568-04	23.112	22.723	0.388
1568-07	23.235	23.016	0.219
			Average=0.443

Source: see Appendix 3.A
Note: The exchange rates were quoted at a variable number of Flemish shillings for £1 sterling.

Appendix 3.E. The London-Antwerp monthly usance exchange rate, 1537-68

Date	Exchange rates	Date	Exchange rates	Date	Exchange rates
1537-03	26.692	1546-04	25.470	1559-11	22.758[a]
1537-04	26.802	1546-05	25.158	1559-12	22.691[a]
1537-05	26.818	1546-06	24.911[b]	1560-01	22.461
1537-06	27.055	1546-07	24.667	1560-02	23.078[a]
1537-07	27.224	1546-08	24.497[b]	1560-03	22.757
1537-08	27.181[b]	1546-09	24.328	1560-04	23.213
1537-09	27.139	1546-10	24.143[c]	1560-05	23.236
1537-10	27.561	1546-11	23.943[c]	1560-06	22.995[b]
1537-11	27.567[c]	1546-12	23.743[c]	1560-07	22.757
1537-12	27.573[c]	1547-01	23.558	1560-08	22.993[b]
1537-01	27.579[c]	1547-02	23.386	1560-09	23.231[b]
1537-02	27.585[c]	1547-03	22.397	1560-10	23.473
1538-03	27.591[a]	1547-04	22.017	1560-11	23.262
1538-04	27.508[a]	1547-05	22.259	1560-12	22.588
1538-05	27.758[a]	1547-06	22.811	1561-01	22.531[b]
1538-06	27.968[a]	1547-07	22.784[a]	1561-02	22.476[b]
1538-07	28.102[a]	1547-08	22.757	1561-03	22.420
1538-08	27.675[a]	1547-09	22.963	1561-04	22.335
1538-09	28.658[a]	1547-10	22.901	1561-05	22.208
1538-10	28.852[a]	1547-11	22.924	1561-06	22.770[b]
1538-11	29.071[a]	1547-12	22.838	1561-07	23.346
1538-12	28.758[a]	1548-01	22.601[a]	1561-08	23.009
1539-01	28.696[a]	1548-02	22.368	1561-09	22.702[a]
1539-02	28.658[a]	1548-03	22.015	1561-10	22.675[a]
1539-03	28.670[a]	1548-04	22.011	1561-11	22.966[a]
1539-04	28.539[a]	1548-05	22.287	1561-12	23.267[b]
1539-05	27.946[a]	1548-06	22.406	1562-01	23.459[a]
1539-06	26.661[a]	1548-07	22.477	1562-02	23.684
1539-07	26.883[a]	1548-08	22.250	1562-03	22.883
1539-08	26.633[a]	1548-09	22.195	1562-04	22.819[c]
1539-09	26.597[a]	1548-10	22.265	1562-05	22.750[c]
1539-10	26.071[a]	1548-11	22.091	1562-06	22.679[c]
1539-11	25.508[a]	1548-12	21.398	1562-07	22.610[c]
1539-12	25.508[a]	1549-01	21.693	1562-08	22.546
1540-01	25.492[a]	1549-02	21.450	1562-09	23.321[a]
1540-02	25.657[a]	1549-03	20.365	1562-10	22.456[a]
1540-03	26.071[a]	1549-04	20.554	1562-11	22.381[b]
1540-04	25.821[a]	1549-05	20.617	1562-12	22.251
1540-05	26.274[a]	1549-06	20.450	1563-01	22.082
1540-06	26.425[a]	1549-07	20.673	1563-02	22.045[b]

1540-07	26.608[a]	1549-08	20.451	1563-03	22.008[a]
1540-08	26.758[a]	1549-09	20.456	1563-04	22.066[b]
1540-09	26.883[a]	1549-10	20.314	1563-05	22.123[b]
1540-10	26.883[a]	1549-11	20.284	1563-06	22.181[a]
1540-11	27.383[a]	1549-12	19.849	1563-07	22.011[c]
1540-12	27.439[b]	1550-01	19.786[c]	1563-08	21.842[c]
1541-01	27.383[a]	1550-02	19.719[c]	1563-09	21.674[c]
1541-02	27.346[a]	1550-03	19.652[c]	1563-10	21.508[a]
1541-03	27.341[a]	1550-04	19.589	1563-11	21.508[a]
1541-04	27.367[a]	1550-05	20.005	1563-12	21.715[b]
1541-05	27.328[a]	1550-06	19.652	1564-01	21.925[a]
1541-06	26.696[a]	1550-07	19.659	1564-02	21.491
1541-07	27.196[a]	1550-08	19.125	1564-03	21.913
1541-08	27.289[a]	1550-09	18.584	1564-04	21.530
1541-09	27.029[a]	1550-10	18.205	1564-05	21.600
1541-10	27.050[a]	1550-11	18.186	1564-06	22.002
1541-11	26.946[a]	1550-12	17.509[b]	1564-07	22.500
1541-12	26.896[a]	1551-01	16.857	1564-08	22.430
1542-01	26.827[a]	1551-02	17.067	1564-09	22.293
1542-02	26.821[a]	1551-03	17.025	1564-10	22.884
1542-03	26.389[a]	1551-04	15.500	1564-11	23.126
1542-04	25.508[a]	1551-05	13.792	1564-12	22.975
1542-05	26.377[a]	1551-06	13.236	1565-01	23.234
1542-06	27.523	1551-07	13.333	1565-02	23.539
1542-07	27.688	1551-08	18.036	1565-03	23.375
1542-08	26.925[a]	1551-09	18.528	1565-04	23.421[c]
1542-09	27.008[a]	1551-10	19.327	1565-05	23.469[c]
1542-10	26.965[a]	1551-11	18.964	1565-06	23.518[c]
1542-11	27.081[a]	1551-12	18.250	1565-07	23.569[c]
1542-12	27.039[a]	1552-01	17.868	1565-08	23.621[c]
1543-01	27.071[a]	1552-02	16.375	1565-09	23.672[c]
1543-02	26.946[a]	1552-03	16.193	1565-10	23.721[c]
1543-03	27.001[b]	1552-06	17.783	1565-11	23.769
1543-04	26.944[a]	1552-07	19.512	1565-12	23.815
1543-05	26.800[a]	1552-08	19.722	1566-01	23.760[b]
1543-06	26.758[a]	1552-12	19.680	1566-02	23.705[b]
1543-07	26.675[a]	1553-01	19.680	1566-03	23.650
1543-08	26.537[a]	1553-02	20.186	1566-04	23.554[b]
1543-09	25.821[a]	1553-04	20.397	1566-05	23.458
1543-10	26.296	1553-08	22.714	1566-06	23.395[b]
1543-11	26.383[a]	1554-01	21.197	1566-07	23.333
1543-12	26.971	1554-02	22.714	1566-08	23.467[a]
1544-01	26.971	1554-12	21.872	1566-09	23.433
1544-02	27.477	1555-07	21.703	1566-10	23.300[a]

1544-03	27.157	1555-10	21.535	1566-11	23.500
1544-04	26.971	1555-12	22.040	1566-12	23.342[a]
1544-05	26.929	1556-03	21.872	1567-01	23.314[b]
1544-06	26.086	1556-06	22.757	1567-02	23.175[a]
1544-07	25.960	1557-01	20.481	1567-03	22.917
1544-08	26.891	1558-03	21.788	1567-04	22.963
1544-09	26.845	1558-04	22.175	1567-05	22.792
1544-10	27.097	1558-05	22.213[a]	1567-06	22.750
1544-11	26.965	1558-06	22.251	1567-07	23.443
1544-12	26.290	1558-07	22.307[c]	1567-08	23.836[a]
1545-01	26.545[b]	1558-08	22.368[c]	1567-09	23.625
1545-02	26.802	1558-09	22.429[c]	1567-10	23.948
1545-03	26.500	1558-10	22.490[c]	1567-11	24.000
1545-04	26.575[b]	1558-11	22.546	1567-12	23.788[a]
1545-05	26.651	1558-12	21.667	1568-01	23.815
1545-06	26.512[c]	1559-01	21.937	1568-02	23.514
1545-07	26.362[c]	1559-02	22.058	1568-03	23.375
1545-08	26.212[c]	1559-03	22.082	1568-04	23.375
1545-09	26.073	1559-04	22.148[c]	1568-05	23.847[a]
1545-10	25.664	1559-05	22.220[c]	1568-06	23.500
1545-11	25.710	1559-06	22.291[c]	1568-07	23.500
1545-12	25.887	1559-07	22.357[a]	1568-08	23.549
1546-01	25.787[c]	1559-08	22.258[a]	1568-09	23.116[a]
1546-02	25.679[c]	1559-09	22.504	1568-10	23.596[a]
1546-03	25.570[c]	1559-10	22.504		

Note. Exchange rates are quoted at a variable number of Flemish groots for one pound sterling. a. those are converted from Antwerp-London exchange rates, b. deriving from linear interpolation, c. deriving from cardinal spline interpolation. Also see the context, pp. 109-14.

Appendix 3.F. The production of gold and silver in England and the Habsburg Netherlands, 1521-81 (£)

	English	
	1526-51	1551-1568
Gold	1,674,432 (33.47%)	306,656 (15.88%)
Silver	3,327,860 (66.53%)	1,624,471 (84.12%)

	The Habsburg Netherlands	
	1521-56	1556-81
Gold	7,050,979 (87.67%)	2,679,377 (13.59%)
Silver	991,778 (12.33%)	17,040,639 (86.41%)

Source: C. E. Challis, *The Tudor Coinage* (Manchester University Press, 1978), p. 232; H. Enno van Gelder and M. Hoc, *Les Monnaies des Pays-Bas Bourguignons et Espagnols, 1434-1713* (Amsterdam, 1960), pp. 100-1

Appendix 3.G. The mint parity based on circulating gold coins (75% of recycling ratio)

Date	% in total circulation				The mint parity of circulating coins
	pre-1544 old coin	the 23 c issue of 1542-5	the 22c issue of 1545-6	the 20c issue of 1546-9	
1539-1544	100				25.814
1544-06	98	2			25.770
1544-07	96.1	3.9			25.725
1544-08	94.1	5.9			25.680
1544-09	92.1	7.9			25.635
1544-10	90.1	9.9			25.589
1544-11	88.1	11.9			25.543
1544-12	86	14			25.497
1545-01	84	16			25.451
1545-02	81.9	18.1			25.405
1545-03	77.9	20.1			25.358
1545-04	75.4	20	4.6		25.168
1545-05	71	19.9	9.1		24.981
1545-06	66.7	19.7	13.6		24.796
1545-07	62.4	19.6	18		24.614
1545-08	58.1	19.5	22.4		24.434
1545-09	54	19.3	26.7		24.257
1545-10	49.8	19.2	31		24.081
1545-11	45.8	19.1	35.1		23.908
1545-12	41.7	19	39.3		23.738
1546-01	37.8	18.9	43.3		23.569
1546-02	33.8	18.8	47.4		23.402
1546-03	30	18.6	51.4		23.238
1546-04	27.5	18.5	51.2	2.8	23.076
1546-05	25	18.4	51	5.6	22.915
1546-06	22.5	18.4	50.8	8.3	22.755
1546-07	20	18.4	50.6	11	22.596
1546-08	17.6	18.3	50.4	13.7	22.439
1546-09	15.1	18.2	50.2	16.5	22.283
1546-10	12.3	18.2	50.3	19.2	22.110
1546-11	9.4	18.3	50.3	22	21.937
1546-12	6.6	18.3	50.4	24.7	21.764
1547-01	3.8	18.2	50.5	27.5	21.590
1547-02	1.2	18.3	50.5	30	21.416
1547-03		16.2	50.7	33.1	21.281
1547-04		11.1	50.5	38.4	21.079
1547-05		6	50.4	43.6	20.877
1547-06		0.9	50.3	48.8	20.677
1547-07			45.8	54.2	20.553
1547-08			40.4	59.6	20.446
1547-09			34.9	65.1	20.338
1547-10			32.9	67.1	20.299

1547-11	30.9	69.1	20.259
1547-12	28.8	71.2	20.218
1548-01	26.7	73.3	20.177
1548-02	24.6	75.4	20.134
1548-03	22.4	77.6	20.091
1548-04	20.2	79.8	20.047
1548-05	17.9	82.1	20.002
1548-06	15.6	84.4	19.956
1548-07	13.2	86.8	20.904
1548-08	10.8	89.2	20.854
1548-09	8.3	91.7	20.804
1548-10	5.1	94.9	20.738
1548-11	1.8	98.2	20.670
1548-12		100	20.633
1558-03~1560-11			22.086
1560-12~1568-10			22.228

Appendix 3.H The speed of communication between London, Calais, and Antwerp, 1551

The date of delivering	The date of receiving	Number of days for communication
	London-Calais	
27 Mar. 1551	30 Mar. 1551	3
24 Aug. 1551	27 Aug. 1551	3
27 Sept. 1551	1 Oct. 1551	4
26 Oct. 1551	28 Oct. 1551	2
29 Oct. 1551	2 Nov. 1551	4
17 Nov. 1551	20 Nov. 1551	3
22 Nov. 1551	25 Nov. 1551	3
4 Dec. 1551	8 Dec. 1551	4
13 Mar. 1552	17 Mar. 1552	4
18 Mar. 1552	21 Mar. 1552	3
26 May 1551	29 May 1551	3
29 May 1551	1 June 1551	3
30 May 1551	8 June 1551	9
6 June 1551	12 June 1551	6
9 June 1551	18 June 1551	9
12 June 1551	14 June 1551	2
20 June 1551	22 June 1551	2
22 June 1551	25 June 1551	3
10 July 1551	15 July 1551	5
23 July 1551	26 July 1551	3
29 July 1551	4 Aug. 1551	6
		Average: 4
	London-Antwerp	
27 June 1551	2 July 1551	5
28 June 1551	3 July 1551	5
3 Oct. 1551	12 Oct. 1551	9
14 Oct. 1551	19 Oct. 1551	5
17 Oct. 1551	23 Oct. 1551	6
16 Nov. 1551	25 Nov. 1551	9
21 Nov. 1551	29 Nov. 1551	8
24 Nov. 1551	1 Dec. 1551	7
25 Nov. 1551	1 Dec. 1551	6
26 Nov. 1551	3 Dec. 1551	7
29 Nov. 1551	4 Dec. 1551	5
30 Nov. 1551	8 Dec. 1551	8
7 Jan. 1552	16 Jan. 1552	9
27 Feb. 1552	6 Mar. 1552	7
12 Mar. 1552	17 Mar. 1552	5
		Average: 7

Source: B. Winchester, *The Johnson Letters, 1542-1552*, unpublished PhD Thesis (University of London, 1953).

Appendix 3. I The estimation of import and export points, 1526-60

	Import point	Export Point
1526 Nov.	27.764	24.828
1542 May	26.030	24.828
1544 June	26.030	21.982
1545 Apr.	24.746	21.982
1546 Jan.	24.500	20.184
1546 Oct.	24.028	20.184
1547 Mar.	21.542	18.892
1547 Apr.	21.542	18.892
1548 July	21.653	19.268
1548 Oct.	20.379	19.268
1549 Feb.	20.379	19.268
1549 Oct.	19.246	19.268
1550 Apr.	17.321	19.268
1550 Aug.	16.113	19.268
1551 Apr.	11.548	19.268
1551 July	11.548	20.186
1551 Oct.	21.628	20.080
1552 Jan.	21.628	20.080
1553 Aug.	21.698	20.080
1556 Oct.	21.698	21.408
1557 Aug.	25.336	21.408
1560 Nov.	25.566	21.408

Source: see Table 3.1 and 3.4

Appendix 4.A The original data of exchange rates, 1667-1680

Date	H-L	H-A	A-L	A-H	Source
1667-06-09	34s 9d	33 3/8			C114/72
1668-01-06	34s 9d	33			C114/70
1668-02-09	34s 2d				C114/72
1668-02-15	34s	32 7/8			C114/72
1668-02-22	34s	32 7/8			L-5
1668-02-22	34s 2d	33			C114/72
1668-02-24	34s 1d	33			C114/70
1668-02-25	34s	32 7/8			C114/72
1668-02-29	34s 4-5d	33			C114/72
1668-02-29	34s 3-4d	32 7/8-15/16			C114/72
1668-03-03	34s 2d	32 1/4			C114/72
1668-03-07	34s	33			C114/72
1668-03-07	34s 2d	32 15/16-33			C114/72
1668-03-09			35s 4d		C114/72
1668-03-09			35s 4-5d		C114/72
1668-03-10	34s 1d	33 1/16			C114/70
1668-03-10	34s 1-2d				C109/23
1668-03-13			35s 1/2-1d	32 7/8	C114/72
1668-03-14	34s 2d	33 1/16			C114/70
1668-03-21	33s 10-11d	33 -33 1/16			C114/70
1668-03-23			34s 11d	32 7/8	C114/72
1668-03-23			35s		C114/76
1668-03-28	33s 10-11d	33 1/16			C114/70
1668-03-28	34s				C114/70
1668-03-28	33s 11d				C114/70
1668-03-31	33s 10-11d				C114/70
1668-03-31	33s 10d	33 1/16			C114/70
1668-04-04	33s 9d	33-33 1/16			C114/70
1668-04-06			34s 6-7d	32 7/8	C114/70
1668-04-06			34s 6d		C114/70
1668-04-07	33s 9-10d	33-33 1/16			C114/70
1668-04-07	33s 6-7d	33 1/16			C114/70
1668-04-14	33s 10d				C109/23
1668-04-14	33s 10-11d				C114/70
1668-04-14	33s 10d	33s			C114/70
1668-04-16			34s 10d	32 13/16-7/8	C114/70
1668-04-18	33s 10d	33			C114/70
1668-04-20			34s 10-11d		C114/70
1668-04-20			34s 11d	32 3/8	C114/70
1668-04-20			35s		C114/70
1668-04-21	33s 10-11d				L-12
1668-04-21	33s 10d	33			C114/70
1668-04-24	33s 10d	32 15/16-33			C114/70
1668-04-27			34s 11d-35s	32 13/16	C114/70
1668-04-28	34s	33 1/16			C114/70

1668-04-28	33s 10d-34s	33			C114/70
1668-05-01			34s 11d	32 15/16	C114/70
1668-05-02	33s 8-9d	33 1/16			C114/70
1668-05-02	33s 11d-34s				C114/70
1668-05-04			34s 11d	32 7/8	C114/70
1668-05-05	33s 10d				C109/23
1668-05-05	33s 10d	32 15/16			C114/70
1668-05-05	33s 11d-34s	33 1/16			C114/70
1668-05-05		33			C114/70
1668-05-09	33s 9d	33 1/16			C114/70
1668-05-11			34s 7-8d		C114/70
1668-05-12	33s 10d	33-33 1/16			C114/70
1668-05-16	33s 8-9d				L-15
1668-05-16	33s 9-10d				L-16
1668-05-16	33s 10d	33 1/16			C114/70
1668-05-18	33s 9-10d	33 1/16	34s 9d	32 15/16	C114/70
1668-05-19	33s 9d				C109/23
1668-05-19	33s 10d				C114/70
1668-05-19	33s 8-9d	33 1/16			C114/70
1668-05-19	33s 9d				C114/70
1668-05-20	33s 9d	33			C114/70
1668-05-21	33s 10d				C114/70
1668-05-23	33s 10d	33 1/16			C114/70
1668-05-25			34s 8-9d	32 7/8	C114/70
1668-05-26	33s 8d	33 1/16			C114/70
1668-05-28			34s 8-9d	32 7/8-15/16	C114/76
1668-06-01			34s 10d	32 15/16	C114/70
1668-06-01				32 15/16	L-17
1668-06-01			34s 11d-35s		C114/76
1668-06-02	33s 9d				C109/23
1668-06-02	33s 9d	33 1/16			C114/70
1668-06-08			34s 10d	33-32 15/16	C114/70
1668-06-09	34s				C109/23
1668-06-09	33s 10d	33 1/16			C114/70
1668-06-13	33s 11d	33 1/16			C114/70
1668-06-15			34s 10d	32 15/16	C114/70
1668-06-16		33 1/16			C114/70
1668-06-16	33s 11d-34s	33 1/8			C114/76
1668-06-18	33s 10-11d				C114/70
1668-06-20			35s 1d	33 1/16	C114/76
1668-06-21	33s 10-11d				C114/70
1668-06-22			34s 10d		L-18
1668-06-22			34s 10-11d	33	C114/70
1668-06-23	34s				C109/23
1668-06-23	33s 11d	33 1/8			C114/76
1668-06-23	34s				C114/76
1668-06-26	33s 11d	33 1/8			C114/76
1668-06-27	33s 11d	33 1/8			C114/76
1668-06-28			34s 8-9d	33	C114/70
1668-06-29			34s 10d	33	C114/70
1668-06-30	33s 11d	33			C114/76

1668-06-30	33s 10-11d	33 1/8			C114/76
1668-07-03				32 15/16	C114/76
1668-07-06			34s 10d	33	C114/76
1668-07-07	33s 11d	33 1/8			C114/76
1668-07-07	33s 10d				C114/76
1668-07-07	33s 10-11d				C114/76
1668-07-10	33s 10d	33 1/8-3/16			C114/76
1668-07-11	33s 11d	33 1/8			C114/76
1668-07-11	33s 10-11d				C114/76
1668-07-13	33s 11d		34s 11d	33	C114/76
1668-07-13			35s 1d		C114/76
1668-07-13			34s 11d-35s	33 1/16	C114/76
1668-07-14	33s 11d	33 1/8			C114/76
1668-07-14	34s				C114/76
1668-07-20			35s 2d	33	C114/76
1668-07-20			35s 1d		C114/76
1668-07-21	34s 1d	33 1/8			C114/76
1668-07-21	34s				C114/76
1668-07-21	33s 11d-34s				C114/76
1668-07-23			35s 1d	33	C114/73
1668-07-24	34s 1-2d				C114/76
1668-07-27			35s 2d	33 1/16	C114/76
1668-07-28	34s	33 1/8			C114/76
1668-07-28	34s 2d				C114/76
1668-07-31	34s	33 1/8			C114/76
1668-08-03			35s 1-2d	33 1/8	C114/76
1668-08-03			35s 1 1/2d		C114/76
1668-08-04	34s 2d	33 1/8			C114/76
1668-08-04	34s				C114/76
1668-08-07	34s	33 1/8	35s 2d		C114/76
1668-08-10			35s 2d	33	C114/76
1668-08-10			34s 11d-35s	33 1/16-1/8	C114/76
1668-08-11	34s	33 1/16			C114/76
1668-08-14	34s	33 1/16			C114/76
1668-08-17			35s-35s 1d	33	C114/76
1668-08-18	34s				C109/20
1668-08-18	34s 1d	32 7/8			C114/73
1668-08-18	34s	32 15/16-33			C114/73
1668-08-18	34s	33-33 1/16			C114/76
1668-08-18		33			C114/76
1668-08-18		32 15/16			C114/76
1668-08-21	34s	33 15/16			C114/73
1668-08-24			35s 1-1 1/2d	32 13/16	C114/76
1668-08-24			35s 1d		C114/76
1668-08-25		32 15/16			C114/73
1668-08-28	34s 1d				C114/73
1668-08-29	34s	32 15/16-33			C114/73
1668-08-31			35s 1d	32 13/16	C114/76
1668-09-01	34s 1d	32 7/8			C114/73
1668-09-04	34s 1d	32 15/16			C114/73
1668-09-07			35s	32 13/16	C114/73

1668-09-08	34s 3d				C114/73
1668-09-08	34s 2-3d	32 15/16			C114/73
1668-09-08	34s 2d	32 15/16-33			C114/73
1668-09-11	34s 2d	32 7/8			C114/73
1668-09-11	34s 3d	32 15/16			C114/73
1668-09-14			35s 1d		C114/73
1668-09-14			35s	32 13/16	C114/73
1668-09-15	34s 4-5d	32 7/8-15/16			C114/73
1668-09-15	34s 3d	32 7/8			C114/73
1668-09-18			35s 1d		C114/73
1668-09-18			35s 2d		C114/73
1668-09-18	34s 4d	32 15/16	35s 1d		C114/73
1668-09-19	34s 5d	32 15/16			C114/73
1668-09-21				32 13/16	C114/73
1668-09-21			35s	32 7/8	C114/73
1668-09-22	34s 9d				C109/23
1668-09-22	34s 6d	32 15/16			C114/73
1668-09-25	34s 6-7d	32 15/16			C114/73
1668-09-25	34s 6d				C114/73
1668-09-27	34s 7d				C109/23
1668-09-27	34s 7d				C109/23
1668-09-28			35s-35s 1d	32 7/8	C114/73
1668-09-28			35s 1d		C114/73
1668-09-29	34s 6-7d				C114/73
1668-10-01			35s	32 15/16	C114/73
1668-10-02	34s 6-7d	33			C114/73
1668-10-02	34s 7d	32 7/8			C114/73
1668-10-05			35s 2d		C114/73
1668-10-06	34s 6d	32 3/4-13/16			C114/73
1668-10-06	34s 6-7d	32 1/2			C114/73
1668-10-06		32 7/8			C114/73
1668-10-09	34s 6d	32 3/4-13/16			C114/73
1668-10-09		32 3/4			C114/73
1668-10-12			35s 1/2d-35s	32 5/8-11/16	C114/73
1668-10-12			35s 3d	32 3/4	C114/73
1668-10-13	34s 6d	32 3/4			C114/73
1668-10-16	34s 6d	32 11/16-3/4			C114/73
1668-10-16	34s 7d	32 3/4			C114/73
1668-10-16	34s 6-7d				C114/73
1668-10-19			35s 1d	32 5/8	C114/73
1668-10-23	34s 7d	32 3/4			C114/73
1668-10-23	34s 6-7d				C114/73
1668-10-26			35s 2d	32 5/8	C114/73
1668-11-02			35s 2d	32 5/8	C114/73
1668-11-02			35s 2-3d	32 5/8-11/16	C114/73
1668-11-03	34s 5d				C109/20
1668-11-03	34s 6d	32 3/4			C114/73
1668-11-06	34s 5-6d	32 13/16			C114/73
1668-11-08	34s 3d				C109/20
1668-11-10	34s 6d	32 13/16			C114/73
1668-11-13	34s 5d	32 13/16			C114/73

1668-11-13	34s 4-5d				C114/73
1668-11-14	34s 5d	32 13/16			C114/73
1668-11-16			35s 2-3d		C114/73
1668-11-20			35s 3-4d	32 3/4-11/16	C114/73
1668-11-21	34s 5d	32 7/8			C114/73
1668-11-27	34s 5-6d				C114/73
1668-11-30			35s 5 1/2-6d	32 3/4	C114/73
1668-11-30			35s 5d		C114/73
1668-11-30	34s 4d	32 13/16	35s 5-6d		C114/73
1668-12-01	34s 4-5d	32 13/16			C114/73
1668-12-05	34s 6d	32 13/16			C114/73
1668-12-07			35s 6d	32 11/16-3/4	C114/73
1668-12-08	34s 5d	32 13/16			C114/73
1668-12-14			35s 3-5d	32 11/16	C114/73
1668-12-18	34s 5d	32 13/16	35s 2d		C114/73
1668-12-18	34s 4-5d				C114/73
1668-12-21			35s 2d		C114/73
1668-12-22	34s 4d				C109/23
1668-12-28			35s 2d		C114/77
1668-12-28			35s 2 1/2d	32 11/16	C114/77
1668-12-29	34s 5-6d	32 3/4			C114/77
1668-12-29	34s 6d				C114/77
1668-12-29	34s 6-7d				C114/77
1669-01-01	34s 5-6d	32 ¾-13/16			C114/77
1669-01-04			35s 4d	32 11/16	C114/77
1669-01-08			35s 3d	32 11/16	C114/77
1669-01-11			35s 4d	32 11/16	C114/77
1669-01-18			35s 3d		C114/77
1669-01-21			35s 3-4d	32 3/4	C114/77
1669-01-22		32 13/16	35s 3d		C114/77
1669-01-23			35s 4d	32 11/16	C114/77
1669-01-25			35s 1-3d		C114/77
1669-01-29	34s 9-10d	32 13/16			C114/75
1669-01-29			35s 3d		C114/77
1669-02-01	34s 8-9d				C109/23
1669-02-01			35s 4d		C114/77
1669-02-01			35s 4-5d	32 11/16-3/4	C114/77
1669-02-01			35s 5d		C114/77
1669-02-05			35s 5-5 1/2d		C114/77
1669-02-08			35s 4 1/2-5d	32 11/16	C114/77
1669-02-09	34s 8d				C109/20
1669-02-09	34s 8d-9d				C109/23
1669-02-11			35s 4-4 1/2d	32 1/4	NEHA
1669-02-12	34s 8d	32 11/16	35s 4d		C114/77
1669-02-15			35s 4d	32 3/4	C114/77
1669-02-18			35s 4d	32 3/4-13/16	C114/77
1669-02-19	34s 9d	32s 6d			C114/69
1669-02-22			35s 4d		C114/69
1669-02-22			35s 4-4 1/2d	32 11/16	C114/77
1669-02-25			35s 3 ½-4d	32 5/8-15/16	C114/69
1669-02-25			35s 3 ½-4d		C114/70

1669-02-26			35s 4d		C114/77
1669-03-01			35s 5-5 1/2d	32 11/16	C114/77
1669-03-02	34s 9d	32 5/8			C114/69
1669-03-03			35s 5d-5 1/2d	32 11/16	C114/69
1669-03-08			35s 6d	32 5/8	C114/69
1669-03-09	34s 10d				C114/69
1669-03-09	34s 9d	32 5/8-11/16			C114/69
1669-03-15			35s 5d-5 1/2d	32 9/16	C114/69
1669-03-15			35s 4 1/2d		C114/69
1669-03-16	34s 8d				C109/23
1669-03-16	34s 8d	32 5/8	35s 5d	32 1/2-9/16	C114/69
1669-03-16	34s 7-8d				C114/69
1669-03-22			35s 4d-5d		C114/69
1669-03-23	34s 7d				C109/20
1669-03-25			35s 5d	32 1/2	NEHA
1669-03-26	34s 8d	32 5/8			C114/70
1669-03-29			35s 4d	32 1/2	C114/69
1669-03-30	34s 8-9d	32 5/8			C114/70
1669-04-02	34s 7d				C114/70
1669-04-02	34s 6-7d	32 5/8			C114/70
1669-04-05			35s 3d		C114/70
1669-04-05			35s 4d	32 7/16	C114/70
1669-04-09	34s 5-6d				C114/70
1669-04-11	34s 8d	32 1/2			C114/74
1669-04-12			35s 3 1/2-4d	32 7/16-1/2	C114/70
1669-04-13	34s 5d				C109/20
1669-04-15			35s 3-4d	32 7/16-1/2	NEHA
1669-04-17	34s 6d	32 1/2			C114/74
1669-04-19			35s 2 1/2d	32 7/16	C114/70
1669-04-20	34s 7d				C109/20
1669-04-22			35s 4d		C114/70
1669-04-23			35s 3-4d	32 7/16	C114/70
1669-04-26			35s 2 1/2d	32 7/16	C114/70
1669-04-27	34s 6d				C109/20
1669-04-27	34s 5-6d				C114/74
1669-04-29			35s 3d	32 7/16-1/2	C114/70
1669-04-30	34s 6d	32 1/2			C114/74
1669-05-03			35s 3 1/2-4d	32 7/16	C114/70
1669-05-03			35s 4d	32s	C114/70
1669-05-04	34s 6-7d	32 1/2			C114/74
1669-05-04	34s 7d				C109/20
1669-05-06	34s 5d	32 5/8			C114/70
1669-05-07	35s 5-6d	32 1/2			C114/74
1669-05-07	34s 7-8d	32 1/2			C114/74
1669-05-09	34s 10d				C114/74
1669-05-10			35s 4 1/2d	32 7/16	C114/74
1669-05-11	34s 8d				C114/74
1669-05-14	34s 8d	32 1/2			C114/74
1669-05-14	34s 8-9d	32 1/2			C114/74
1669-05-17			35s 4-5d		C114/74
1669-05-21	34s 8d				C109/20

1669-05-21	34s 8d	32 1/2			C114/74
1669-05-24			35s 4 1/2-5d	32 1/2	C114/74
1669-05-25	34s 8d	32 1/2			C114/74
1669-05-27			35s 4-4 1/2d	32 7/16-1/2	C114/74
1669-05-28	34s 8d				C114/74
1669-05-31			35s 4 1/2d	32 7/16	C114/74
1669-06-03			35s 4 1/2d	32 7/16	C114/74
1669-06-04	34s 8d	32			C114/74
1669-06-04		32 1/2			C114/74
1669-06-07			35s 4d	32 7/16	C114/74
1669-06-08	34s 8d				C109/23
1669-06-11	34s 8d	32 7/16-1/2	35s 4d		C114/74
1669-06-12	34s 9-10d				C114/74
1669-06-14			35s 2d	32 7/16	C114/74
1669-06-17			35s 2 ½-3d	32 7/16	C114/74
1669-06-18	34s 8d	32 1/2			C114/74
1669-06-21			35s 2 1/2-3d	32 7/16	C114/74
1669-06-22	34s 9d	32 1/2			C114/74
1669-06-25	34s 8-9d	32 7/16-1/2			C114/74
1669-06-26	34s 9d	32 1/2			C114/74
1669-06-28			35s 3d		C114/74
1669-06-28			35s 2 1/2-3d	32 3/8	C114/74
1669-06-29	34s 9d				C114/74
1669-07-01	34s 6d	32 1/2			C114/74
1669-07-02	34s 5d				C114/74
1669-07-05			35s 2 1/2-3d	32 3/8	C114/74
1669-07-09	34s 6d	32 1/2			C114/74
1669-07-09		32 1/2-9/16			C114/74
1669-07-12			35s 3d		C114/74
1669-07-13	34s 6d	32 9/16			C114/74
1669-07-13		32 1/2			C114/74
1669-07-13	34s 6d				C109/20
1669-07-14	34s 5d				C109/20
1669-07-16	34s 6d	32 9/16			C114/74
1669-07-16		32 5/8			C114/74
1669-07-19				32 1/2	C114/74
1669-07-20	34s 5d				C114/74
1669-07-20	34s 5-6d	32 5/8			C114/74
1669-07-20	34s 5d				C109/20
1669-07-23	34s 5d	32 11/16			C114/74
1669-07-23	34s 5d	32 5/8-11/16			C114/74
1669-07-26			35s 2 1/2d		C114/74
1669-07-27	34s 5d				C109/20
1669-07-30	34s 5-6d	32 11/16-3/4	35s 4d		C114/74
1669-08-02			35s 4 1/2d	32 1/2-9/16	C114/74
1669-08-02			35s 5d	32 9/16	C114/74
1669-08-03	34s 6d				C109/20
1669-08-06			35s 4-4 1/2d		C114/74
1669-08-06			35s 4-5d		C114/74
1669-08-09			35s 4 1/2d	32 9/16	C114/74
1669-08-10	34s 5d				C109/20

1669-08-13	34s 6d	32 3/4	35s 4d	32 9/16	C114/74
1669-08-13		32 3/4-13/16			C114/74
1669-08-16	34s 5-6d	32 3/4			C114/74
1669-08-16	34s 6d	32 3/4			C114/74
1669-08-17	34s 6d	32 11/16-3/4			C114/74
1669-08-20	34s 6d	32 3/4	35s 4d	32 5/8	C114/74
1669-08-20		32 11/16-3/4			C114/74
1669-08-20	34s 6d				C109/20
1669-08-21			35s 4d		C114/74
1669-08-23	34s 6-7d	32 3/4			C114/74
1669-08-27	34s 7d	32 3/4			C114/74
1669-08-27		32			C114/74
1669-08-30			35s 4d	32 9/16-5/8	C114/74
1669-09-03	34s 7d		35s 4d		C114/74
1669-09-03	34s 6-7d	32 3/4			C114/74
1669-09-06	34s 6-7d	32 1/4	35s 4 1/2d	32 9/16	C114/74
1669-09-09			35s 4d	32 5/8	NEHA
1669-09-10	34s 6d		35s 5d		C114/74
1669-09-10	34s 6d				C109/20
1669-09-13	34s 6-7d	32 1/16-3/4	35s 5d	32 9/16	C114/74
1669-09-14	34s 7d	32 11/16			C114/74
1669-09-16			35s 4 1/2-5d	32 7/16-5/8	NEHA
1669-09-17			35s 4 1/2-5d		C114/74
1669-09-21	34s 8d	32 5/8			C114/74
1669-09-21	34s 8-9d	32 5/8			C114/74
1669-09-24	34s 10d				C109/23
1669-09-27			35s 5 1/2d		C114/74
1669-09-28	34s 7d	32 1/2-9/16			C114/74
1669-09-28	34s 9-10d	32 1/2-9/16			C114/74
1669-09-30			35s 5d	32 1/2	NEHA
1669-10-01			36s 3-4d		C114/74
1669-10-01			35s 4d		C114/74
1669-10-05	34s 8d	32 7/8			C114/74
1669-10-06	34s 7-8d	32 1/2			C114/74
1669-10-07			35s 3d	32 5/16-3/8	NEHA
1669-10-08			35s 2 1/2d	32 1/4-5/16	C114/74
1669-10-11			35s 2d	32 1/4	C114/74
1669-10-14			35s 2-3d	32 1/4-5/16	NEHA
1669-10-15	34s 9-10d	32 3/8	35s 2 1/2d	32 5/16	C114/74
1669-10-15			35s 2d		C114/74
1669-10-18			35s 1d	32 1/4	C114/74
1669-10-21			35s 2d	32 1/4-5/16	NEHA
1669-10-22	34s 9-10d	32 3/8			C114/74
1669-10-26	34s 10d	32 5/16-3/8			C114/74
1669-10-26		32 3/8			C114/74
1669-10-28			35s 1d	32 1/4	NEHA
1669-10-29	34s 11d	32 5/16			C114/74
1669-10-29	34s 10d	32 3/8			C114/74
1669-11-01			35s 1d		C114/74
1669-11-02			35s 1 1/2-2d	32 1/4	C114/74
1669-11-04			35s 1 1/2-2d	32 1/4	NEHA

1669-11-05			35s 1-1 1/2d	32 1/4-5/16	C114/74
1669-11-08			35s 1d		C114/74
1669-11-08			35s 1 1/2-2d	32 1/4	C114/74
1669-11-09	34s 11d	32 3/8			C114/74
1669-11-11			35s 1d	32 1/4	C114/74
1669-11-11			35s 1d	32 1/4	NEHA
1669-11-12	34s 8d				L-119
1669-11-12	34s 9-10d				C114/74
1669-11-12	34s 10d	32 3/8			C114/74
1669-11-12	34s 11d	32 1/3			C114/74
1669-11-15			35s 1-1 1/2d		C114/74
1669-11-18			35s 1d	32 3/16-1/4	NEHA
1669-11-23	34s 10-11d	32 3/16-1/4			C114/74
1669-11-23	34s 10d	32 1/4			C114/74
1669-11-25			35s 1d	32 3/16	NEHA
1669-11-26	34s 10-11d	32 3/16			C114/74
1669-11-29	34s 10-11d	32 1/8	35s 1d		C114/74
1669-11-30	34s 10-11d	32 1/8			C114/74
1669-11-30	34s 9-10d	32 1/8			C114/74
1669-11-30	34s 10-11d				C109/24
1669-12-03	34s 10-11d	32 1/16-1/8			C114/74
1669-12-06	34s 10d	32 1/16			C114/74
1669-12-07	34s 10-11d	32 3/16			C114/74
1669-12-10	34s 9-10d	32 1/8	34s 11d	32	C114/74
1669-12-13			34s 9d	32	C114/74
1669-12-14	34s 9d	32 3/16			C114/74
1669-12-17	34s 10d	32 1/8	34s 8d	32-32 1/16	C114/74
1669-12-20			34s 7d		C114/74
1669-12-21	34s 8d	32 1/8			C114/74
1669-12-21	34s 8-9d	32 1/8			C114/74
1669-12-22	34s 5d				C114/77
1669-12-24	34s 7d	32 1/16			C114/74
1669-12-27			34s 6d	31 7/8	C114/74
1669-12-31			34s 5d	31 1/8	C114/74
1670-01-03			34s 4d		C114/74
1670-01-04	34s 6d	31 13/16			C114/74
1670-01-06			34s 4d	31 1/4	C114/74
1670-01-07	34s 6d		34s 4-5d	31 7/16	C114/74
1670-01-07	34s 6-7d	31 3/4	34s 4d		C114/74
1670-01-11	34s 6d	31 3/4			C114/74
1670-01-14	34s 5-6d	31 3/4	34s 4-5d		C114/74
1670-01-14	34s 6d	31 3/4	34s 5d		C114/74
1670-01-14	34s 6d				C109/20
1670-01-18	34s 7d	31 13/16	34s 5-6d		C114/74
1670-01-21	34s 6d	31 15/16	34s 7-8d		C114/74
1670-01-21	34s 6-7d	31 15/16-32	34s 6-7d	31 13/16	C114/74
1670-01-24	34s 7-8d	31 7/8			C114/74
1670-01-28			34s 8d	31 1/2	C114/74
1670-01-28			34s 9-10d	31 13/16	C114/74
1670-01-31			34s 9d		C114/74
1670-02-01	34s 7-8d	31 7/8-15/16			C114/74

1670-02-01	34s 8-9d	31 15/16			C114/74
1670-02-01	34s 8d				C109/20
1670-02-02			34s 9d	31 7/8	C114/74
1670-02-11			34s 9d		C114/74
1670-02-14			34s 7d	31 15/16	C114/74
1670-02-18	34s 9d				C109/20
1670-02-21			34s 7d	31 7/8	C114/74
1670-02-23			34s 8d	31 7/8	C114/74
1670-03-01	34s 9d				C109/20
1670-03-15	34s 7d				C109/20
1670-03-22	34s 3d				C109/20
1670-04-05	34s				C109/20
1670-04-12	34s 2d				C109/20
1670-04-22	34s 2s				C109/20
1670-05-06	33s 11d				C109/20
1670-05-17	33s 11d				C109/20
1670-07-19	33s 10d				C109/20
1670-08-27	33s 10d				C109/20
1670-09-20	34s 1-2d	32 15/16			C114/73
1670-09-23			35s	32 7/8	C114/73
1670-09-27	34s 3d	32 3/4-15/16			C114/73
1670-09-27	34s 2d				C109/20
1670-09-30			34s 11d-35s	32 7/8	C114/73
1670-11-04	34s 3d				C109/20
1670-11-25	34s 6d				C109/20
1670-12-09	34s 8d				C109/20
1670-12-13	34s 9d				C109/20
1670-12-20	34s 9d				C109/20
1671-02-17	34s 6d				C109/20
1671-02-14	34s 6d				C109/20
1671-02-28	34s 7d				C109/20
1671-03-07	34s 6d				C109/20
1671-03-28	34s 7-8d	33 1/8			C114/71
1671-03-28	34s 8d	33 1/16			C114/71
1671-03-31	34s 7-8d	33 1/16			C114/71
1671-03-31	34s 8d	33 1/16-1/8			C114/71
1671-04-04	34s 7-8d	33 1/16-1/8			C114/71
1671-04-04	34s 8d	33 1/16			C114/71
1671-04-07	34s 8d	33 1/16			C114/71
1671-04-07	34s 7d				C109/20
1671-04-10			35s 9 1/2-10 1/2d	33	C114/71
1671-04-11	34.667	33 1/16			C114/71
1671-04-14	34s 8d	33 1/16	35s 10d	33	C114/71
1671-04-14	34s 8d				C109/20
1671-04-16	34s 8d	33 1/2			C114/71
1671-04-18	34s 8d	33 1/16	35s 8-8 1/2d		C114/71
1671-04-20			35s 9d	32 15/16-33	NEHA
1671-04-20			35s 9d	32 15/16-33	C114/71
1671-04-21	34s 8d	33 1/16	35s 9-10d		C114/71
1671-04-21			35s 9d	32 15/16	C114/71
1671-04-24			35s 9-9 1/2d		C114/71

1671-04-28	34s 6-7d	33 1/16			C114/71
1671-04-28	34s 6d	33 1/16			C114/71
1671-04-28	34s 5-6d				C114/71
1671-04-28	34s 8d	33			C114/71
1671-05-?	34s 8d	33			C114/71
1671-05-02	34s 5-6d	33 1/16			C114/71
1671-05-02	34s 4d	33			C114/71
1671-05-04			35s 8d	32 15/16	C114/71
1671-05-05	34s 4d	33 1/16-1/8	35s 7-8d		C114/71
1671-05-08	34s 4d	33 1/8	35s 7-8d	32 15/16	C114/71
1671-05-09	34s 4d	33 1/8	35s 8 1/2-9d		C114/71
1671-05-09		33 1/16			C114/71
1671-05-09	34s 4d				C109/20
1671-05-09	34s 3-4d				C109/23
1671-05-11			35s 7d	32 15/16	NEHA
1671-05-12	34s 5-6d	33 1/16			C114/71
1671-05-12	34s 6d				C114/71
1671-05-12	34s 3d	33 1/8			C114/71
1671-05-12	34s 4-5d	33 1/16			C114/71
1671-05-16	34s 4-5d	33 1/8			C114/71
1671-05-16	34s 4d	33 1/8			C114/71
1671-05-19	34s 5d	33 1/8	35s 7-8d		C114/71
1671-05-19	34s 6d				C114/71
1671-05-21			35s 7d	32 15/16-33	C114/71
1671-05-23	34s 5d				C114/71
1671-05-23	34s 4d				C109/20
1671-05-26	34s 6d	33 1/4-1/3	35s 9-9 1/2d	33 1/16	C114/71
1671-05-26	34s 5-6d		35s 9d		C114/71
1671-05-26	34s 6d	33 1/4			C114/71
1671-05-30	34s 6d				C114/71
1671-06-02	34s 5-6d	33 1/4			C114/71
1671-06-02	34s 5d	33 1/4-5/16			C114/71
1671-06-02	34s 6d	33 1/4-5/16			C114/71
1671-06-05			35s 10d	33 1/16	C114/71
1671-06-06	34s 5d	33 1/3			C114/71
1671-06-09	34s 4d	33 1/4			C114/71
1671-06-09	34s 3-4d	33 1/3	35s 9d	33 1/8-3/16	C114/71
1671-06-13				33 1/3	C114/71
1671-06-16	34s 3d			33 1/3	C114/71
1671-06-16	34s 4d	33 1/3	35s 8 1/2d	33 1/4	C114/71
1671-06-20	34s 3d	33 3/8			C114/71
1671-06-20	34s 2d				C109/20
1671-06-23			35s 9-9 1/2d		C114/71
1671-06-23	34s 3d	33 3/8			C114/78
1671-06-23		33 1/3			C114/78
1671-06-27	34s 3d				C114/78
1671-06-27	34s 2-3d	33 1/3			C114/78
1671-06-30	34s 1-2d	33 1/4			C114/78
1671-06-30	34s 2-3d				C114/78
1671-06-30	34s 2d				C114/78
1671-06-30	34s 3d				C114/78

1671-06-31			35s 10 1/2d		C114/78
1671-07-02			35s 9 1/2-10d	33 1/4	C114/78
1671-07-04	34s 2d	33 1/4			C114/78
1671-07-07			35s 9 1/2-10d	33 1/4	L-156
1671-07-07	34s 2d	33 1/4			C114/78
1671-07-07		33 1/3			C114/78
1671-07-11	34s 2-3d				C114/78
1671-07-11	34s 2d	33 1/3			C114/78
1671-07-11	34s 3d				C114/78
1671-07-11	34s 2d				C109/20
1671-07-14			35s 10d	33 1/8	C114/78
1671-07-17	34s 4d				C114/78
1671-07-18			35s 10 1/2-11d	33 3/16-1/4	L-158
1671-07-18	34s 3d	33 1/3			C114/78
1671-07-18	34s 4d	33 7/16			C114/78
1671-07-18	34s 4d				C109/20
1671-07-21	34s 4d	33 1/2-5/16	35s 11d		C114/78
1671-07-25	34s 4d	33 7/16			C114/78
1671-07-25		33 3/16			C114/78
1671-07-27	34s 3d	33 3/8			C114/78
1671-07-28	34s 4d				C109/20
1671-07-28		33 3/8			C114/78
1671-07-28	34s 4d	33 1/2	35s 10 1/2-11d	33 3/16-1/4	C114/78
1671-07-28	34s 5d	33 7/16	35s 11d	33 3 /16	C114/78
1671-07-29	34s 2d	33 1/4			C114/78
1671-08-01	34s 4d	33 1/3-3/8			C114/78
1671-08-01	34s 4-5d				C114/78
1671-08-04	34s 4d		35s 11d	33 3/8	C114/78
1671-08-08	34s 5d	33 3/16-1/4			C114/78
1671-08-11	34s 5-6d	33 1/4			C114/78
1671-08-11	34s 5d	33 1/4-5/8			C114/78
1671-08-15	34s 5d				C114/78
1671-08-15	34s 4-5d	33 1/4			C114/78
1671-08-15	34s 4d	33 3/16			C114/78
1671-08-18	34s 5-6d	33 1/8			C114/78
1671-08-21			35s 10d	33 1/4	C114/78
1671-08-22	34s 6d	33 3/16			C114/78
1671-08-22	34s 5-6d				C114/78
1671-08-22	34s 4d				C114/78
1671-08-22	34s 5d	33 1/8			C114/78
1671-08-26	34s 4d	33 1/8			C114/78
1671-08-28			35s 9-10d		C114/78
1671-08-29	34s 5d	33			C114/78
1671-09-01	34s 5d	32 15/16			C114/78
1671-09-01		33			C114/78
1671-09-02	34s 5d				C114/78
1671-09-03	34s 6d				C109/20
1671-09-05	34s 5d				C114/78
1671-09-05	34s 4-5d	32 15/16			C114/78
1671-09-08	34s 6d		35s 9d		C114/78
1671-09-11			35s 7 1/2-8d		C114/78

1671-09-11	34s 8d				C109/20
1671-09-12	34s 6d	32 15/16			C114/78
1671-09-12	34s 6-7d				C114/78
1671-09-14	34s 6d	32 15/16			C114/78
1671-09-18			35s 8d	32 13/16	C114/78
1671-09-19	34s 7d	32 15/16			C114/78
1671-09-19	34s 8d	33 1/16			C114/78
1671-09-19		33			C114/78
1671-09-22	34s 8d	33 1/16			C114/78
1671-09-22	34s 6d				C114/78
1671-09-25			35s 10d	32 13/16	C114/78
1671-09-26	34s 7d	33 1/16			C114/78
1671-09-26	34s 8d				C114/78
1671-09-29	34s 5d	33 1/16	35s 9d	32 3/4	C114/78
1671-09-30	34s 6d	33 1/8			C114/78
1671-10-02			35s 7-7 1/2d	32 3/4	C114/78
1671-10-03	34s 6d				C114/78
1671-10-03	34s 5d	33 1/8			C114/78
1671-10-06	34s 6d	33 1/8	35s 6-6 1/2d	33	C114/78
1671-10-06	34s 5d				C114/78
1671-10-09			35s 7d		C114/78
1671-10-10	34s 5d	33 1/8			C114/78
1671-10-13	34s 4d	33 1/8	35s 7d	32 15/16	C114/78
1671-10-13	34s 3-4d			32 15/16-33	C114/78
1671-10-17	34s 3d	33 1/8			C114/78
1671-10-20	34s 1-2d	33 3/16			C114/75
1671-10-20	34s 3d		35s 6 1/2-7d	32 15/16	C114/78
1671-10-20			35s 7d	32 15/16	C114/78
1671-10-23			35s 6-7d		C114/75
1671-10-24	34s 1d	33 1/8-3/16			C114/75
1671-10-24	34s 1-2d	33 1/16			C114/78
1671-10-24	34s 2-3d	33 1/8			C114/78
1671-10-27	34s 1-2d				C114/75
1671-10-27	34s 1d	33 1/8-3/16			C114/75
1671-10-27			35s 4d		C114/78
1671-10-31	34s 1-2d	33 1/8			C114/75
1671-11-03	34s 1-2d	33 1/16-1/8			C114/75
1671-11-03	34s 2d	33 1/8	35s 4-5d	32 7/8-15/16	C114/75
1671-11-04	34s 2d	33 1/8			C114/78
1671-11-10	34s 2d	33 1/8	35s 4d	32 15/16	C114/75
1671-11-10	34s 2-3d				C114/78
1671-11-13			35s 3 1/2d	32 15/16	C114/75
1671-11-13	34s 2d	33 1/8	35s 3-4d	32 7/8	C114/78
1671-11-14	34s 2d				C114/78
1671-11-17			35s 3-3 1/2d	32 15/16	C114/75
1671-11-18	34s 3d	33 1/8			C114/78
1671-11-20			35s 4d	32 7/8	C114/75
1671-11-23	34s 3d				C109/20
1671-11-24			35s 3-4d	32 15/16	C114/75
1671-11-24			35s 3d		C114/75
1671-11-24			35s 3 1/2d	32 7/8	C114/75

1671-11-24	34s 3-4d	33 1/8			C114/78
1671-11-27			35s 3 1/2d	32 15/16	C114/75
1671-11-27	34s 3d	33 1/16			C114/78
1671-11-28	34s 3d	33 1/16			C114/78
1671-11-28	34s 2d				C109/20
1671-12-01			35s 4d	32 15/16	C114/75
1671-12-01	34s 3-4d	33 1/8			C114/78
1671-12-01	34s 3d	33 1/16-1/8			C114/78
1671-12-05	34s 4d	33 1/8			C114/78
1671-12-05	34s 3-4d				C114/78
1671-12-08	34s 4d	33 3/16	35s 5 1/2-6d	32 15/16	C114/78
1671-12-12	34s 4d	33 1/4			C114/78
1671-12-15				32 15/16	C114/78
1671-12-15	34s 4d	33 1/8		32 7/8	C114/78
1671-12-18			35s 6-7d		C114/78
1671-12-19	34s 4d	33 1/4-7/16			C114/78
1671-12-19	34s 3d	33 1/4			C114/78
1671-12-21		33 1/4			C114/78
1671-12-22			35s 6-7d	33	C114/78
1671-12-22	34s 4d	33 1/4	35s 6d	32 15/16-33	C114/78
1671-12-25			35s 6d	33	C114/78
1671-12-29			35s 6-7d	32 1/8	C114/78
1671-12-29	34s 3d	33 1/3	35s 6d	33	C114/78
1672-01-01			35s 7d	33 1/8	C114/78
1672-01-05			35s 7-8d	33 1/8	C114/78
1672-01-05			35s 6-7d	33 3/16-1/4	C114/78
1672-01-08			35s 8d	33 1/16	C114/78
1672-01-08			35s 7 1/2d		C114/78
1672-01-08			35s 7d	33 1/8	C114/78
1672-01-12			35s 7d	33 3/16	C114/78
1672-01-12			35s 7 1/2-8d	33-33 1/16	C114/78
1672-01-12			35s 6d	32 7/8	C114/78
1672-01-12				32 7/8-15/16	C114/78
1672-01-15			35s 6-7d		C114/78
1672-01-15			35s 7-8d	33 1/16	C114/78
1672-01-16	34s 5d	33 1/8			C114/78
1672-01-19	34s 3-4d				C114/78
1672-01-20			35s 8-8 1/2d	33-33 1/16	L-179
1672-01-26	34s 3d	33 3/16			C114/78
1672-01-26		33 1/4			C114/78
1672-01-29			35s 8-8 1/2d	33-33 1/16	C114/78
1672-02-02	34s 3d				C114/78
1672-02-05			35s 7d		C114/78
1672-02-06	34s 4d	33 1/16			C114/78
1672-02-06	34s 5d				C114/78
1672-02-06	34s 4d				C109/20
1672-02-08			35s 6d	33	NEHA
1672-02-08	34s 3d	33 1/8			C114/78
1672-02-09			35s 6d	32 15/16	C114/78
1672-02-13	34s 3d	32 15/16			C114/78
1672-02-16	34s 6d				C114/78

1672-02-19			35s 6d	32 7/8	C114/78
1672-02-23	34s 5-6d	32 3/4			C114/78
1672-02-23	34s 6d	32 1/2			C114/78
1672-02-27	34s 6d				C114/78
1672-03-01	34s 7d	32 1/2-9/16	35s 6d	32 3/4	C114/78
1672-03-04			35s 6d	32 11/16	C114/78
1672-03-04				32 3/4	C114/78
1672-03-05	34s 8d	32 1/2			C114/78
1672-03-05	34s 9d		35s 7-8d		C114/78
1672-03-08	34s 9-10d		35s 6d	32 1/2	C114/78
1672-03-11	34s 10-11d	32 1/2			C114/78
1672-03-12	34s 8d	32 5/16			C114/78
1672-03-12	34s 9-10d	32 1/4			C114/78
1672-03-14			35s 5d	32 3/8	NEHA
1672-03-14	34s 8d	32 1/2			C114/78
1672-03-15	34s 8-9d				C114/78
1672-03-15	34s 8-10d	32 1/4	35s 5-5 1/2d	32 3/16-1/4	C114/78
1672-03-19	34s 4d	32 1/4			C114/78
1672-03-19	34s 4-5d	32 3/16			C114/78
1672-03-22	34s 2d	32 3/8-1/2			C114/75
1672-03-22	34s 3d	32 3/8			C114/75
1672-03-22	34s 3-4d	32 1/2			C114/75
1672-03-22			35s 4-5d	32 3/8	C114/78
1672-03-29	32s 7-8d	32 7/16-5/8			C114/75
1672-03-29	33s	32 5/8			C114/75
1672-03-29	32s 10d	32 9/16			C114/75
1672-03-29				32 1/16	C114/78
1672-04-01			34s-34s 2d	32 3/8-1/2	C114/78
1672-04-02	32s 10d	32 1/2			C114/75
1672-04-02	32s 11d-33s	32 5/16			C114/75
1672-04-02	32s 8d				C114/75
1672-04-05	32s 10d-33s	32 3/8			C114/75
1672-04-05	32s 11d	32 1/4			C114/75
1672-04-08			33s 2d	32 3/8	C114/75
1672-04-08			33s 1d		C114/75
1672-04-08	32s 10d				C109/19
1672-04-12	32s 10d-33s	32 5/16-3/8			C114/75
1672-04-12	33s 2d	32 5/8			C114/75
1672-04-12	32s 11d	32 3/8			C114/75
1672-04-15	32s 10d	32 1/3	33s 5-6d		C114/75
1672-04-22			33s 6d		C114/75
1672-04-23	33s	32 1/2			C114/75
1672-04-26	33s	32 1/2			C114/75
1672-04-26	32s 10d				C114/75
1672-04-29			33s 7-8d		C114/75
1672-04-29			33s 7d	32 3/16	C114/75
1672-04-29			33s 6-7d	32 1/8-3/16	C114/75
1672-04-30	33s	32 7/8			C114/75
1672-05-03	33s	32 1/2-9/16	33s 8d	32 3/8-1/2	C114/75
1672-05-03	32s 10d				C114/78
1672-05-03	32s 10d				C109/20

1672-05-09			33s 5-6d	32 3/8	NEHA
1672-05-10	33s	32 7/8			C114/75
1672-05-10	33s 1d	33			C114/75
1672-05-10	32s 9-10d	32 7/8-15/16			C114/75
1672-05-13			33s 7d		C114/75
1672-05-17	32s 10d		33s 5d	32 9/16	C114/75
1672-05-17	32s 9-10d	32 7/8	33s 6-7d		C114/75
1672-05-20			33s 7 1/2-8d	32 5/8	C114/75
1672-05-20			33s 6d	32 5/8-3/4	C114/75
1672-05-21	32s 9d	32 3/4			C114/75
1672-05-24		32 7/16-1/2			C114/75
1672-05-24		32 1/2			C114/75
1672-05-24	32s 9-10d	32 3/8			C114/75
1672-05-24	32s 9d	32 5/8	33s 7-7 1/2d	32 3/4	C114/75
1672-05-25			33s 6d		C114/75
1672-05-31	32s 9d		33s 7d	32 5/8	C114/75
1672-05-31				32 1/2	C114/75
1672-06-04	32s 9d	33 1/2			C114/75
1672-06-07	32s 6-8d	34 3/4-35	33s 6d	32 5/8	C114/75
1672-06-10			33s 7 1/2-8d	32 1/8	C114/75
1672-06-14		33 1/2	33s 7d	34	C114/75
1672-06-14		33 1/2-3/4			C114/75
1672-06-14	33s	33 3/4			C114/75
1672-06-21			37s	38s	L-195
1672-06-21	32s 8d	34 1/2			C114/75
1672-06-21	32s 6d	35			C114/75
1672-06-21	32s 9d		37s 6-7d	37 1/2	C114/75
1672-06-21	32s 9-10d		37s		C114/75
1672-06-24			40s	37s	L-196
1672-06-24			37s		C114/75
1672-06-28			38s-38s 6d	36 1/2-37	C114/75
1672-06-28	32s 9d				C109/20
1672-07-01			36s		C114/75
1672-07-02	32s 9-10d	33 1/2-3/4			C114/75
1672-07-02	32s 8d	33 3/4-7/8			C114/75
1672-07-05			35s	33	C114/75
1672-07-05	32s 9-10d	34	35s 6-8d	33 1/4	C114/75
1672-07-05	32s 10d-33s	33 3/4-34	35s 7d		C114/75
1672-07-08	32s 8d	34 1/4	35s 8d	33 1/4	C114/75
1672-07-08	32s 10d-33s	33 3/4-34			C114/75
1672-07-11			35s 6d	33 1/2	C114/75
1672-07-12	32s 9d	34			C114/75
1672-07-12	33s	34 1/4			C114/75
1672-07-15			35s 5-6d	33 1/2-3/4	C114/75
1672-07-15	32s 10d		35s		C114/75
1672-07-15	32s 9d	34 1/2			C114/78
1672-07-17	33s 2-3d	33 3/4			C114/75
1672-07-19			35s 1,3.4.5d	33 3/4	C114/75
1672-07-19			35s 4-8d	33 1/2-5/8	C114/75
1672-07-19	33s-33s 1d				C114/78
1672-07-23	33s	33 1/2			C114/78

1672-07-26			35s 6d	33 5/8	C114/75
1672-07-26	33s 1d	34			C114/78
1672-07-26	33s	33 3/4			C114/78
1672-07-26	33s-33s 1d	33 7/8			C114/78
1672-07-26	33s 1-2d				C109/20
1672-07-29	33s	33 3/4-34			C114/78
1672-08-02	32s 10-11d		35s 4-6d	33 5/8	C114/78
1672-08-02	32s 11d	33 3/4			C114/78
1672-08-02	32s 11d-33s				C114/78
1672-08-06	33s 1d	33 5/8			C114/78
1672-08-06	33s	33 3/4			C114/78
1672-08-12	32s 10d	33 5/8	35s 2d		C114/78
1672-08-12	33s		35s 3d	33 5/8	C114/78
1672-08-16	33s 1-2d	33 1/4			C114/75
1672-08-16	33s	33 1/3	35s 2d	33 3/8-1/4	C114/78
1672-08-19			34s 7d	33 3/8	C114/78
1672-08-19			34s 6-8d		C114/78
1672-08-20	33s 1d	33 1/8			C114/75
1672-08-23	33s 1d	33 1/8		33 1/4	C114/78
1672-08-23			34s 2-6d	33 1/4	C114/78
1672-08-24	33s 1d	33 1/8-3/16			C114/75
1672-08-30	33s	33			C114/75
1672-08-30		32 7/8-15/16			C114/75
1672-09-02			33s 8-9d	33 1/16	C114/75
1672-09-02			33s 9d	33	C114/78
1672-09-03	33s	32 3/4			C114/75
1672-09-06		32 11/16			L-210
1672-09-06	33s				C114/75
1672-09-09			33s 9d	32 7/8	C114/75
1672-09-09			34s	32 3/4	C114/75
1672-09-09			33s 10-11d	32 15/16	C114/75
1672-09-13	33s-33s 1d		33s 8-10d	32 7/8	C114/75
1672-09-16			34s	32 7/8	C114/75
1672-09-16				32 3/4	C114/75
1672-09-20	33s 5d	32 11/16			C114/75
1672-09-20		32 9/16			C114/75
1672-09-23			34s 4d	32 3/4	C114/75
1672-09-23			34s 2-3d		C114/75
1672-09-27	33s 7-8d	32 9/16			C114/75
1672-10-01	33s 8d	32 1/3-3/8			C114/75
1672-10-04	33s 6d	32 1/4-1/3			C114/75
1672-10-04	33s 8d	32 1/4	34s 2-3d	32 3/8-7/16	C114/75
1672-10-07			34s 2-3d	32 1/2	C114/75
1672-10-11			34s 3d		C114/75
1672-10-11			34s 4d		C114/75
1672-10-11	33s 8d	32 1/4	34s 2-3d	32 3/8	C114/75
1672-10-15	33s 8d	32 1/4			C114/75
1672-10-18	33s 6-7d				C114/75
1672-10-18	33s 6d	32 3/16			C114/75
1672-10-18	33s 7-8d	32 1/4	34s	32 1/8	C114/75
1672-10-21	33s 6d	32 1/4	34s 1-2d	32 1/8	C114/75

1672-10-25	33s 4d	32 7/8			C114/75
1672-10-25		32 7/8-33	34s	32 1/16	C114/75
1672-10-25	33s 4-5d				C109/19
1672-10-26	33s 6d	32 5/8			C114/75
1672-10-28			34s 1-2d	32 1/4	C114/75
1672-10-28			34s	32 1/8	C114/75
1672-10-28			33s 11d-34s		C114/75
1672-10-31	33s 2-3d	33 1/8			C114/75
1672-11-04	33s 1d	32 1/2	33s 10d	32 1/4	C114/75
1672-11-07	33s 3d				C114/75
1672-11-08	33s	32 5/8	33s 10d	32 3/16	C114/75
1672-11-08	33s 1-2d		33s 9-10d	32 3/8	C114/75
1672-11-11			33s 6d	32 3/8	C114/75
1672-11-11			33s 7-11d		C114/75
1672-11-15	33s 2d				C114/75
1672-11-18	33s 3d	32 1/3	33s 10d	32 1/4	C114/75
1672-11-22	33s 4-5d	32 7/8			C114/75
1672-11-25				32 1/4	C114/75
1672-11-25	33s 4d	32 3/8	33s 10d	32 3/8	C114/75
1672-11-29	33s 3-4d	32 1/4	33s 10d	32 3/8	C114/75
1672-11-29	33s 4d	32 5/16			C114/75
1672-12-02			33s 10-11d	32 1/8	C114/75
1672-12-02			33s 10d	32 1/4	C114/75
1672-12-06	33s 6d	32 1/4	33s 8d		C114/75
1672-12-09			34s		C114/75
1672-12-10	33s 6d	32 1/4			C114/75
1672-12-16			33s 11d-34s	32 1/8	C114/75
1672-12-20	33s 8d	32 1/4			C114/78
1672-12-23			33s 11d	32 1/8	C114/78
1672-12-23			33s 11d-34s	32 3/16	C114/78
1672-12-30	33s 8-9d		34s 1d	32 1/8	C114/78
1672-12-30	33s 9d				C114/78
1673-01-03	33s 9d	32 1/2	34s 4d	32 1/2	C114/78
1673-01-06			34s 3d		C114/78
1673-01-06			34s 1-2d	32 3/8	C114/78
1673-01-07	33s 9d	32 5/16			C114/78
1673-01-08			34s 2d	32 1/4	C114/78
1673-01-10			34s 2d	32 1/8	C114/78
1673-01-13			34s 2d		C114/78
1673-01-17			34s 2-3d	32 1/4-5/16	C114/78
1673-01-20	33s 8-9d	32 3/8			C114/75
1673-01-20			34s 1-2d	32 5/16	C114/78
1673-01-20			34s 3d		C114/78
1673-01-23	33s 9d	32 1/2			C114/75
1673-01-24			34s 3d	32 3/8	C114/78
1673-02-03			34s 3-4d		C114/78
1673-02-10			34s 2-3d		C114/78
1673-02-12			34s 2d	32 1/2	C114/78
1673-02-17	33s 6d	32 5/8			C114/75
1673-02-24			34s 1d		C114/78
1673-02-28	33s 4d				C114/78

1673-03-03	33s 4d	32 1/2			C114/78
1673-03-07	33 4d				C114/78
1673-03-07	33s 3-4d	32 5/8			C114/78
1673-03-07	33s 2-3d	32 5/8-11/16			C114/78
1673-03-14			34s		C114/78
1673-03-17	33s 2d	32 5/8-11/16	34s	32 1/2	C114/78
1673-03-21			34s	32 5/8	C114/78
1673-03-24	33s 1d		33s 10-11d	32 1/2	C114/78
1673-04-04	33s 2d				C109/20
1673-05-12			33s 10-11d	32 3/4	C114/71
1673-05-16	32s 8d		33s 11d-34s	32 13/16-7/8	C114/71
1673-05-30			34s 2-3d	33 1/16	C114/71
1673-06-02			34s 2d	33 1/16	C114/71
1673-09-04	33s 8d				C109/20
1673-10-13	32s 4d				C109/19
1673-10-27	31s				C109/19
1673-10-31	31s 3d				C109/19
1673-12-16	33s 7d				C109/20
1673-12-23	33s 8d	32 1/4			C114/78
1674-02-13	31s 8d				C109/23
1674-04-06	31s 10-11d				C109/19
1674-04-10	31s 6d-7d				C109/23
1674-06-04			33s 9d	34 3/4	NEHA
1674-07-07	30s 10d				C109/23
1674-07-16			33s 9 1/2d	34 9/16-5/8	NEHA
1674-07-23			33s 9d	34 5/8	NEHA
1674-07-31	31s 2d				C109/20
1674-08-06			33s 9 1/2d	34 5/8	NEHA
1674-08-20			34s	34 3/8	NEHA
1674-08-27			34s	34	NEHA
1674-08-31	31s 1-2d				C109/20
1674-09-03			34s 4-5d	33 7/8-15/16	NEHA
1674-09-10			34s 4d	33 7/8	NEHA
1674-09-18	31s 9d				C109/19
1674-09-24			34s 1-2d	34 1/8-3/16	NEHA
1674-10-01			34s 1d	34 1/8-3/16	NEHA
1674-10-08			34s 2d	34-34 1/8	NEHA
1674-10-13	31s 6d				C109/19
1674-10-22			34s 2 1/2d	34 1/2	NEHA
1674-10-29			34s 2 1/2d	34 1/2	NEHA
1674-11-05			34s 3d	34 1/4-3/8	NEHA
1674-11-06	31s 7d				C109/19
1674-11-12			34s 3-4d	34 3/4	NEHA
1674-11-20	31s 10-11d				C109/19
1674-11-23	31s 8d				C109/19
1674-11-30	31s 6-7d				C109/19
1674-12-08	31s 6d	34 1/2			C114/76
1674-12-08	31s 6-7d	34 9/16			C114/76
1674-12-11	31s 6-7d				C114/76
1674-12-15	31s 7-8d	34 9/16			C114/76
1674-12-15	31s 7d	34 7/16-5/8			C114/76

1674-12-15	31s 7d				C109/19
1674-12-22	31s 6-7d	34 5/8-11/16			C114/76
1674-12-22	31s 7d	34 5/8			C114/77
1674-12-25	31s 7d		34s 2d		C114/76
1674-12-28	31s 7d				C114/76
1674-12-29	31s 6-7d	34 1/2			C114/77
1675-01-01			34s 2 1/2d	34 1/2	C114/76
1675-01-01			34s 2d		C114/76
1675-01-01			34s 3d		C114/76
1675-01-04			34s 3-4d	34 1/2	C114/76
1675-01-08			34s 3-3 1/2d	34 9/16	C114/76
1675-01-08			34s 4d		C114/77
1675-01-11		34 3/8			C114/72
1675-01-11	31s 8d	34 5/8			C114/76
1675-01-11	31s 5-6d	34 15/16			C114/77
1675-01-12	31s 8d				C109/19
1675-01-15	31s 7d	34 7/8	34s 3d		C114/76
1675-01-15			34s 3 1/2d		C114/76
1675-01-18			34s 3 1/2d	34 1/2-9/16	C114/76
1675-01-18			34s 3-3 1/2d		C114/76
1675-01-18			34s 4-5d		C114/76
1675-01-22			34s 4-4 1/2d	34 11/16-3/4	C114/76
1675-01-22			34s 4 1/2-5d	34 5/8	C114/76
1675-01-22	31s 4-5d	34 7/8-15/16			C114/77
1675-01-22		34 15/16			C114/77
1675-01-29			34s 5d	34 3/4	C114/76
1675-01-29	31s 7-8d	34 3/4			C114/77
1675-01-29	31s 4-5d	34 13/16			C114/77
1675-02-01			34s 4-5d	34 3/4	C114/76
1675-02-01	31s 6-7d	34 3/4	34s 4d	34 5/8	C114/77
1675-02-01			34s 4-4 1/2d	34 3/4	C114/77
1675-02-05	31s 6-7d	34 3/4			C114/77
1675-02-05	31s 7d	34 5/8			C114/77
1675-02-08			34s 5d		C114/77
1675-02-09	31s 7d	34 9/16			C114/77
1675-02-09	31s 8d	34 5/8			C114/77
1675-02-12	31s 8-9d	34 9/16	34s 4d	34 5/8-11/16	C114/77
1675-02-12	31s 9-10d	34 5/8	34s 5d	34 9/16-5/8	C114/77
1675-02-12	31s 11d-32s				C114/77
1675-02-15			34s 5d	34 11/16	C114/77
1675-02-15	31s 8d	34 5/8	34s 8d	34 9/16	C114/77
1675-02-19	31s 10d	34 5/8	34s 8d		C114/77
1675-02-23	31s 8-9d	34 5/8			C114/77
1675-02-23	31s 11d	34 5/8-11/16			C114/77
1675-02-26	31s 10d	34 1/2	34s 7d	34 7/16-1/2	C114/77
1675-02-26	32s				C114/77
1675-03-01			34s 7-8d	34 1/2	C114/77
1675-03-05	31s 10-11d	34 1/2	34s 7d	34 3/8	C114/77
1675-03-08	32s 1d	34 1/2			C114/77
1675-03-12			34s 7d	34 3/8	C114/77
1675-03-12			34s 6-7d	34 1/2-9/16	C114/77

1675-03-12		34 1/2	34s 7-8d		C114/77
1675-03-15			34s 7-7 1/2d	34 1/2	C114/77
1675-03-16	32s 1-2d	34 7/16-1/2			C114/77
1675-03-19	32s 1d	34 7/16-1/2	34s 7d		C114/77
1675-03-19	32s	34 1/2			C114/77
1675-03-22			34s 7 1/2-7d		C114/77
1675-03-23	32s 1d	34 7/16-1/2			C114/77
1675-03-26			34s 6d		C114/77
1675-03-26			34s 6-7d		C114/77
1675-03-29	32s	34 7/16	34s 6-6 1/2d	34 3/8	C114/77
1675-03-30	32s 1d	34 7/16			C114/77
1675-04-01			34s 6 1/2d	34 5/16	C114/77
1675-04-02	32s 1-2d	34 1/2	34s 6 1/2-7d	34 5/16	C114/77
1675-04-02	32s 1d	34 7/16			C114/77
1675-04-05			34s 6 1/2d	34 5/16	C114/77
1675-04-09	32s 1d	34 9/16	34s 6-7d	34 3/8	C114/77
1675-04-09	32s 2d		34s 7d	34 5/16-3/8	C114/77
1675-04-09			34s 7d	34 3/8	C114/77
1675-04-16	32s 10d	34 5/8	34s 6 1/2-7 1/2d	34 3/8-7/16	C114/77
1675-04-16	32s				C114/77
1675-04-16	31s 11d	34 5/8			C114/77
1675-04-17	31s 11d-32s	34 5/8-11/16			C114/77
1675-04-19			34s 7 1/2d		C114/77
1675-04-20	31s 10d	34 5/8			C114/77
1675-04-23	31s 9d	34 5/8-11/16			C114/77
1675-04-23	31s 10d				C114/77
1675-04-26			34s 8 1/2d		C114/77
1675-04-27	32s 1d	34 5/8			C114/77
1675-04-27		34 5/8-11/16			C114/77
1675-04-30			34s 9 1/2-10d		C114/77
1675-04-30			34s 9-9 1/2d	34 9/16-5/8	C114/77
1675-04-30			34s 9d	34 9/16	C114/77
1675-05-04	32s 4d	34 5/8			C114/77
1675-05-07	32s 2-3d	34 5/8	34s 11d		C114/77
1675-05-07	32s 2d				C114/77
1675-05-17			34s 10d	34 1/2	C114/77
1675-05-18	32s 4d				L-235
1675-05-18	32s 3d	34 3/4			C114/77
1675-05-18	32s 4-5d	34 5/8			C114/77
1675-05-18	32s 3d	34 5/8-11/16			C114/77
1675-05-21			34s 10d	34 1/2	C114/77
1675-05-28	32s 3-4d	34 7/8			C114/72
1675-05-28	32s 4d				C114/72
1675-05-31			34s 10d		C114/77
1675-05-31	32s				C109/19
1675-06-01	31s 11d-32s	34 7/8			C114/72
1675-06-04	32s 1d	34 13/16			C114/72
1675-06-04	32s				C114/72
1675-06-07			34s 9-10d	34 11/16	C114/72
1675-06-08	31s 11d-32s	34 3/4-13/16			C114/72
1675-06-11	32s	34 3/4	34s 9-10d	34 11/16-3/4	C114/72

1675-06-11			34s 9d	34 11/16	C114/72
1675-06-18			34s 10d		C114/72
1675-06-21	32s 1d	34 3/4			C114/77
1675-06-22	32s 1-2d	34 3/4			C114/77
1675-06-22	32s				C114/77
1675-06-25	32s	34 3/4			C114/77
1675-06-25	32s 1d	34 3/4-13/16			C114/77
1675-06-28			34s 10d		C114/77
1675-06-29	32s 1-2d	34 13/16			C114/77
1675-07-05			34s 10d	34 5/8	C114/77
1675-07-05			34s 11d		C114/77
1675-07-06	32s 2d	34 3/4			C114/77
1675-07-06	32s 2-3d	34 3/4-11/16			C114/77
1675-07-09	32s 1-2d	34 11/16	35s	34 5/8	C114/77
1675-07-13	32s 2-3d	34 5/8-11/16			C114/77
1675-07-13	32s 3d	34 11/16			C114/77
1675-07-16			35s-34s 11 1/2d	34 5/8	C114/76
1675-07-16	32s 3d	34 11/16			C114/77
1675-07-16	32s 2d	34 5/8			C114/77
1675-07-19			35s	34 5/8	C114/77
1675-07-20	32s 3-4d	34 5/8			C114/77
1675-07-23	32s 2-3d	34 5/8-11/16			C114/76
1675-07-27	32s 2-3d	34 5/8-11/16			C114/76
1675-07-30			35s 1d	34 5/8	C114/76
1675-08-03	32s 4d	34 5/8			C114/76
1675-08-06			35s 1d	34 1/2	C114/76
1675-08-09			35s 1d		C114/76
1675-08-10	32s 3-4d	34 5/8			C114/76
1675-08-10	32s 4d				C114/76
1675-08-13	32s 4d				C114/76
1675-08-13	32s 5d	34 9/16			C114/76
1675-08-17	32s 3-4d	34 1/2			C114/76
1675-08-17	32s 4d	34 9/16			C114/76
1675-08-20	32s 5d		35s 1d	34 1/2	C114/76
1675-08-23			35s	34 1/4-5/16	C114/76
1675-08-24	32s 5d	34 3/8			C114/76
1675-08-24	32s 5d				C109/23
1675-08-27	32s 6d	34 5/16			C114/76
1675-08-27	32s 6d	34 3/8-7/16			C114/76
1675-08-30			35s 1d		C114/76
1675-08-31	32s 6-7d	34 3/8			C114/76
1675-08-31	32s 7d	34 5/16-3/8			C114/76
1675-09-03	32s 7d	34 1/4	35s 1d	34 1/4	C114/76
1675-09-06	32s 7d	34 3/8			C114/76
1675-09-07	32s 7-8d	34 3/8			C114/76
1675-09-13	32s 7d	34 3/8	35s 1-2d		C114/76
1675-09-13			35s 2 1/2d		C114/76
1675-09-14	32s 6-7d	34 3/8			C114/76
1675-09-14	32s 7d	34 7/16			C114/76
1675-09-17	32s 6-7d	34 1/2			C114/76
1675-09-20			35s 2d	34 3/8	C114/76

1675-09-24	32s 6d	34 1/2			C114/76
1675-09-24	32s 6-7d	34 1/2	35s 2d	34 1/4	C114/76
1675-09-27			35s 2 1/2d		C114/76
1675-09-28	32s 6d				C114/76
1675-09-28	32s 6-7d	34 1/2			C114/76
1675-10-01	32s 6-7d	34 9/16			C114/76
1675-10-04			35s 3 1/2d	34 3/8	C114/76
1675-10-05	32 7d	34 5/8			C114/76
1675-10-08	32s 6d				C109/23
1675-10-12	32s 6d	34 1/4			C114/76
1675-10-12	32 7d	34s 5/8-11/16			C114/76
1675-10-14			35s 1d	34 7/16	NEHA
1675-10-19	32s 7d	34 9/16			C114/72
1675-10-19	32s 8d	34 1/2			C114/72
1675-10-22	32s 7-8d	34 9/16			C114/72
1675-10-22	32s 7d				C114/72
1675-10-26	32s 8d	34 1/2			C114/72
1675-10-26		34 7/16-1/2			C114/72
1675-10-29			35s 1 1/2d	34 9/16	C114/76
1675-11-01	32s 7-8d				C114/72
1675-11-09	32s 9d	34 3/8			C114/72
1675-11-12	32s 9-10d	34 1/4			C114/72
1675-11-12	32s 9d	34 3/8			C114/72
1675-11-14	33s 1d	34 5/16			C114/72
1675-11-15	33s	34s 3/8			C114/69
1675-11-16	32s 11d	34 3/8			C114/72
1675-11-19			35s 2d		C114/72
1675-11-22			35s 3d		C114/72
1675-11-23	33s 1d	34 1/4			C114/72
1675-11-26	32s 11d	34 1/8			C114/72
1675-11-26		34 5/16			C114/72
1675-11-26	33s 1d	34 3/16			C114/72
1675-11-29	33s	34 1/8	35s 3-4d	34 1/16	C114/72
1675-11-30	32s 9-10d	34 3/16			C114/72
1675-12-01	33s	34 3/16-1/4			C114/72
1675-12-03	33s	34 5/16			C114/72
1675-12-03	32s 10-11d	34 1/4	35s 3d		C114/72
1675-12-06	32s 11d				C109/23
1675-12-10			35s 3d	34	C114/69
1675-12-10	32s 11d	34 5/16			C114/72
1675-12-10			35s 3-3 1/2d	34	C114/76
1675-12-13	32s 1d				L-263
1675-12-13	33s 1-2d				C114/72
1675-12-14		34 1/3			L-264
1675-12-14	33s 1d	34 1/4-5/16			C114/72
1675-12-17	33s 7-8d	34 3/8			C114/69
1675-12-20	33s 6d				C114/69
1675-12-24			35s 8d	34 1/8	C114/69
1675-12-31	33s 1d	34s 9/16			C114/69
1676-01-10	33s 2d	34 1/2			C114/69
1676-01-11	33s 2d	34 3/8			L-267

1676-01-11	33s 1-2d	34 1/2			C114/69
1676-01-14		34 1/2-5/8			C114/69
1676-01-14		34 9/16			C114/69
1676-01-14	33s 2d	34 1/2			C114/69
1676-01-18	33s 3d	34s 1/2			C114/69
1676-01-18	33s 2d				C109/23
1676-01-21	33s 2d	34 5/8			C114/76
1676-01-25	33s 1d	34 5/8			C114/76
1676-02-01	33s 2d	34 1/2-9/16			C114/76
1676-02-04	33s 1d	34 1/2			C114/73
1676-02-04			35s 6d	34 1/2	C114/76
1676-02-11	33s 3d	34 1/2			C114/73
1676-02-11			35s 7d	34 3/8	C114/76
1676-02-15	32s 11d	34 1/2			C114/76
1676-02-18	32s 11d	34 7/16			C114/76
1676-02-22	33s	34 7/16			C114/73
1676-02-25	33s 2d	34s 1/8-3/8			C114/73
1676-02-25	33s 3-4d	34 1/4			C114/73
1676-02-29	33s 1-2d	34 3/8			C114/73
1676-03-03			35s 8-9d	34 3/8-7/16	C114/73
1676-03-05	32s 4d	34 1/2			C114/73
1676-03-07	33s 2d	34 5/16			C114/73
1676-03-10	33s 3-4d	34 1/4			C114/76
1676-03-14	33s 3-4d	34 1/4-5/16			C114/73
1676-03-17			35s 8-8 1/2d	34 7/16-1/2	C114/76
1676-03-20			35s 9d	34 1/4-5/16	L-280
1676-03-20			35s 8d		C114/73
1676-03-20	33s 3d	34 1/4			C114/76
1676-03-21	33s 2-3d	34 1/4-5/16			C114/73
1676-03-21		34 1/4			C114/73
1676-03-24	33s 2-3d	34 1/4-5/16	35s 8d	34 3/16	C114/76
1676-03-31	33s 3d	34 1/4			C114/76
1676-03-31	33s 3d				C109/23
1676-04-03			35s 7-8d		C114/73
1676-04-04	33s 2-3d	34 5/16			C114/76
1676-04-04	33s 3-4d	34 1/4			C114/76
1676-04-07	33s 2-3d	34 5/16			C114/76
1676-04-07	33s 3d				C109/23
1676-04-11	33s 3d	34 5/16			C114/73
1676-04-14	33s 3d	34 5/16			C114/73
1676-04-14	33s 2d				C114/76
1676-04-18	33s 2d				C114/76
1676-04-20			35s 9d	34 1/4	NEHA
1676-04-21	33s 2d				C109/23
1676-04-25	33s 2-3d	34 3/8			C114/73
1676-04-25	33s 2d				C114/73
1676-04-28	33s 4d				C109/23
1676-05-01			35s 8 1/2d	34 1/4	C114/73
1676-05-02	33s 4d	34 3/8			C114/73
1676-05-05			35s 8-9d	34 3/8-7/16	C114/76
1676-05-05	33s 4d				C109/23

1676-05-08			35s 8d	34 5/16	C114/73
1676-05-09	33s 4d	34 3/8-7/16			C114/73
1676-05-12	33s 4d	34 5/16-3/8			C114/73
1676-05-12			35s 9-9 1/2d	34 3/8-7/16	C114/76
1676-05-20			35s 9d	34 1/4	C114/73
1676-05-22			35s 10d	34 3/8	C114/76
1676-05-26			35s 10 1/2-11d	34 3/8	C114/73
1676-06-02	33s 3d	33 15/16-34			C114/76
1676-06-02	33s 3-4d				C109/23
1676-06-07	33s 5-6d				C109/23
1676-06-09	33 5d	34 1/8	35s 9-9 1/2d		C114/76
1676-06-10	33s 5-6d				L-292
1676-06-10	33s 5d	34 1/8			C114/76
1676-06-13	33s 10d				C114/76
1676-06-13	33s 7d	34 1/8			C114/76
1676-06-16	33s 6-7d	34 1/8-7/16			C114/76
1676-06-16	33s 8d	34 1/8			C114/76
1676-06-16	33s 7-8d				C109/23
1676-06-19	33s 8d	34 1/8			C114/76
1676-06-20	33s 9d	34 1/8			C114/76
1676-06-23	33s 9d				C114/76
1676-06-23	33s 9-10d				C109/23
1676-06-27	33s 9-10d				C109/23
1676-06-27	33s 10d	33 15/16-34			C114/76
1676-06-30	33s 11d	33 7/8-15/16			C114/76
1676-05-01			35s 8 1/2d	34 1/4	C114/73
1676-05-02	33s 4d	34 3/8			C114/73
1676-07-04	34s 1d	33 13/16-7/8			C114/76
1676-07-08	34s 4d	33 11/16			C114/72
1676-07-11	34s 2-3d	33 13/16-7/8			C114/76
1676-07-17			36s 2d		C114/76
1676-07-21	34s 2d	33 15/16			C114/72
1676-07-21	34s 3d				C114/72
1676-07-28	34s 2d	33 13/16-7/8			C114/72
1676-08-04	34s 4d	33 11/16-3/4			C114/72
1676-08-07			36s		C114/72
1676-08-08	34s 4d	33 3/4			C114/72
1676-08-14			36s 3d	33 3/4	C114/72
1676-08-15	34s 3-4d	33 5/8			C114/76
1676-08-18	34s 5d	33 13/16			C114/76
1676-08-21			36s 3d	33 11/16-5/8	C114/72
1676-08-21			36s 2d	33 11/16	C114/72
1676-08-24			36s 2 1/2-3d	33 3/8	C114/72
1676-08-25	34s 4d	34			C114/76
1676-08-25	34s 4-5d	33 15/16			C114/76
1676-08-28			36s 2d	33 3/4-13/16	C114/76
1676-08-29	34s 2-3d	33 15/16			C114/76
1676-09-01	34s 2d	34 1/16-1/8			C114/76
1676-09-04			36s 2 1/2d		C114/76
1676-09-05	34s 3d	34 1/8-3/16			C114/76
1676-09-05	34s 2-3d				C109/23

1676-09-12	34s 4d				C109/23
1676-09-12	34s 3-4d	34 3/16-1/4			C114/76
1676-09-13	34s 3d				C109/23
1676-09-15	34s 4d	34 1/8			C114/76
1676-09-22	34s 4d	33 7/8			C114/69
1676-09-22		34 1/16	36s 4d	34 1/16	C114/73
1676-09-24			36s 4d	33 7/8	C114/73
1676-09-26	34s 4d	33 13/16			C114/73
1676-09-26	34s 4d				C109/23
1676-10-03	34s 3d	33 3/4			C114/73
1676-10-06	34s 3d	33 3/4			C114/69
1676-10-08	34s 3d	33 11/16			C114/69
1676-10-10	34s 3d	33 11/16			L-315
1676-10-10	34s 3d				C109/23
1676-10-10				33 9/16	Posthumus
1676-10-13	34s 3-4d	33 5/8-11/16			C114/69
1676-10-13	34s 4d		36s 2 1/2d	33 3/4	C114/73
1676-10-16			36s 2-2 1/2d		C114/73
1676-10-20	34s 3-4d	33 11/16			C114/69
1676-10-20	34s 4d	33 5/8			C114/73
1676-10-27	34s 4d	33 5/8	36s 2-2 1/2d		C114/73
1676-10-30			36s 2 1/2d	33 1/2	C114/69
1676-10-31	34s 5d	33 5/8			C114/73
1676-10-31	34s 3-4d				C114/73
1676-11-03	34s 6-7d	33 5/8			C114/73
1676-11-03	34s 5d	33 9/16			C114/73
1676-11-06			36s 2 1/2d	33 5/8	C114/73
1676-11-06			36s 2 1/2-3d	33 1/2	C114/73
1676-11-14	34s 7d	33 5/8			C114/76
1676-11-20			36s 3 1/2-4d	32 1/2	C114/73
1676-11-21	34s 8d	33 5/8			C114/76
1676-11-24			36s 3-4d	33 9/16	C114/73
1676-11-24	34s 7-8d	33 5/8-11/16			C114/76
1676-11-28	34s 8d	33 5/8			C114/77
1676-12-01	34s 8d	33 9/16-5/8			C114/77
1676-12-05	34s 8d	33 9/16			C114/77
1676-12-08	34s 8d	33 9/16			C114/77
1676-12-12	34s 8d	33 9/16			C114/76
1676-12-12	34s 8d				C109/23
1676-12-15			36s 6 1/2d	33 9/16	C114/76
1676-12-18			36s 6-6 1/2d		C114/77
1676-12-19	34s 9d	33 9/16			C114/77
1676-12-29			36s 6d	33 1/2	C114/77
1677-01-01			36s 6d	33 9/16	C114/76
1677-01-12			36s 4 1/2-5d	33 1/2-7/16	C114/77
1677-01-19	34s 4-5d	33 9/16			C114/77
1677-01-19	34s 4d				C109/23
1677-01-23	34s 7d	33 11/16			C114/73
1677-01-23	34s 6d	33 11/16			C114/77
1677-01-26	34s 8d	33 5/8			C114/73
1677-01-26			36s 4-5d	33 3/8	C114/77

1677-01-28				33 3/8	Posthumus
1677-01-29			36s 3-4d	33 3/4	C114/77
1677-01-30	34s 6-7d	33 9/16			C114/77
1677-02-01			36s 3d	33 7/16	NEHA
1677-02-05	34s 8d				C114/77
1677-02-06	34s 7-8d	33 9/16			C114/77
1677-02-07	34s 8d	33 5/8			C114/72
1677-02-12			36s 3d		C114/77
1677-02-13	34s 6d	33 1/2-9/16			C114/72
1677-02-16	34s 7d	33 9/16			C114/72
1677-02-16	34s 5-6d	33 1/2-9/16			C114/72
1677-02-18				33 7/16	Posthumus
1677-02-19	34s 6-7d	33 9/16			C114/72
1677-02-20	34s 7d	33 1/2-9/16			C114/72
1677-02-23	34s 7d	33 7/16-1/2			C114/72
1677-02-23			36s 2d	33 7/16	C114/77
1677-02-27	34s 8d				C114/72
1677-02-27	34s 7d	33 1/2			C114/72
1677-03-02	34s 7-8d	33 1/2			C114/72
1677-03-02	34s 8d				C114/72
1677-03-05	34s 9d	33 5/16			C114/77
1677-03-06	34s 7-8d	33 1/2-9/16			C114/72
1677-03-06	34s 7d				C109/19
1677-03-09			36s 1-3d	33 7/16	C114/72
1677-03-13	34s 8d	33 7/16			C114/77
1677-03-16	34s 7-8d	33 7/16-1/2			C114/77
1677-03-18				33 7/16	Posthumus
1677-03-20	34s 8d				C109/19
1677-03-23	34s 8d	33 1/3	36s 2d	33 5/16-1/2	C114/77
1677-03-30	34s 8d	33 1/4			C114/77
1677-04-03	34s 9d	33 1/4			C114/77
1677-04-06	34s 9d				C114/77
1677-04-09				33 1/8-3/16	L-341
1677-04-09			36s 2 1/2d	33 3/16-1/4	C114/77
1677-04-10	34s 9d	33 3/16-1/4			C114/77
1677-04-12			36s 2-3d	33 5/8	NEHA
1677-04-17			36s 2 1/2d	33 3/16-1/4	C114/72
1677-04-19			36s 2-3d	33 1/8-3/16	C114/77
1677-04-20	34s 8-9d	33 1/4	36s 2 1/2-3d	33 1/8	C114/77
1677-04-20	34s 8d	33 1/4-5/16			C114/77
1677-04-20	34s 8d				C109/19
1677-04-30	34s 9d	33 1/4			C114/77
1677-05-04	34s 8d				C114/77
1677-05-07			36s	33 1/8	C114/77
1677-05-08	34s 8-9d				C114/77
1677-05-15	34s 8d	33 1/4			C114/77
1677-05-21			36s 1/2-1d		C114/77
1677-05-22	34s 8d				C114/72
1677-05-25	34s 9d	33 1/4			C114/72
1677-05-29	34s 8-9d				C114/72
1677-06-01	34s 8-9d	33 3/16			C114/72

1677-06-01		33 1/8-3/16			C114/72
1677-06-08	34s 8-9d	33 3/16	36s	33 1/16	C114/72
1677-06-12	34s 9d	33 1/8-3/16			C114/72
1677-06-15	34s 8-9d	33 1/8			C114/72
1677-06-17	34s 8d	33 1/16			C114/76
1677-06-22	34s 8d	33 1/16			C114/76
1677-06-26	34s 8-9d	33 1/16			C114/76
1677-06-29	34s 8d				C114/76
1677-07-02			35s 11d	32 15/16	C114/72
1677-07-03	34s 9d	33 1/16			C114/76
1677-07-06	34s 9d	33 1/8			C114/76
1677-07-09	34s 8-9d	33 1/16			C114/76
1677-07-10	34s 8d	33 1/16			C114/76
1677-07-13			35s 11 1/2d-36s	32 15/16	C114/76
1677-07-15			35s 11d		C114/78
1677-07-16	34s 8-9d	33 1/16-1/8			C114/76
1677-07-17	34s 9d	33 1/8			C114/76
1677-07-18	34s 9-10d	33 1/8			C114/76
1677-07-20	34s 9d	33 1/8			C114/78
1677-07-20	34s 9d				C109/19
1677-07-22			35s 11d		C114/78
1677-07-22				33	Posthumus
1677-07-23			36s 1d		C114/76
1677-07-24	34s 9d	33 3/16-1/4			C114/78
1677-08-03	34s 9-10d	33 1/4			C114/78
1677-08-03	34s 8-9d				C114/78
1677-08-06			36s 2d		C114/78
1677-08-07	34s 9d	33 1/3			C114/78
1677-08-09	34s 9-10d				C114/78
1677-08-10	34s 8-9d	33 3/8-7/16	36s 1-1 1/2d	33 3/16-1/4	C114/78
1677-08-12	34s 9d	33 1/8			C114/78
1677-08-14	34s 8d	33 3/8-1/2			C114/78
1677-08-24	34s 9d	33 1/4			C114/77
1677-08-24		33 1/3			C114/77
1677-08-24	34s 8d				C109/19
1677-08-27			36s 1d		C114/78
1677-08-28	34s 9d	34 1/4			C114/77
1677-08-31	34s 8 1/2d	34 1/4			C114/77
1677-08-31			36s 1d	33 1/4-5/16	C114/78
1677-09-03			36s		C114/77
1677-09-04	34s 8d	34 1/8			C114/77
1677-09-07	34s 7d	33 3/16			C114/77
1677-09-10			35s 11d-36s	33 1/8	C114/77
1677-09-11	34s 8d	33 1/8			C114/77
1677-09-14			35s 11d		C114/77
1677-09-17			35s 10 1/2d	33	C114/77
1677-09-17			35s 11d		C114/77
1677-09-18	34s 7d	33 3/8			C114/77
1677-09-18	34s 8d	33 1/8			C114/77
1677-09-21	34s 7d				C114/76
1677-09-21	34s 7-8d	33 1/3			C114/76

1677-09-25	34s 7d	33 3/8			C114/76
1677-10-02	34s 7-8d	33 3/8			C114/76
1677-10-05	34s 7d	33 1/3			C114/76
1677-10-05	34s 7-8d	33 3/8			C114/76
1677-10-09	34s 7d	33 3/8			C114/76
1677-10-12	34s 7d	33 3/8	35s 11d		C114/76
1677-10-12		33 1/3-3/8			C114/76
1677-10-16	34s 7 1/2d	33 3/8			C114/76
1677-10-19	34s 8d	33 3/8			C114/76
1677-10-19	34s 7d	33 1/3			C114/76
1677-10-19	34s 8-9d				C114/78
1677-10-23	34s 7-8d	33 1/4			C114/78
1677-11-02	34s 7d	33 1/4-1/3	35s 9 1/2d		C114/78
1677-11-03	34s 8d	33 1/4			C114/78
1677-11-07	34s 7d	33 5/16			C114/78
1677-11-09	34s 7d	33 1/4-5/16			C114/78
1677-11-09	34s 6d	33 1/4			C114/78
1677-11-13	34s 5-6d	33 5/16			C114/78
1677-11-13	34s 7d	33 3/16			C114/78
1677-11-19	34s 6d	33 1/16			C114/78
1677-11-19	34s 6d	33 1/8			C114/78
1677-11-20	34s 6d	33 1/16			C114/76
1677-11-20	34s 6d	33			C114/76
1677-11-23	34s 6d	33			C114/76
1677-11-27	34s 6d	32 7/8			C114/76
1677-11-30	34s 5d	32 15/16			C114/76
1677-11-30		32 7/8			C114/76
1677-12-04	34s 5d	32 7/8			C114/76
1677-12-07	34s 5-6d	32 5/8			C114/76
1677-12-07	34s 4-5d	32 15/16			C114/76
1677-12-10			35s 6 1/2-7d		C114/76
1677-12-11	34s 4-5d	33 1/8			C114/76
1677-12-14	34s 4d	33 1/16			C114/76
1677-12-14	34s 3-4d		35s 7d		C114/76
1677-12-17			35s 7d		C114/71
1677-12-17			35s 6 1/2d	32 13/16	C114/76
1677-12-18	34s 2-3d				C114/76
1677-12-18	34s 3d				C109/19
1677-12-21	34s 2-3d	33 1/3	35s 7-7 1/2d		C114/76
1677-12-21	34s 3-4d	33 3/8			C114/76
1677-12-24			35s 8d		C114/76
1677-12-25	34s 3d	33 1/3			C114/76
1677-12-28	34s 3d	33 3/8	35s 7-8d	33 1/8	C114/76
1678-01-01	34s 2d	33 1/3			C114/76
1678-01-04	34s 2-3d			33 1/4	C114/76
1678-01-07			35s 9d		C114/76
1678-01-09			35s 8-9d		C114/76
1678-01-11			35s 9d		C114/72
1678-01-15	34s 2d				L-381
1678-01-15	34s 2-3d	33 1/3			C114/72
1678-01-18	34s				C114/72

1678-01-18			35s 7d	33 3/8	C114/76
1678-01-21			35s 6-6 1/2d		C114/76
1678-01-21				33 1/4	Posthumus
1678-01-22	34s	33 3/8			C114/72
1678-01-25	34s	33 7/16			C114/72
1678-01-25	33s 10d-34s				C114/76
1678-01-28			35s 6d		C114/72
1678-01-29	33s 7-8d	33 7/16			C114/72
1678-02-01	33s 4-5d	33 1/2			C114/72
1678-02-01	33s 10-11d				C114/77
1678-02-05	33s 4d	33 1/2			C114/72
1678-02-08	33s 4d				C114/72
1678-02-08	33s 3-4d	33 1/2-9/16			C114/77
1678-02-11			34s 10-11d		C114/72
1678-02-12	33s				C114/77
1678-02-15			34s 4d	33 1/4	C114/72
1678-02-19	32s 6d	33 5/8			C114/72
1678-02-19	32s 5-6d	33 1/2-5/8			C114/72
1678-02-19	32s 6-7d				C114/77
1678-02-22			34s 4-5d		C114/71
1678-02-22			34s 5d	33 7/16	C114/72
1678-02-22			34s 5 1/2d		C114/72
1678-02-26	32s -32s 2d				L-388
1678-02-26	32s 1-2d	33 1/2			C114/77
1678-02-26	32s-32s 1d				C114/77
1678-02-26	32s 2d				C114/77
1678-02-26	32s-32s 1d				C109/19
1678-02-28	32s 1d	33 7/16			C114/78
1678-03-01	32s 2d	33 1/2			C114/77
1678-03-05	32s 7-8d				C114/73
1678-03-05	32s 5-6d	33 7/16			C114/73
1678-03-08	32s 7-8d				C114/73
1678-03-11			34s 1-2d		C114/77
1678-03-12	32s 6-10d	33 1/3-3/8			C114/73
1678-03-15			34s 2d	33 3/8	C114/77
1678-03-19	32s 8d	33 1/3-3/8			C114/73
1678-03-19	32s 8-9d	33 1/3			C114/73
1678-03-22	32s 8d	33 1/3			C114/71
1678-03-22	32s 7d				C109/19
1678-03-26	32s 7d	33 1/3			C114/71
1678-03-29			33s 10-11d		C114/73
1678-04-05	32s 6-7d	33 1/4			C114/71
1678-04-05	32s 7-8d				C114/71
1678-04-15			33s 10d		C114/71
1678-04-16	32s 6-6 1/2d				C114/71
1678-04-23	32s 6d	33 1/16-1/8			C114/71
1678-04-26	32s 7d	33 1/16			C114/71
1678-04-29			34s 1d	33	C114/71
1678-04-29			34s		C114/71
1678-04-30	32s 7d	33			C114/71
1678-05-03	32s 7d	32 15/16			C114/71

1678-05-03	32s 7-8d		34s 3d	33	C114/71
1678-05-06			34s 4 1/2d		C114/71
1678-05-07	32s 7-8d	33			C114/71
1678-05-14	32s 8d	32 15/16			C114/71
1678-05-17	32s 7d		33s 11d		C114/71
1678-05-20			34s 4d		C114/71
1678-05-24	32s 8d	33	34s 5d		C114/71
1678-05-24		33 1/8			C114/71
1678-05-27			33s 11 1/2d-34s		C114/71
1678-06-04	32s 10-11d	32 15/16-33			C114/71
1678-06-07	33s 2-3d	33-33 1/16			C114/71
1678-06-07	33s 2d				C114/71
1678-06-07	32s 7-8d		34s 4-5d		C114/71
1678-06-11	33s 2d	33 1/8			C114/71
1678-06-14	33s 3-6d	33 1/16			C114/71
1678-06-14	33s 6-7d				C114/71
1678-06-18	33s 7-8d	33 1/16			C114/71
1678-06-18	33s 6-7d	33 1/16			C114/71
1678-07-05	33s 8d	32 15/16-33			C114/71
1678-07-09	33s 7-8d				C114/71
1678-07-09	33s 7d				C114/71
1678-07-11			34s 8-9d		C114/71
1678-07-12	33s 5-6d	32 15/16			C114/71
1678-07-16	33s 6-7d	32 15/16-33			C114/71
1678-07-19	33s 6d	32 15/16-33			C114/71
1678-07-22			34s 9d	33	C114/71
1678-07-26			34s 8-9d	32 7/8-15/16	C114/71
1678-07-28	33s 9d	33			C114/71
1678-07-30	33s 6-7d	33 1/16			C114/71
1678-07-30	33s 6d	33			C114/71
1678-08-02	33s 8d	33 1/16	34s 8-9d		C114/71
1678-08-06	33s 9d				C114/71
1678-08-09	33s 9d	33 1/16			C114/71
1678-08-12	33s 7d	33			C114/71
1678-08-13	33s 8-9d	33 1/8			C114/71
1678-08-13	33s 10d	33 1/16-1/8			C114/71
1678-08-16	34s 2d				C114/71
1678-08-16	34s	33 1/8			C114/71
1678-08-23	33s 11d-34s	33 1/3	35s 1d		C114/71
1678-08-23	34s	33 5/16			C114/78
1678-08-30	34s	33 1/3			C114/71
1678-09-01	34s 2d	33 1/3			C114/71
1678-09-04	34s 1-2d	33 1/3			C114/71
1678-09-04	34s 2d				C114/71
1678-09-06	34s	33 1/4			C114/71
1678-09-10	34s	33 1/4-5/16			C114/71
1678-09-11	34s 2d	33 1/4			C114/71
1678-09-13		33 3/16-1/4			C114/71
1678-09-13	34s	33 1/3	35s 2-3d	33 1/4	C114/71
1678-09-17	34s	33 1/3			C114/71
1678-09-23			35s 2-3d		C114/71

1678-09-24	34s	33 1/3			C114/71
1678-09-24	34s 2d	33 1/3			C114/71
1678-09-27	34s 2d	33 1/3			C114/71
1678-09-27		33 1/3-3/8	35s 2-3d	33 3/8	C114/71
1678-09-30			35s 3d		C114/71
1678-10-01	34s	33 1/3			C114/71
1678-10-01	34s 1d				C114/71
1678-10-22	33s 7-8d	33 1/8			C114/71
1678-10-22	33s 8d	33 1/4			C114/71
1678-10-25	33s 8-9d	33			C114/71
1678-11-01	33s 8d	33			C114/71
1678-11-01	33s 8-9d				C114/71
1678-11-05	33s 8d	33			C114/71
1678-11-08	33s 8-9d	32 15/16-33			C114/71
1678-11-08	33s 8d	33			C114/71
1678-11-12	33s 8-9d				C114/71
1678-11-12	33s 9d				C114/71
1678-11-15	33s 9d	33			C114/71
1678-11-16			35s 2 1/3d	33 3/16	C114/71
1678-11-18			34s 10 1/2d		C114/71
1678-11-18			34s 11d	32 7/8	C114/71
1678-11-19	33s 8-9d	32 15/16			C114/71
1678-11-19	33s 9d	33			C114/71
1678-11-19	33s 7-8d				C114/71
1678-11-22	33s 8d	33 1/16			C114/71
1678-11-22		33 1/8			C114/71
1678-11-25			34s 11d	32 7/8	C114/71
1678-11-26	33.667	33 1/8			C114/71
1678-11-29	33s 8-9d	33 1/8			C114/71
1678-11-29	33.667				C114/71
1678-12-03	33s 8 1/2-9d	33 1/8			C114/71
1678-12-10	33s 9-10d	33 1/16			C114/71
1678-12-10	33s 9d				C114/71
1678-12-12	33s 9d				C114/71
1678-12-12			34s 11d		C114/75
1678-12-20			35s 1d	33 1/16	C114/71
1678-12-21			35s 2d	33	C114/71
1678-12-23			35s 1 1/2d	33 1/16	C114/71
1678-12-24	33s 10d	33			C114/71
1678-12-24	34s				C114/71
1679-01-03			35s-35s 1d	33	C114/75
1679-01-07	34s	33			C114/71
1679-01-10	34s	33			C114/71
1679-01-14	34s	33 1/8			C114/71
1679-01-14		33 3/16			C114/71
1679-01-17	34s	33 1/16			C114/71
1679-01-17					C114/72
1679-01-20			35s 2d	33 1/16	C114/71
1679-01-28	34s 2d	33 1/4			C114/78
1679-02-04	34s 1d	33 3/16			C114/78
1679-02-04		33 1/8-3/16			C114/78

1679-02-07	34s				C114/78
1679-02-07	34s-34s 1d				C114/78
1679-02-11	34s	33 1/16			C114/78
1679-02-11	34s 1d	33 1/8			C114/78
1679-02-14	34s 1d	33 1/8			C114/78
1679-02-17			35s 2d		C114/75
1679-02-18	34s 1d	33 1/16			C114/78
1679-02-19	34s 1d	33 1/16			C114/78
1679-02-20			35s 2 1/2d	33 1/8	NEHA
1679-02-25	34s 1d	33			C114/78
1679-02-25	34s 1-1 1/2d				C114/78
1679-02-28	34s 2-3s	33			C114/78
1679-02-28		32 1/2			C114/78
1679-02-28		32 7/16-1/2			C114/78
1679-02-28	34s 2d	33 1/16			C114/78
1679-03-03			35s 4-4 1/2d		C114/78
1679-03-07	34s 4d	33 1/8			C114/76
1679-03-10			35s 5-6d	33	C114/78
1679-03-11	34s 3-4d				C114/78
1679-03-11	34s 4d	33 1/16-1/8			C114/78
1679-03-14	34s 4d	33 1/16	35s 6d	33	C114/76
1679-03-17					C114/78
1679-03-21			35s 5-6d	33	C114/76
1679-03-28	34s 5-6d	33 1/16			C114/76
1679-03-28	34s 4-5d	33 1/8			C114/76
1679-04-04	34s 5d	33 1/8			C114/76
1679-04-04	34s 4-5d	33 1/16			C114/76
1679-04-08	34s 4-5d				C114/76
1679-04-08	34s 5d	33			C114/76
1679-04-11	34s 4d	33	35s 5 1/2-6d	33	C114/76
1679-04-11			35s 7d	33 1/16-1/8	C114/76
1679-04-15	34s 4-5d	32 15/16-33			C114/76
1679-04-18	34s 4-5d	33			C114/76
1679-04-18	34s 4d				C114/76
1679-04-25		32 7/8-15/16			L-442
1679-04-25	34s 6d				C114/76
1679-04-25	34s 5d	32 15/16-33			C114/76
1679-04-25	34s 5-6d				C114/76
1679-04-29	34s 5d	32 7/8-15/16			C114/76
1679-04-29		32 7/8			C114/76
1679-04-30	34s 5d	32 7/8			C114/76
1679-05-02	34s 6-7d	32 7/8-15/16			C114/76
1679-05-06	34s 6d	32 7/8-15/16			C114/76
1679-05-09	34s 8d	32 7/8			C114/76
1679-05-09	34s 6-7d	32 15/16-33			C114/76
1679-05-13	34s 7-8d	32 15/16			C114/76
1679-05-20	34s 8d	32 15/16-33			C114/76
1679-05-23	34s 7d				C114/74
1679-05-23	34s 8d	33			C114/74
1679-05-30	34s 6d	33			C114/74
1679-05-30			35s 8d		C114/76

1679-05-30			35s 10d		C114/76
1679-06-03	34s 7d	33			C114/74
1679-06-06	34s 4d	33			C114/74
1679-06-06	34s 5-6d				C114/74
1679-06-13	34s 5-6d	33 1/8			C114/74
1679-06-17	34s 6d	33 1/8			C114/74
1679-06-20			35s 9d	32 7/8-33	C114/74
1679-06-20	34s 8d	33 3/16			C114/78
1679-06-27			35s 9-10d	33 1/16-1/8	C114/74
1679-06-27	34s 8d	33 3/16			C114/78
1679-07-01	34s 8d	33 1/4			C114/78
1679-07-01		33 3/16-1/4			C114/78
1679-07-07			35s 10d		C114/78
1679-07-08	34s 8d	33 1/4			C114/78
1679-07-11	34s 8-9d	33 1/8-3/16			C114/78
1679-07-11	34s 8d	33 1/8			C114/78
1679-07-15	34s 8-9d	33 1/8			C114/78
1679-07-17	34s 6-7d				C114/78
1679-07-22	34s 8-9d	33 3/16			C114/73
1679-07-28			35s 11d		C114/78
1679-07-29	34s 8-9d	33 1/16			C114/73
1679-08-01	34s 8-9d	33			C114/73
1679-08-01			36s-36s 1d		C114/78
1679-08-08	34s 9-10d	33			C114/73
1679-08-14	34s 9d	33			C114/73
1679-08-15			36s 1/2d		C114/73
1679-08-15			36s-36s 1d		C114/74
1679-08-18			36s		C114/73
1679-08-18			36s-36s 1/2d		C114/73
1679-08-22	34s 9d	33 1/16			C114/74
1679-08-22		33 1/8	36s 1/2-1d		C114/74
1679-08-29	34s 9-10d	33 1/16			C114/74
1679-08-29	34s 10d	33 1/8			C114/74
1679-08-29	34s 9d				C114/74
1679-09-01			36s		C114/73
1679-09-02	34s 10d	33			C114/74
1679-09-05	34s 9-10d	33 1/16	36s 1/2d		C114/74
1679-09-05	34s 10d				C114/74
1679-09-09	34s 9-10d	33 1/16			C114/74
1679-09-12	34s 9d	33 1/16			C114/74
1679-09-12	34s 10d	33 1/8			C114/77
1679-09-19	34s 10d	33 1/8	36s		C114/74
1679-09-26	34s 11d-35s	32 15/16-33			L-464
1679-09-26	34s 10d	33			C114/77
1679-09-30	35s				C114/72
1679-10-01			35s 10d		C114/72
1679-10-03	35s 2d	32 1/2			C114/72
1679-10-03	35s 1d		36s 1d		C114/72
1679-10-07	35s 1-2d	32 1/4			C114/72
1679-10-10	35s 2-3d	32 1/2			C114/72
1679-10-13			36s 1/2d		C114/72

1679-10-14	35s 3-4d	32 11/16			C114/72
1679-10-17	35s 1-2d				C114/72
1679-10-17	35s 2d				C114/72
1679-10-17	35s 2-3d	32 3/4-13/16	36s 1/2d	32 3/4	C114/72
1679-10-20			36s 1/2-1d		C114/72
1679-10-20			36s		C114/72
1679-10-21	34s 8-9d	33			C114/72
1679-10-24	34s 7d	33 1/16			C114/77
1679-10-26	34s 11d-35s	32 15/16-33			C114/72
1679-10-27			35s 10-11d	32 3/4	C114/72
1679-10-31	34s 7-8d	33 1/8			C114/77
1679-11-?	34s 5-6d	33 3/16-1/4			C114/69
1679-11-04	34s 5d	33 3/16			C114/77
1679-11-11	34s 4-5d	33 3/16			C114/77
1679-11-14	34s 4-5d				C114/77
1679-11-14	34s 6d	33 1/8			C114/77
1679-11-14	34s 5d	33 3/16			C114/77
1679-11-18	34s 5-6d	33 5/16-3/8			C114/69
1679-11-21	34s 7-8d	33 3/16			C114/69
1679-11-21	34s 8d	33 1/4			C114/69
1679-12-05	34s 8d	33 1/4			C114/69
1679-12-05	34s 8-9d	33 3/16-1/4			C114/69
1679-12-12	34s 7-8d	33 5/16-1/3			C114/69
1679-12-12	34s 8-9d	33 1/3			C114/74
1679-12-18			35s 11d	33 3/16	NEHA
1679-12-20			35s 11 1/2d		C114/72
1679-12-23	34s 7-8d	33 5/16			C114/74
1679-12-29			35s 11d		C114/74
1680-01-09	34s 7d	33 5/16			C114/74
1680-01-13	34s 7d	33 1/3-3/8			C114/74
1680-01-16			35s 11d	33 1/4-5/16	C114/74
1680-01-16	34s 4-5d	33 1/3			C114/77
1680-01-19			35s 10 1/2d		C114/74
1680-01-20	34s 5-6d	33 5/16			C114/77
1680-01-20	34s 5d				C114/77
1680-01-20	34s 6d	33 1/3-7/16			C114/77
1680-01-23	34s 5d	33 3/8-7/16			C114/77
1680-01-30			35s 11d		C114/77
1680-02-02			35s 11d		C114/77
1680-02-03	34s 4-5d	33 9/16			C114/77
1680-02-06			36s 1d		C114/77
1680-02-10	34s 5d				C109/19
1680-02-17	34s 6-7d	33 7/16			C114/77
1680-02-17	34s 6d	33 1/2			C114/77
1680-02-20			36s 1d		C114/77
1680-03-02	34s 8d	33 1/4			C114/77
1680-03-05			36s 1d		C114/77
1680-03-08			36s 1d		C114/77
1680-03-09	34s 9d	33 1/4			C114/77
1680-03-12	34s 8-9d	33 1/4	36s 1d		C114/77
1680-03-12	34s 8 1/2-9d				C114/77

1680-03-15			36s 1/2-1d	C114/77
1680-03-16	34s 9d	33 1/4		C114/77
1680-03-19			36s	C114/77
1680-03-26			36s	C114/77

Source: C114/69-78, C109/19-24, and NEHA: Bijzondere Collecties 674.
H. Roseveare, *Markets and Merchants of the Late Seventeenth Century: the Marescoe-David Letters, 1668-1680* (Oxford, 1987); N. W. Posthumus, *Inquiry into the History of Prices in Holland* (Leiden, 1964)
Note: (1) The Amsterdam-London and Hamburg-London exchange rates are quoted at double usance, and the exchange rates between Amsterdam and Hamburg are quoted at sigh.
(2) The Hamburg-London exchange rates are quoted at variable number of Schilling-Flemish per £1 Sterling, and the Amsterdam-London at variable number of Schelling-Vlaamsch per £1 Sterling. The exchange rates between Amsterdam and Hamburg are quoted at variable number of stuiver for one Hamburg taler.

Appendix 4.B The weekly average exchange rates, 1668-1680

1668 Week	Month	Day	Hamburg-London	Hamburg-Amsterdam	Amsterdam-London	Amsterdam-Hamburg
1	Jan.	1-7	34.750	33.000	35.583*	32.904b
2		8-14	34.167	32.979b	35.479*	32.901b
3		15-21	34.000	32.955b	35.449b	32.898b
4		22-28	34.063	32.930b	35.424b	32.895b
5	Feb.	29-4	34.063a	32.907b	35.402b	32.892b
6		5-11	34.063a	32.888b	35.383b	32.889b
7		12-18	34.063a	32.875	35.365b	32.886b
8		19-25	34.063	32.938	35.349b	32.883b
9	Mar.	26-4	34.278	32.719	35.333*	32.880b
10		5-11	34.083	33.011	35.354	32.878b
11		12-18	34.167	33.063	35.063	32.875
12		19-25	33.875	33.031	34.959	32.875
13	Apr.	26-1	33.900	33.063	34.917*	32.750*
14		2-8	33.695	33.042	34.521	32.875
15		9-15	33.813	33.000	34.625*	32.125*
16		16-22	33.819	32.625	34.906	32.610
17		23-29	33.917	33.011	34.958	32.813
18	May	30-6	33.864	33.016	34.917	32.938
19		7-13	33.792	33.047	34.625	32.875*
20		14-20	33.771	33.047	34.750	32.938
21		21-27	33.778	33.063	34.708	32.875
22	June	28-3	33.750	33.063	34.833	32.927
23		4-10	33.833	33.063	34.833	32.969
24		11-17	33.938	33.083	34.833	32.938
25		18-24	33.917	33.125	34.930	33.031
26	July	25-1	33.907	33.094	34.771	33.000
27		2-8	33.875	33.125	34.833	32.969
28		9-15	33.910	33.135	34.986	33.031
29		16-22	34.014	33.125	35.125	33.000
30		23-29	34.097	33.125	35.125	33.031
31	Aug.	30-5	34.056	33.125	35.125	33.125
32		6-12	34.000	33.094	35.097	33.047
33		13-19	34.021	32.979	35.042	33.000
34		20-26	34.000	32.938	35.094	32.813
35	Sep.	27-2	34.055	32.922	35.083	32.813
36		3-9	34.177	32.948	35.000	32.813
37		10-16	34.261	32.898	35.042	32.813
38		17-23	34.417	32.938	35.292	32.844
39		24-30	34.542	32.938	35.063	32.875
40	Oct.	1-7	34.542	32.806	35.084	32.938
41		8-14	34.500	32.760	35.136	32.703
42		15-21	34.542	32.735	35.083	32.625
43		22-28	34.563	32.750	35.167	32.625
44	Nov.	29-4	34.500	32.750	35.188	32.641
45		5-11	34.479	32.813	35.167*	32.625*
46		12-18	34.403	32.813	35.208	32.672a

47		19-25	34.417	32.875	35.292	32.719
48	Dec.	26-2	34.389	32.813	35.451	32.750
49		3-9	34.459	32.813	35.500	32.719
50		10-16	34.500*	32.813*	35.333	32.688
51		17-23	34.375	32.813	35.167	32.688a
52		24-31	34.467	32.750	35.188	32.688
1669						
Week	Month	Day				
1	Jan.	1-7	34.458	32.781	35.333*	32.688*
2		8-14	34.528a	32.791a	35.292	32.688
3		15-21	34.597a	32.802a	35.313	33.750
4		22-28	34.667	32.813	35.250	32.688
5	Feb.	29-4	34.792	32.813	35.344	32.719
6		5-11	34.688	32.750a	35.396	32.469
7		12-18	34.667	32.688	35.333	32.766
8		19-25	34.750	32.500	35.364	32.734
9	Mar.	26-4	34.750	32.625	35.403	32.688
10		5-11	34.792	32.656	35.500	32.625
11		12-18	34.646	32.625	35.410	32.547
12		19-25	34.583	32.625a	35.396	32.500
13	Apr.	26-1	34.688	32.625	35.333	32.500
14		2-8	34.563	32.625	35.292	32.438
15		9-15	34.563	32.500	35.302	32.469
16		16-22	34.542	32.500	35.271	32.438
17		23-29	34.479	32.531*	35.250	32.448
18	May	30-6	34.511	32.542	35.323	32.438
19		7-13	34.896	32.500	35.375	32.438
20		14-20	34.688	32.500	35.375	32.461a
21		21-27	34.667	32.500	35.375	32.485
22	June	28-3	34.667	32.375a	35.375	32.438
23		4-10	34.667	32.250	35.333	32.438
24		11-17	34.730	32.469	35.266	32.438
25		18-24	34.709	32.500	35.229	32.438
26	July	25-1	34.677	32.490	35.240	32.375
27		2-8	34.417	32.507a	35.229	32.375
28		9-15	34.472	32.523	35.250	32.437a
29		16-22	34.458	32.604	35.229a	32.500
30		23-29	34.417	32.672	35.208	32.523a
31	Aug.	30-5	34.479	32.719	35.375	32.547
32		6-12	34.417	32.734a	35.354a	32.563
33		13-19	34.490	32.750	35.333	32.563
34		20-26	34.521	32.740	35.333	32.625
35	Sep.	27-2	34.583	32.750	35.333	32.531
36		3-9	34.556	32.500	35.347	32.594
37		10-16	34.542	32.547	35.410	32.547
38		17-23	34.688	32.625	35.396	32.523a
39		24-30	34.736	32.531	35.438	32.500
40	Oct.	1-7	34.646	32.688	35.292	32.344
41		8-14	34.719a	32.531a	35.194	32.271
42		15-21	34.792	32.375	35.156	32.281
43		22-28	34.813	32.365	35.125	32.250

44	Nov.	29-4	34.875	32.344	35.125	32.250
45		5-11	34.917	32.375	35.115	32.260
46		12-18	34.802	32.354	35.115	32.219
47		19-25	34.854	32.235	35.083	32.219
48	Dec.	26-2	34.854	32.141	35.083	32.250*
49		3-9	34.861	32.115	34.958[a]	32.125[a]
50		10-16	34.771	32.156	34.834	32.000
51		17-23	34.656	32.289	34.542	32.031
52		24-31	34.583	32.065	34.459	31.500
1670						
Week	Month	Day				
1	Jan.	1-7	34.500	31.781	34.344	31.344
2		8-14	34.486	31.750	34.396	31.577[a]
3		15-21	34.542	31.906	34.542	31.813
4		22-28	34.625	31.875	34.730	31.656
5	Feb.	29-4	34.667	31.922	34.750	31.875
6		5-11	34.708[a]		34.750	31.875*
7		12-18	34.750		34.583	31.938
8		19-25	34.750[a]		34.625	31.875
9	Mar.	26-4	34.750			
10		5-11	34.583			
11		12-18	34.250			
12		19-25	34.166[a]			
13	Apr.	26-1	34.083[a]			
14		2-8	34.000			
15		9-15	34.167			
16		16-22	34.167			
17		23-29	34.042[a]			
18	May	30-6	33.917			
19		7-13	33.917[a]			
20		14-20	33.917			
21		21-27				
22	June	28-3				
23		4-10				
24		11-17				
25		18-24				
26	July	25-1				
27		2-8				
28		9-15				
29		16-22	33.833			
30		23-29				
31	Aug.	30-5				
32		6-12				
33		13-19				
34		20-26				
35	Sep.	27-2	33.833			
36		3-9				
37		10-16				
38		17-23	34.125	32.938	35.000	32.875
39		24-30	34.209	32.833	34.958	32.875
40	Oct.	1-7				

41		8-14				
42		15-21				
43		22-28				
44	Nov.	29-4	34.250			
45		5-11				
46		12-18				
47		19-25	34.500			
48	Dec.	26-2				
49		3-9	34.667			
50		10-16	34.750			
51		17-23	34.750			
52		24-31				
1671						
Week	Month	Day				
1	Jan.	1-7				
2		8-14				
3		15-21				
4		22-28				
5	Feb.	29-4				
6		5-11	34.500			
7		12-18	34.500			
8		19-25	34.583			
9	Mar.	26-4	34.541[a]			
10		5-11	34.500			
11		12-18	34.549[a]			
12		19-25	34.597[a]			
13	Apr.	26-1	34.646	33.086		
14		2-8	34.636	33.073		
15		9-15	34.667	33.063	35.833	33.000
16		16-22	34.667	33.063	35.787	32.953
17		23-29	34.542	33.042	35.771	32.945[a]
18	May	30-6	34.375	33.039	35.693	32.938
19		7-13	34.363	33.115	35.646	32.938
20		14-20	34.406	33.125	35.625	32.688[*]
21		21-27	34.442	33.271	35.701	33.016
22	June	28-3	34.469	33.298	35.726[a]	33.086[a]
23		4-10	34.347	33.305	35.750	33.156
24		11-17	34.292	33.333	35.708	33.305
25		18-24	34.222	33.361	35.771	33.333[*]
26	July	25-1	34.201	33.292	35.875	33.333[*]
27		2-8	34.167	33.278	35.813	33.250
28		9-15	34.208	33.333	35.833	33.125
29		16-22	34.312	33.444	35.907	33.219
30		23-29	34.300	33.330	35.907	33.203
31	Aug.	30-5	34.347	33.354	35.917	33.375
32		6-12	34.431	33.250	35.889[a]	33.333[a]
33		13-19	34.396	33.188	35.861[a]	33.292[a]
34		20-26	34.408	33.146	35.833	33.250
35	Sep.	27-2	34.417	32.979	35.792	33.140[a]
36		3-9	34.448	32.938	35.750	33.031[a]
37		10-16	34.552	32.938	35.646	32.921[a]

38		17-23	34.604	33.016	35.667	32.813
39		24-30	34.542	33.083	35.792	32.781
40	Oct.	1-7	34.459	33.125	35.563	32.875
41		8-14	34.347	33.125	35.583	32.953
42		15-21	34.208	33.156	35.573	32.938
43		22-28	34.125	33.109	35.438	32.922[a]
44	Nov.	29-4	34.146	33.117	35.375	32.906
45		5-11	34.188	33.125	35.333	32.938
46		12-18	34.195	33.125	35.285	32.917
47		19-25	34.271	33.125	35.292	32.896
48	Dec.	26-2	34.242	33.086	35.313	32.938
49		3-9	34.319	33.156	35.479	32.938
50		10-16	34.333	33.188	35.563[*]	32.906
51		17-23	34.305	33.274	35.528	32.985
52		24-31	34.250	33.333	35.514	32.708
1672						
Week	Month	Day				
1	Jan.	1-7	34.208[a]	33.260[a]	35.583	33.156
2		8-14	34.167[*]	33.188[*]	35.601	33.031
3		15-21	34.355	33.125	35.618	33.047
4		22-28	34.250	33.219	35.653[a]	33.039[a]
5	Feb.	29-4	34.250	33.125[*]	35.688	33.031
6		5-11	34.333	33.094	35.528	32.969
7		12-18	34.375	32.938	35.500[*]	32.875[*]
8		19-25	34.479	32.625	35.500	32.875
9	Mar.	26-4	34.542	32.531	35.500	32.729
10		5-11	34.771	32.500	35.625	32.500
11		12-18	34.717	32.328	35.427	32.297
12		19-25	34.283	32.350	35.375[*]	32.375[*]
13	Apr.	26-1	32.819	32.573	34.083	32.438
14		2-8	32.854	32.380	33.125	32.375
15		9-15	32.959	32.482	33.458	32.307[a]
16		16-22	32.951[a]	32.491[a]	33.500	32.239[a]
17		23-29	32.944	32.500	33.583	32.172
18	May	30-6	32.944	32.703	33.667	32.438
19		7-13	32.958	32.927	33.521	32.531
20		14-20	32.813	32.875	33.526	32.625
21		21-27	32.764	32.544	33.552	32.750
22	June	28-3	32.750	33.250[*]	33.583	32.563
23		4-10	32.667	34.188	33.573	32.375
24		11-17	33.000	33.625	33.583	34.000
25		18-24	32.677	34.750	37.708	37.500
26	July	25-1	32.750	34.336[a]	37.125	36.750
27		2-8	32.792	33.927	35.533	33.167
28		9-15	32.833	34.250	35.319	33.563
29		16-22	33.125	32.750	35.521	33.656
30		23-29	33.042	33.800	35.500	33.625
31	Aug.	30-5	32.917	33.750	35.417	33.625
32		6-12	32.979	33.667	35.209	33.625
33		13-19	33.063	33.292	34.861	33.344
34		20-26	33.083	33.135	34.333	33.250

35	Sep.	27-2	33.000	32.953	33.729	33.031
36		3-9	33.000	32.724	33.875	32.854
37		10-16	33.042	32.674[a]	33.875	32.833
38		17-23	33.417	32.625	34.271	32.750
39		24-30	33.625	32.563	34.239[a]	32.601[a]
40	Oct.	1-7	33.611	32.299	34.208	32.453
41		8-14	33.667	32.250	34.264	32.375
42		15-21	33.567	32.234	34.063	32.125
43		22-28	33.403	32.813	34.021	32.146
44	Nov.	29-4	33.146	32.813	33.833	32.250
45		5-11	33.125	32.625	33.719	32.313
46		12-18	33.209	32.333	33.833	32.250
47		19-25	33.354	32.625	33.833	32.313
48	Dec.	26-2	33.313	32.281	33.854	32.250
49		3-9	33.500	32.250	33.834	32.187[a]
50		10-16	33.500	32.250	33.958	32.125
51		17-23	33.667	32.250	33.938	32.156
52		24-31	33.729	32.328[a]	34.083	32.125
1673						
Week	Month	Day				
1	Jan.	1-7	33.750	32.406	34.236	32.438
2		8-14	33.729[a]	32.391[a]	34.167	32.188
3		15-21	33.708	32.375	34.194	32.297
4		22-28	33.750	32.500	34.250	32.375
5	Feb.	29-4	33.458[*]	32.000[*]	34.292	32.417[a]
6		5-11	33.479[a]	32.311[a]	34.208	32.458[a]
7		12-18	33.500	32.625	34.167	32.500
8		19-25	33.416[a]	32.562[a]	34.083	32.500[a]
9	Mar.	26-4	33.333	32.500	34.000	32.500[a]
10		5-11	33.305	32.625	34.000[a]	32.500[a]
11		12-18	33.167	32.656	34.000	32.500
12		19-25	33.083	32.664[b]	33.938	32.563
13	Apr.	26-1	33.125[a]	32.672[b]		
14		2-8	33.167	32.680[b]		
15		9-15				
16		16-22				
17		23-29				
18	May	30-6				
19		7-13			33.875	32.750
20		14-20	32.667		33.958	32.844
21		21-27				
22	June	28-3			34.188	33.063
23		4-10				
24		11-17				
25		18-24				
26	July	25-1				
27		2-8				
28		9-15				
29		16-22				
30		23-29				
31	Aug.	30-5				

32		6-12				
33		13-19				
34		20-26				
35	Sep.	27-2				
36		3-9	33.667			
37		10-16				
38		17-23				
39		24-30				
40	Oct.	1-7				
41		8-14	32.333			
42		15-21				
43		22-28	31.000			
44	Nov.	29-4	31.333			
45		5-11				
46		12-18				
47		19-25				
48	Dec.	26-2				
49		3-9				
50		10-16	33.583			
51		17-23	33.667	32.250		
52		24-31				
1674						
Week	Month	Day				
1	Jan.	1-7				
2		8-14				
3		15-21				
4		22-28				
5	Feb.	29-4				
6		5-11				
7		12-18	31.667			
8		19-25				
9	Mar.	26-4				
10		5-11				
11		12-18				
12		19-25				
13	Apr.	26-1				
14		2-8	31.875			
15		9-15	31.542			
16		16-22				
17		23-29				
18	May	30-6				
19		7-13				
20		14-20				
21		21-27				
22	June	28-3				
23		4-10			33.750	34.250
24		11-17				
25		18-24				
26	July	25-1				
27		2-8	30.833			
28		9-15				

29		16-22			33.792	34.594
30		23-29			33.750	34.125
31	Aug.	30-5	31.167		33.771[a]	34.374[a]
32		6-12			33.792	34.625
33		13-19			33.896[a]	34.374[a]
34		20-26			34.000	34.125
35	Sep.	27-2	31.125		34.000	34.000
36		3-9			34.375	33.906
37		10-16			34.333	33.875
38		17-23	31.750		34.229[a]	34.140[a]
39		24-30			34.125	34.406
40	Oct.	1-7			34.083	34.531
41		8-14	31.500		34.167	34.063
42		15-21			34.187[a]	34.281[a]
43		22-28			34.208	34.500
44	Nov.	29-4			34.208	34.500
45		5-11	31.583		34.250	34.313
46		12-18	31.694[a]		34.292	34.250
47		19-25	31.806		34.277[b]	34.757[b]
48	Dec.	26-2	31.542		34.257[b]	34.735[b]
49		3-9	31.521	34.531	34.234[b]	34.693[b]
50		10-16	31.583	34.484	34.211[b]	34.640[b]
51		17-23	31.563	34.625	34.188[b]	34.584[b]
52		24-31	31.569	34.500	34.167	34.535[b]
1675						
Week	Month	Day				
1	Jan.	1-7	31.583[a]	34.573[a]	34.229	34.500
2		8-14	31.597	34.646	34.302	34.563
3		15-21	31.583	34.875	34.296	34.531
4		22-28	31.375	34.922	34.375	34.672
5	Feb.	29-4	31.514	34.771	34.370	34.719
6		5-11	31.594	34.641	34.417	34.625[*]
7		12-18	31.781	34.604	34.459	34.609
8		19-25	31.819	34.635	34.667	34.547[a]
9	Mar.	26-4	31.917	34.500	34.604	34.485
10		5-11	31.979	34.500	34.583	34.375
11		12-18	32.125	34.485	34.589	34.469
12		19-25	32.055	34.479	34.594	34.375[*]
13	Apr.	26-1	32.042	34.438	34.526	34.344
14		2-8	32.104	34.469	34.552	34.313
15		9-15	32.125	34.563	34.569	34.365
16		16-22	32.108	34.633	34.604	34.406
17		23-29	31.889	34.646	34.708	34.476[a]
18	May	30-6	32.333	34.625	34.778	34.547
19		7-13	32.188	34.625	34.917	34.313[*]
20		14-20	32.302	34.677	34.833	34.500
21		21-27	32.224[a]	34.776[a]	34.833	34.500
22	June	28-3	32.146	34.875	34.833	34.594[a]
23		4-10	32.014	34.797	34.792	34.688
24		11-17	32.000	34.750	34.771	34.703
25		18-24	32.069	34.750	34.833	34.719[*]

26	July	25-1	32.069	34.781	34.833	34.672[a]
27		2-8	32.188	34.735	34.875	34.625
28		9-15	32.194	34.677	35.000	34.625
29		16-22	32.236	34.646	34.990	34.625
30		23-29	32.208	34.656	35.000[*]	34.625[*]
31	Aug.	30-5	32.333	34.625	35.083	34.625
32		6-12	32.313	34.625	35.083	34.500
33		13-19	32.344	34.542	35.083[*]	34.500[*]
34		20-26	32.417	34.375	35.042	34.391
35	Sep.	27-2	32.531	34.359	35.083	34.282
36		3-9	32.597	34.333	35.083	34.250
37		10-16	32.569	34.396	35.167	34.312[a]
38		17-23	32.542	34.500	35.167	34.375
39		24-30	32.521	34.500	35.188	34.250
40	Oct.	1-7	32.563	34.594	35.292	34.375
41		8-14	32.528	34.453	35.135	34.406
42		15-21	32.625	34.531	35.132[a]	34.458[a]
43		22-28	32.625	34.511	35.128[a]	34.510[a]
44	Nov.	29-4	32.625	34.469[*]	35.125	34.563
45		5-11	32.750	34.375	35.153[a]	34.437[a]
46		12-18	32.908	34.338	35.181[a]	34.312[a]
47		19-25	33.083	34.250	35.209	34.187[a]
48	Dec.	26-2	32.958	34.193	35.292	34.063
49		3-9	32.931	34.281	35.250	34.031[a]
50		10-16	33.042	34.302	35.261	34.000
51		17-23	33.563	34.375	35.463[a]	34.062[a]
52		24-31	33.083	34.563	35.667	34.125
1676						
Week	Month	Day				
1	Jan.	1-7	33.417[*]	34.625[*]	35.634[a]	34.200[a]
2		8-14	33.157	34.500	35.600[a]	34.275[a]
3		15-21	33.195	34.563	35.567[a]	34.350[a]
4		22-28	33.111	34.625	35.533[a]	34.425[a]
5	Feb.	29-4	33.111	34.516	35.500	34.500
6		5-11	33.250	34.500	35.583	34.375
7		12-18	32.917	34.469	35.625[a]	34.281[a]
8		19-25	33.153	34.313	35.667[*]	34.188[*]
9	Mar.	26-4	33.125	34.375	35.708	34.406
10		5-11	32.931	34.021	35.698[a]	34.437[a]
11		12-18	33.292	34.281	35.688	34.469
12		19-25	33.222	34.266	35.695	34.234
13	Apr.	26-1	33.250	34.250	35.660[a]	34.238[a]
14		2-8	33.240	34.292	35.625	34.242[a]
15		9-15	33.222	34.313	35.687[a]	34.246[a]
16		16-22	33.167	34.344[a]	35.750	34.250
17		23-29	33.236	34.375	35.729[a]	34.289[a]
18	May	30-6	33.333	34.375	35.708	34.328
19		7-13	33.333	34.375	35.719	34.359
20		14-20	33.396[a]	34.312[a]	35.750	34.250
21		21-27	33.458[*]	34.250[*]	35.865	34.375
22	June	28-3	33.271	33.969	35.818[a]	34.322[b]

23		4-10	33.431	34.125	35.771	34.261[b]
24		11-17	33.650	34.177	35.830[b]	34.193[b]
25		18-24	33.740	34.125	35.898[b]	34.119[b]
26	July	25-1	33.847	33.938	35.970[b]	34.041[b]
27		2-8	34.208	33.766	36.042[b]	33.959[b]
28		9-15	34.208	33.844	36.110[b]	33.875[*]
29		16-22	34.209	33.938	36.167	33.718[a]
30		23-29	34.167	33.844	36.111[a]	33.561[a]
31	Aug.	30-5	34.333	33.719	36.056[a]	33.405[a]
32		6-12	34.333	33.750	36.000	33.250[*]
33		13-19	34.347	33.729	36.250	33.750
34		20-26	34.354	33.969	36.215	33.573
35	Sep.	27-2	34.188	34.016	36.167	33.781
36		3-9	34.229	34.156	36.208	33.828[a]
37		10-16	34.302	34.172	36.333	33.875
38		17-23	34.333	33.969	36.333	34.063
39		24-30	34.333	33.813	36.333	33.875
40	Oct.	1-7	34.250	33.750	36.271[a]	33.812[a]
41		8-14	34.281	33.677	36.208	33.750
42		15-21	34.313	33.656	36.188	33.656[a]
43		22-28	34.333	33.625	36.188	33.563[*]
44	Nov.	29-4	34.417	33.604	36.208	33.500
45		5-11	34.667[*]	33.625[*]	36.219	33.563
46		12-18	34.583	33.625	36.229[*]	33.500[*]
47		19-25	34.646	33.625	36.302	33.531
48	Dec.	26-2	34.667	33.578	36.391[a]	33.547[a]
49		3-9	34.667	33.563	36.479[*]	33.563[*]
50		10-16	34.667	33.563	36.542	33.563
51		17-23	34.750	33.563	36.521	33.531[a]
52		24-31	34.651[a]	33.563[a]	36.500	33.500
1677						
Week	Month	Day				
1	Jan.	1-7	34.551[a]	33.563[a]	36.500	33.563
2		8-14	34.453[a]	33.563[a]	36.396	33.469
3		15-21	34.354	33.563	36.385[a]	33.422[a]
4		22-28	34.583	33.667	36.375	33.375
5	Feb.	29-4	34.542	33.563	36.271	33.594
6		5-11	34.653	33.594	36.260[a]	33.542[a]
7		12-18	34.514	33.542	36.250	33.490[a]
8		19-25	34.569	33.521	36.167	33.438
9	Mar.	26-4	34.636	33.500	36.167[a]	33.438[a]
10		5-11	34.653	33.422	36.167	33.438
11		12-18	34.646	33.453	36.167[a]	33.422[s]
12		19-25	34.667	33.333	36.167	33.406
13	Apr.	26-1	34.667	33.250	36.181[a]	33.328[s]
14		2-8	34.750	33.250	36.194[a]	33.250[s]
15		9-15	34.750	33.219	36.208	33.172
16		16-22	34.688	33.307	36.215	33.167
17		23-29	34.698[a]	33.320[a]	36.143[a]	33.153[a]
18	May	30-6	34.709	33.333	36.072[a]	33.139[a]
19		7-13	34.708	33.333[a]	36.000	33.125

20		14-20	34.667	33.333	36.031[a]	33.109[a]
21		21-27	34.709	33.250	36.063	33.094[a]
22	June	28-3	34.708	33.172	36.031[a]	33.078[a]
23		4-10	34.708	33.188	36.000	33.063
24		11-17	34.708	33.115	35.917[*]	33.031[a]
25		18-24	34.667	33.063	35.917[a]	33.000[a]
26	July	25-1	34.688	33.063	35.917[a]	32.969[a]
27		2-8	34.750	33.094	35.917	32.938
28		9-15	34.688	33.063	35.948	32.938
29		16-22	34.750	33.117	35.917	33.008[a]
30		23-29	34.750	33.219	36.083	33.078[a]
31	Aug.	30-5	34.750	33.250	36.109[a]	33.148[a]
32		6-12	34.750	33.288	36.136	33.219
33		13-19	34.667	33.438	36.083[*]	33.240[a]
34		20-26	34.709	33.292	36.083[a]	33.260[a]
35	Sep.	27-2	34.729	33.333	36.083	33.281
36		3-9	34.625	33.156	36.000	33.203[a]
37		10-16	34.667	33.125	35.938	33.125
38		17-23	34.615	33.278	35.896	33.000
39		24-30	34.583	33.375	35.903[a]	32.978[b]
40	Oct.	1-7	34.611	33.361	35.910[a]	32.955[b]
41		8-14	34.583	33.368	35.917	32.932[b]
42		15-21	34.646	33.361	35.875[a]	32.909[b]
43		22-28	34.625	33.250	35.834[a]	32.887[b]
44	Nov.	29-4	34.625	33.271	35.792	32.867[b]
45		5-11	34.555	33.281	35.719[a]	32.848[b]
46		12-18	34.521	33.250	35.646[a]	32.833[b]
47		19-25	34.500	33.050	35.573[a]	32.820[b]
48	Dec.	26-2	34.459	32.896	35.500[*]	32.811[b]
49		3-9	34.417	32.729	35.536[a]	32.807[b]
50		10-16	34.333	32.781	35.573	32.807[b]
51		17-23	34.240	33.354	35.576	32.813
52		24-31	34.250	33.354	35.646	33.125
1678						
Week	Month	Day				
1	Jan.	1-7	34.188	33.333	35.750	33.250
2		8-14	34.156[a]	33.333[a]	35.729	33.312[a]
3		15-21	34.125	33.333	35.552	33.375
4		22-28	33.972	33.406	35.500	33.344[a]
5	Feb.	29-4	33.625	33.469	35.186[a]	33.312[a]
6		5-11	33.319	33.516	34.875	33.281[a]
7		12-18	33.000	33.594[*]	34.333	33.250
8		19-25	32.500	33.594	34.417	33.438
9	Mar.	26-4	32.111	33.354	34.271[a]	33.417[a]
10		5-11	32.569	33.438	34.125	33.396[a]
11		12-18	32.667	33.354	34.167	33.375
12		19-25	32.656	33.340	34.021[a]	33.314[b]
13	Apr.	26-1	32.583	33.333	33.875	33.250[b]
14		2-8	32.584	33.250	33.792[*]	33.185[b]
15		9-15	32.552[a]	33.193[a]	33.833	33.121[b]
16		16-22	32.521	33.135[a]	33.958[*]	33.059[b]

17		23-29	32.542	33.078	34.042	33.000
18	May	30-6	32.597	32.969	34.313	33.000
19		7-13	32.625	33.000	33.958*	32.938*
20		14-20	32.625	32.938	34.125	32.940b
21		21-27	32.667	33.063	34.198	32.945b
22	June	28-3	32.818a	33.031a	34.286a	32.953b
23		4-10	32.969	33.000	34.375	32.963b
24		11-17	33.361	33.094	34.441a	32.973b
25		18-24	33.584	33.063	34.508a	32.982b
26	July	25-1	33.750*	33.000*	34.574a	32.991b
27		2-8	33.667	32.969	34.641a	32.997b
28		9-15	33.555	32.938	34.708	33.001b
29		16-22	33.521	32.969	34.750	33.000
30		23-29	33.750	33.000	34.708	32.906
31	Aug.	30-5	33.570	33.042	34.708	33.000*
32		6-12	33.694	33.031	34.750*	33.000*
33		13-19	33.927	33.115	34.916a	33.050a
34		20-26	34.208	33.323	35.083	33.100a
35	Sep.	27-2	34.084	33.333	35.125a	33.150a
36		3-9	34.097	33.292	35.166a	33.200a
37		10-16	34.056	33.271	35.208	33.250
38		17-23	34.000	33.333	35.208	33.312a
39		24-30	34.111	33.338	35.229	33.375
40	Oct.	1-7	34.042	33.333	35.201b	33.337b
41		8-14	33.917*	33.250*	35.171b	33.296b
42		15-21	33.792a	33.187a	35.140b	33.251b
43		22-28	33.667	33.125	35.106b	33.203b
44	Nov.	29-4	33.688	33.000	35.071b	33.150b
45		5-11	33.681	32.990	35.034b	33.093b
46		12-18	33.736	33.000	34.995	33.031
47		19-25	33.688	33.031	34.917	32.875
48	Dec.	26-2	33.681	33.125	34.917a	32.917a
49		3-9	33.729	33.125	34.917a	32.958a
50		10-16	33.764	33.063	34.917	33.000a
51		17-23	33.792*	33.031a	35.125	33.042
52		24-31	33.917	33.000	35.167*	33.000*
1679						
Week	Month	Day				
1	Jan.	1-7	34.000	33.000	35.042	33.000
2		8-14	34.000	33.156	35.104a	33.031a
3		15-21	34.000	33.063	35.167	33.063
4		22-28	34.167	33.250	35.167a	33.075a
5	Feb.	29-4	34.083	33.172	35.167a	33.087a
6		5-11	34.031	33.094	35.167a	33.100a
7		12-18	34.083	33.094	35.167	33.112a
8		19-25	34.090	33.031	35.208	33.125
9	Mar.	26-4	34.188	32.758	35.354	33.062a
10		5-11	34.319	33.110	35.458	33.000
11		12-18	34.333	33.063	35.500	33.000
12		19-25	34.458*	33.125*	35.458	33.000
13	Apr.	26-1	34.458	33.094	35.482a	33.016a

14		2-8	34.396	33.031	35.507[a]	33.031[a]
15		9-15	34.354	32.985	35.531	33.047
16		16-22	34.354	33.000	35.563[b]	33.037[b]
17		23-29	34.448	32.914	35.595[b]	33.024[b]
18	May	30-6	34.486	32.896	35.627[b]	33.008[b]
19		7-13	34.611	32.927	35.659[b]	32.993[b]
20		14-20	34.667	32.969	35.691[b]	32.977[b]
21		21-27	34.625	33.000	35.721[b]	32.962[b]
22	June	28-3	34.542	33.000	35.750	32.950[b]
23		4-10	34.396	33.000	35.750[a]	32.941[b]
24		11-17	34.479	33.125	35.750[a]	32.937[b]
25		18-24	34.667	33.188	35.750	32.938
26	July	25-1	34.667	33.219	35.792	33.094
27		2-8	34.667	33.250	35.833	33.085[b]
28		9-15	34.694	33.135	35.861[a]	33.074[b]
29		16-22	34.625	33.188	35.889[a]	33.060[b]
30		23-29	34.708	33.063	35.917	33.045[b]
31	Aug.	30-5	34.708	33.000	36.042	33.027[b]
32		6-12	34.750	33.000	36.034[a]	33.009[b]
33		13-19	34.750	33.000	36.026	32.989[b]
34		20-26	34.750	33.094	36.063	32.968[b]
35	Sep.	27-2	34.802	33.063	36.000	32.946[b]
36		3-9	34.806	33.063	36.042	32.923[b]
37		10-16	34.792	33.094	36.021[a]	32.901[b]
38		17-23	34.833	33.125	36.000	32.878[b]
39		24-30	34.930	32.985	35.979[a]	32.856[b]
40	Oct.	1-7	35.125	32.375	35.958	32.834[b]
41		8-14	35.250	33.094	36.042	32.813[*]
42		15-21	35.052	32.922	36.035	32.750
43		22-28	34.771	33.016	35.875	32.750
44	Nov.	29-4	34.500	33.177	35.865[b]	32.801[b]
45		5-11	34.375	33.188	35.867[b]	32.854[b]
46		12-18	34.438	33.219	35.877[b]	32.909[b]
47		19-25	34.646	33.260	35.891[b]	32.966[b]
48	Dec.	26-2	34.833[*]	33.000[*]	35.906[b]	33.023[b]
49		3-9	34.688	33.276	35.917[*]	33.079[b]
50		10-16	34.667	33.328	35.927[a]	33.134[b]
51		17-23	34.625	33.313	35.938	33.438
52		24-31	34.611[a]	33.319[a]	35.917	33.398[a]
1680						
Week	Month	Day				
1	Jan.	1-7	34.597[a]	33.326[a]	35.924[a]	33.359[a]
2		8-14	34.583	33.333	35.910[a]	33.320[a]
3		15-21	34.438	33.344	35.896	33.281
4		22-28	34.417	33.406	35.906[a]	33.285[b]
5	Feb.	29-4	34.475	33.563	35.917	33.284[b]
6		5-11	34.389[*]	33.516[a]	36.083	33.276[b]
7		12-18	34.521	33.469	36.083[a]	33.261[b]
8		19-25	34.594[a]	33.401[a]	36.083	33.238[b]
9	Mar.	26-4	34.667	33.333	36.083[a]	33.208[b]
10		5-11	34.750	33.333	36.083	33.170[b]

11		12-18	34.729	33.333	36.073	33.125[b]
12		19-25	34.760[b]	33.333[b]	36.000	33.073[b]
13	Apr.	26-1	34.791[b]	33.333[b]	36.000	33.013[b]

Sources: Quotations from Roseveare (1987) with * and Appendix 4.A. H. Roseveare, *Markets and Merchants of the Late Seventeenth Century: the Marescoe-David Letters, 1668-1680* (Oxford, 1987), Appendix G.

Note: a. linear interpolation, b. cardinal spline interpolation and polynomial extrapolation

Appendix 4.C. The weekly direct- and cross- exchange rates between Hamburg and London and the differences, 1668-80

Date	Hamburg on London	Hamburg-Amsterdam-London	The difference
		1668-70	
1668-W1	34.750		
1668-W2	34.167	34.509	-0.342
1668-W3	34.000	34.418	-0.418
1668-W4	34.063	34.340	-0.277
1668-W5	34.063	34.187	-0.125
1668-W6	34.063	34.259	-0.197
1668-W7	34.063	34.176	-0.114
1668-W8	34.063	34.185	-0.122
1668-W9	34.278	34.438	-0.160
1668-W10	34.083	34.252	-0.168
1668-W11	34.167	34.218	-0.051
1668-W12	33.875	33.968	-0.093
1668-W13	33.900	33.835	0.065
1668-W14	33.695	33.816	-0.122
1668-W15	33.813	33.475	0.338
1668-W16	33.819	33.576	0.244
1668-W17	33.917	33.838	0.079
1668-W18	33.864	33.883	-0.018
1668-W19	33.792	33.811	-0.020
1668-W20	33.771	33.528	0.243
1668-W21	33.778	33.633	0.144
1668-W22	33.750	33.593	0.157
1668-W23	33.833	33.714	0.119
1668-W24	33.938	33.692	0.245
1668-W25	33.917	33.650	0.267
1668-W26	33.907	33.776	0.131
1668-W27	33.875	33.590	0.285
1668-W28	33.910	33.639	0.270
1668-W29	34.014	33.798	0.216
1668-W30	34.097	33.932	0.165
1668-W31	34.056	33.932	0.124
1668-W32	34.000	33.964	0.036
1668-W33	34.021	34.055	-0.035
1668-W34	34.000	34.045	-0.045
1668-W35	34.055	34.111	-0.055
1668-W36	34.177	34.074	0.103
1668-W37	34.261	34.044	0.216
1668-W38	34.417	34.044	0.373
1668-W39	34.542	34.085	0.457
1668-W40	34.542	34.201	0.341
1668-W41	34.500	34.269	0.231
1668-W42	34.542	34.347	0.195
1668-W43	34.563	34.280	0.283
1668-W44	34.500	34.362	0.138
1668-W45	34.479	34.316	0.163
1668-W46	34.403	34.296	0.107
1668-W47	34.417	34.271	0.146

1668-W48	34.389	34.418	-0.029
1668-W49	34.459	34.573	-0.115
1668-W50	34.500	34.621	-0.121
1668-W51	34.375	34.458	-0.083
1668-W52	34.467	34.362	0.105
1669-W1	34.458	34.349	0.109
1669-W2	34.528	34.480	0.047
1669-W3	34.597	34.429	0.169
1669-W4	34.667	34.398	0.269
1669-W5	34.792	34.377	0.415
1669-W6	34.688	34.534	0.153
1669-W7	34.667	34.652	0.015
1669-W8	34.750	34.789	-0.039
1669-W9	34.750	34.651	0.099
1669-W10	34.792	34.691	0.100
1669-W11	34.646	34.820	-0.174
1669-W12	34.583	34.731	-0.148
1669-W13	34.688	34.718	-0.030
1669-W14	34.563	34.656	-0.094
1669-W15	34.563	34.749	-0.186
1669-W16	34.542	34.759	-0.217
1669-W17	34.479	34.694	-0.215
1669-W18	34.511	34.663	-0.153
1669-W19	34.896	34.779	0.116
1669-W20	34.688	34.831	-0.143
1669-W21	34.667	34.831	-0.164
1669-W22	34.667	34.966	-0.299
1669-W23	34.667	35.101	-0.434
1669-W24	34.730	34.823	-0.093
1669-W25	34.709	34.723	-0.014
1669-W26	34.677	34.698	-0.021
1669-W27	34.417	34.690	-0.273
1669-W28	34.472	34.662	-0.190
1669-W29	34.458	34.597	-0.138
1669-W30	34.417	34.505	-0.088
1669-W31	34.479	34.434	0.045
1669-W32	34.417	34.581	-0.164
1669-W33	34.490	34.544	-0.055
1669-W34	34.521	34.535	-0.014
1669-W35	34.583	34.524	0.059
1669-W36	34.556	34.789	-0.234
1669-W37	34.542	34.753	-0.212
1669-W38	34.688	34.732	-0.044
1669-W39	34.736	34.818	-0.082
1669-W40	34.646	34.693	-0.047
1669-W41	34.719	34.716	0.003
1669-W42	34.792	34.787	0.005
1669-W43	34.813	34.760	0.052
1669-W44	34.875	34.752	0.123
1669-W45	34.917	34.718	0.199
1669-W46	34.802	34.730	0.072

1669-W47	34.854	34.859	-0.005
1669-W48	34.854	34.930	-0.075
1669-W49	34.861	34.958	-0.097
1669-W50	34.771	34.788	-0.017
1669-W51	34.656	34.698	-0.042
1669-W52	34.583	34.472	0.111
1670-W1	34.500	34.696	-0.196
1670-W2	34.486	34.614	-0.128
1670-W3	34.542	34.497	0.045
1670-W4	34.625	34.677	-0.052
1670-W5	34.667	34.815	-0.148
		1671-3	
1671-W14	34.636	34.670	-0.035
1671-W15	34.667	34.681	-0.014
1671-W16	34.667	34.681	-0.014
1671-W17	34.542	34.658	-0.117
1671-W18	34.375	34.646	-0.271
1671-W19	34.363	34.446	-0.083
1671-W20	34.406	34.435	-0.029
1671-W21	34.442	34.264	0.178
1671-W22	34.469	34.309	0.159
1671-W23	34.347	34.325	0.022
1671-W24	34.292	34.320	-0.029
1671-W25	34.222	34.251	-0.029
1671-W26	34.201	34.383	-0.182
1671-W27	34.167	34.498	-0.331
1671-W28	34.208	34.380	-0.172
1671-W29	34.312	34.286	0.027
1671-W30	34.300	34.473	-0.173
1671-W31	34.347	34.449	-0.102
1671-W32	34.431	34.567	-0.136
1671-W33	34.396	34.605	-0.209
1671-W34	34.408	34.621	-0.213
1671-W35	34.417	34.769	-0.352
1671-W36	34.448	34.773	-0.325
1671-W37	34.552	34.732	-0.180
1671-W38	34.604	34.549	0.055
1671-W39	34.542	34.499	0.043
1671-W40	34.459	34.576	-0.117
1671-W41	34.347	34.355	-0.007
1671-W42	34.208	34.342	-0.134
1671-W43	34.125	34.381	-0.256
1671-W44	34.146	34.242	-0.096
1671-W45	34.188	34.174	0.014
1671-W46	34.195	34.133	0.062
1671-W47	34.271	34.087	0.184
1671-W48	34.242	34.133	0.108
1671-W49	34.319	34.081	0.238
1671-W50	34.333	34.210	0.123
1671-W51	34.305	34.201	0.104
1671-W52	34.250	34.107	0.143

1672-W1	34.208	34.168	0.040
1672-W2	34.167	34.310	-0.143
1672-W3	34.355	34.392	-0.037
1672-W4	34.250	34.311	-0.061
1672-W5	34.250	34.442	-0.192
1672-W6	34.333	34.508	-0.175
1672-W7	34.375	34.516	-0.141
1672-W8	34.479	34.820	-0.341
1672-W9	34.542	34.921	-0.379
1672-W10	34.771	34.954	-0.183
1672-W11	34.717	35.263	-0.547
1672-W12	34.283	35.044	-0.761
1672-W13	32.819	34.815	-1.995
1672-W14	32.854	33.683	-0.829
1672-W15	32.959	32.634	0.325
1672-W16	32.951	32.953	-0.001
1672-W17	32.944	32.985	-0.040
1672-W18	32.944	32.861	0.083
1672-W19	32.958	32.719	0.239
1672-W20	32.813	32.628	0.184
1672-W21	32.764	32.966	-0.202
1672-W22	32.750	32.291	0.459
1672-W23	32.667	31.434	1.232
1672-W24	33.000	31.951	1.049
1672-W25	32.677	30.925	1.752
1672-W26	32.750	35.143	-2.393
1672-W27	32.792	35.016	-2.224
1672-W28	32.833	33.199	-0.366
1672-W29	33.125	33.488	-0.363
1672-W30	33.042	33.629	-0.588
1672-W31	32.917	33.659	-0.743
1672-W32	32.979	33.664	-0.685
1672-W33	33.063	33.843	-0.780
1672-W34	33.083	33.667	-0.584
1672-W35	33.000	33.340	-0.340
1672-W36	33.000	32.983	0.017
1672-W37	33.042	33.176	-0.134
1672-W38	33.417	33.226	0.191
1672-W39	33.625	33.678	-0.053
1672-W40	33.611	33.923	-0.311
1672-W41	33.667	33.943	-0.276
1672-W42	33.567	34.015	-0.448
1672-W43	33.403	33.219	0.184
1672-W44	33.146	33.178	-0.033
1672-W45	33.125	33.185	-0.060
1672-W46	33.209	33.371	-0.163
1672-W47	33.354	33.185	0.169
1672-W48	33.313	33.538	-0.226
1672-W49	33.500	33.592	-0.092
1672-W50	33.500	33.571	-0.071
1672-W51	33.667	33.695	-0.028

1672-W52	33.729	33.593	0.136
1673-W1	33.750	33.656	0.094
1673-W2	33.729	33.823	-0.094
1673-W3	33.708	33.771	-0.063
1673-W4	33.750	33.668	0.082
1673-W5	33.458	34.250	-0.792
1673-W6	33.479	33.962	-0.483
1673-W7	33.500	33.553	-0.053
1673-W8	33.416	33.577	-0.160
1673-W9	33.333	33.559	-0.226
1673-W10	33.305	33.349	-0.043
1673-W11	33.167	33.317	-0.150
1673-W12	33.083	33.317	-0.234

1674-80

1674-W50	31.583	31.730	-0.146
1674-W51	31.563	31.626	-0.063
1674-W52	31.569	31.796	-0.227
1675-W1	31.583	31.624	-0.041
1675-W2	31.597	31.615	-0.018
1675-W3	31.583	31.474	0.109
1675-W4	31.375	31.427	-0.052
1675-W5	31.514	31.636	-0.122
1675-W6	31.594	31.750	-0.156
1675-W7	31.781	31.827	-0.046
1675-W8	31.819	31.837	-0.017
1675-W9	31.917	32.155	-0.238
1675-W10	31.979	32.096	-0.117
1675-W11	32.125	32.091	0.034
1675-W12	32.055	32.101	-0.046
1675-W13	32.042	32.145	-0.103
1675-W14	32.104	32.053	0.051
1675-W15	32.125	31.991	0.134
1675-W16	32.108	31.941	0.167
1675-W17	31.889	31.962	-0.073
1675-W18	32.333	32.077	0.256
1675-W19	32.188	32.141	0.046
1675-W20	32.302	32.221	0.081
1675-W21	32.224	32.053	0.171
1675-W22	32.146	31.961	0.184
1675-W23	32.014	32.033	-0.020
1675-W24	32.000	32.039	-0.039
1675-W25	32.069	32.019	0.050
1675-W26	32.069	32.048	0.022
1675-W27	32.188	32.091	0.097
1675-W28	32.194	32.183	0.012
1675-W29	32.236	32.327	-0.091
1675-W30	32.208	32.308	-0.100
1675-W31	32.333	32.347	-0.014
1675-W32	32.313	32.423	-0.111
1675-W33	32.344	32.502	-0.158
1675-W34	32.417	32.659	-0.242

1675-W35	32.531	32.635	-0.104
1675-W36	32.597	32.699	-0.102
1675-W37	32.569	32.639	-0.070
1675-W38	32.542	32.618	-0.076
1675-W39	32.521	32.619	-0.098
1675-W40	32.563	32.549	0.013
1675-W41	32.528	32.779	-0.252
1675-W42	32.625	32.560	0.065
1675-W43	32.625	32.576	0.049
1675-W44	32.625	32.612	0.013
1675-W45	32.750	32.698	0.052
1675-W46	32.908	32.760	0.149
1675-W47	33.083	32.870	0.213
1675-W48	32.958	32.951	0.008
1675-W49	32.931	32.943	-0.013
1675-W50	33.042	32.884	0.157
1675-W51	33.563	32.824	0.738
1675-W52	33.083	32.834	0.249
1676-W1	33.417	32.963	0.454
1676-W2	33.157	33.051	0.105
1676-W3	33.195	32.961	0.234
1676-W4	33.111	32.870	0.241
1676-W5	33.111	32.944	0.167
1676-W6	33.250	32.928	0.322
1676-W7	32.917	33.034	-0.117
1676-W8	33.153	33.224	-0.071
1676-W9	33.125	33.203	-0.078
1676-W10	33.264	33.261	0.003
1676-W11	33.292	33.322	-0.030
1676-W12	33.222	33.328	-0.106
1676-W13	33.250	33.350	-0.100
1676-W14	33.240	33.277	-0.037
1676-W15	33.222	33.224	-0.002
1676-W16	33.167	33.252	-0.085
1676-W17	33.236	33.280	-0.044
1676-W18	33.333	33.260	0.073
1676-W19	33.333	33.241	0.092
1676-W20	33.396	33.312	0.084
1676-W21	33.458	33.401	0.057
1676-W22	33.271	33.786	-0.515
1676-W23	33.431	33.587	-0.157
1676-W24	33.650	33.492	0.158
1676-W25	33.740	33.685	0.055
1676-W26	33.847	33.853	-0.006
1676-W27	34.208	34.088	0.120
1676-W28	34.208	34.146	0.062
1676-W29	34.209	34.039	0.169
1676-W30	34.167	34.196	-0.029
1676-W31	34.333	34.270	0.063
1676-W32	34.333	34.186	0.147
1676-W33	34.347	34.154	0.193

1676-W34	34.354	34.149	0.205
1676-W35	34.188	34.069	0.118
1676-W36	34.229	33.884	0.345
1676-W37	34.302	33.907	0.395
1676-W38	34.333	34.228	0.105
1676-W39	34.333	34.386	-0.053
1676-W40	34.250	34.449	-0.199
1676-W41	34.281	34.464	-0.183
1676-W42	34.313	34.426	-0.114
1676-W43	34.333	34.439	-0.106
1676-W44	34.417	34.460	-0.043
1676-W45	34.667	34.458	0.209
1676-W46	34.583	34.468	0.115
1676-W47	34.646	34.478	0.168
1676-W48	34.667	34.596	0.071
1676-W49	34.667	34.696	-0.029
1676-W50	34.667	34.781	-0.114
1676-W51	34.750	34.841	-0.091
1676-W52	34.651	34.821	-0.170
1677-W1	34.551	34.801	-0.249
1677-W2	34.453	34.801	-0.348
1677-W3	34.354	34.702	-0.348
1677-W4	34.583	34.584	-0.001
1677-W5	34.542	34.682	-0.140
1677-W6	34.653	34.550	0.103
1677-W7	34.514	34.594	-0.080
1677-W8	34.569	34.605	-0.036
1677-W9	34.636	34.548	0.088
1677-W10	34.653	34.628	0.024
1677-W11	34.646	34.596	0.050
1677-W12	34.667	34.721	-0.054
1677-W13	34.667	34.807	-0.140
1677-W14	34.750	34.820	-0.070
1677-W15	34.750	34.866	-0.116
1677-W16	34.688	34.787	-0.100
1677-W17	34.698	34.780	-0.082
1677-W18	34.709	34.698	0.011
1677-W19	34.708	34.629	0.079
1677-W20	34.667	34.560	0.107
1677-W21	34.709	34.677	0.032
1677-W22	34.708	34.789	-0.081
1677-W23	34.708	34.742	-0.034
1677-W24	34.708	34.788	-0.080
1677-W25	34.667	34.763	-0.096
1677-W26	34.688	34.763	-0.075
1677-W27	34.750	34.730	0.020
1677-W28	34.688	34.763	-0.075
1677-W29	34.750	34.735	0.015
1677-W30	34.750	34.599	0.151
1677-W31	34.750	34.726	0.024
1677-W32	34.750	34.712	0.038

1677-W33	34.667	34.582	0.085
1677-W34	34.709	34.683	0.025
1677-W35	34.729	34.640	0.089
1677-W36	34.625	34.825	-0.200
1677-W37	34.667	34.777	-0.110
1677-W38	34.615	34.558	0.057
1677-W39	34.583	34.417	0.166
1677-W40	34.611	34.438	0.173
1677-W41	34.583	34.438	0.145
1677-W42	34.646	34.452	0.194
1677-W43	34.625	34.527	0.098
1677-W44	34.625	34.465	0.160
1677-W45	34.555	34.414	0.141
1677-W46	34.521	34.376	0.145
1677-W47	34.500	34.513	-0.013
1677-W48	34.459	34.604	-0.146
1677-W49	34.417	34.620	-0.204
1677-W50	34.333	34.362	-0.028
1677-W51	34.240	34.129	0.111
1677-W52	34.250	34.132	0.118
1678-W1	34.188	34.221	-0.033
1678-W2	34.156	34.320	-0.164
1678-W3	34.125	34.300	-0.175
1678-W4	33.972	34.055	-0.083
1678-W5	33.625	33.942	-0.317
1678-W6	33.319	33.595	-0.276
1678-W7	33.000	33.220	-0.220
1678-W8	32.500	32.704	-0.204
1678-W9	32.111	32.896	-0.785
1678-W10	32.569	32.797	-0.228
1678-W11	32.667	32.740	-0.073
1678-W12	32.656	32.794	-0.138
1678-W13	32.583	32.660	-0.077
1678-W14	32.584	32.602	-0.018
1678-W15	32.552	32.578	-0.025
1678-W16	32.521	32.674	-0.153
1678-W17	32.542	32.851	-0.310
1678-W18	32.597	33.041	-0.444
1678-W19	32.625	33.273	-0.648
1678-W20	32.625	32.992	-0.367
1678-W21	32.667	33.028	-0.361
1678-W22	32.818	33.130	-0.313
1678-W23	32.969	33.247	-0.279
1678-W24	33.361	33.239	0.122
1678-W25	33.584	33.335	0.249
1678-W26	33.750	33.462	0.288
1678-W27	33.667	33.558	0.109
1678-W28	33.555	33.655	-0.100
1678-W29	33.521	33.688	-0.167
1678-W30	33.750	33.697	0.053
1678-W31	33.570	33.614	-0.044

1678-W32	33.694	33.624	0.070
1678-W33	33.927	33.580	0.347
1678-W34	33.979	33.530	0.449
1678-W35	34.084	33.680	0.403
1678-W36	34.097	33.762	0.335
1678-W37	34.056	33.823	0.233
1678-W38	34.000	33.800	0.200
1678-W39	34.111	33.795	0.317
1678-W40	34.042	33.820	0.221
1678-W41	33.917	33.805	0.112
1678-W42	33.792	33.782	0.009
1678-W43	33.667	33.854	-0.187
1678-W44	33.688	33.989	-0.301
1678-W45	33.681	34.045	-0.364
1678-W46	33.736	33.933	-0.197
1678-W47	33.688	33.903	-0.215
1678-W48	33.681	33.731	-0.050
1678-W49	33.729	33.731	-0.002
1678-W50	33.764	33.795	-0.031
1678-W51	33.792	33.827	-0.035
1678-W52	33.917	34.061	-0.144
1679-W1	34.000	34.101	-0.101
1679-W2	34.000	33.820	0.180
1679-W3	34.000	33.976	0.024
1679-W4	34.167	33.845	0.322
1679-W5	34.083	33.925	0.158
1679-W6	34.031	34.005	0.027
1679-W7	34.083	34.005	0.078
1679-W8	34.090	34.069	0.021
1679-W9	34.188	34.394	-0.206
1679-W10	34.319	34.169	0.150
1679-W11	34.333	34.319	0.014
1679-W12	34.458	34.294	0.164
1679-W13	34.458	34.286	0.172
1679-W14	34.396	34.375	0.021
1679-W15	34.354	34.447	-0.093
1679-W16	34.354	34.454	-0.100
1679-W17	34.448	34.521	-0.073
1679-W18	34.486	34.657	-0.171
1679-W19	34.611	34.613	-0.002
1679-W20	34.667	34.524	0.143
1679-W21	34.625	34.469	0.156
1679-W22	34.542	34.634	-0.092
1679-W23	34.396	34.667	-0.271
1679-W24	34.479	34.536	-0.057
1679-W25	34.667	34.471	0.196
1679-W26	34.667	34.438	0.229
1679-W27	34.667	34.446	0.221
1679-W28	34.694	34.605	0.089
1679-W29	34.625	34.578	0.047
1679-W30	34.708	34.736	-0.028

1679-W31	34.708	34.829	-0.121
1679-W32	34.750	34.950	-0.200
1679-W33	34.750	34.942	-0.192
1679-W34	34.750	34.836	-0.086
1679-W35	34.802	34.904	-0.102
1679-W36	34.806	34.843	-0.037
1679-W37	34.792	34.851	-0.059
1679-W38	34.833	34.798	0.035
1679-W39	34.930	34.925	0.005
1679-W40	35.125	35.562	-0.437
1679-W41	35.250	35.303	-0.053
1679-W42	35.052	35.066	-0.014
1679-W43	34.771	34.926	-0.156
1679-W44	34.500	34.602	-0.102
1679-W45	34.375	34.740	-0.365
1679-W46	34.438	34.660	-0.222
1679-W47	34.646	34.520	0.126
1679-W48	34.833	34.922	-0.089
1679-W49	34.688	34.572	0.115
1679-W50	34.667	34.486	0.181
1679-W51	34.625	34.512	0.113
1679-W52	34.611	34.514	0.097
1680-W1	34.597	34.488	0.109
1680-W2	34.583	34.487	0.096
1680-W3	34.438	34.463	-0.025
1680-W4	34.417	34.385	0.032
1680-W5	34.475	34.235	0.240
1680-W6	34.389	34.293	0.096
1680-W7	34.521	34.500	0.021
1680-W8	34.594	34.570	0.024
1680-W9	34.667	34.640	0.027
1680-W10	34.750	34.640	0.110
1680-W11	34.729	34.640	0.089
1680-W12	34.701	34.623	0.078
1680-W13	34.739	34.563	0.176

Source: Appendix 4.A and 4.B

Note: The exchange rates are quoted at a variable number of schelling-Flemish for £1 sterling. The Hamburg-Amsterdam-London cross exchange rates are calculated on the following formula, $E_t^{HAL} = \frac{E_{t-4}^{AL}}{E_t^{HA}} * 32$, where E^{AL}, E^{HA} and E^{HAL} are designated as the Amsterdam-London, Hamburg-Amsterdam and Hamburg-Amsterdam-London exchange rates, respectively.

Appendix 4.D. The weekly direct- and cross- exchange rates between Amsterdam and London and the differences, 1668-80

	Amsterdam on London	Amsterdam-Hamburg-London	The difference
		1668-70	
1668-W1	34.750		
1668-W2	35.479	35.661	-0.182
1668-W3	35.500	34.981	0.519
1668-W4	35.416	34.883	0.533
1668-W5	35.375	34.886	0.489
1668-W6	35.333	34.896	0.437
1668-W7	35.300	34.867	0.433
1668-W8	35.333	34.959	0.374
1668-W9	35.333	34.931	0.402
1668-W10	35.354	35.044	0.310
1668-W11	35.063	35.015	0.047
1668-W12	34.959	35.101	-0.143
1668-W13	34.917	34.669	0.248
1668-W14	34.521	34.827	-0.306
1668-W15	34.625	33.826	0.799
1668-W16	34.906	34.457	0.450
1668-W17	34.958	34.678	0.280
1668-W18	34.917	34.910	0.007
1668-W19	34.625	34.790	-0.165
1668-W20	34.750	34.781	-0.031
1668-W21	34.708	34.694	0.014
1668-W22	34.833	34.756	0.077
1668-W23	34.833	34.772	0.061
1668-W24	34.833	34.824	0.009
1668-W25	34.930	35.031	-0.101
1668-W26	34.771	34.977	-0.206
1668-W27	34.833	34.933	-0.100
1668-W28	34.986	34.967	0.019
1668-W29	35.125	34.970	0.155
1668-W30	35.125	35.110	0.015
1668-W31	35.125	35.296	-0.171
1668-W32	35.097	35.170	-0.073
1668-W33	35.042	35.063	-0.020
1668-W34	35.094	34.885	0.209
1668-W35	35.083	34.863	0.220
1668-W36	35.000	34.920	0.080
1668-W37	35.042	35.045	-0.003
1668-W38	35.083	35.164	-0.081
1668-W39	35.063	35.358	-0.295
1668-W40	35.084	35.554	-0.470
1668-W41	35.136	35.301	-0.165
1668-W42	35.083	35.174	-0.091
1668-W43	35.167	35.216	-0.049
1668-W44	35.188	35.254	-0.067
1668-W45	35.167	35.174	-0.007
1668-W46	35.208	35.203	0.005
1668-W47	35.292	35.176	0.116

1668-W48	35.451	35.224	0.228
1668-W49	35.500	35.161	0.339
1668-W50	35.333	35.199	0.134
1668-W51	35.167	35.241	-0.074
1668-W52	35.188	35.114	0.074
1669-W1	35.333	35.207	0.126
1669-W2	35.292	35.198	0.093
1669-W3	35.271	35.337	-0.066
1669-W4	35.250	35.340	-0.090
1669-W5	35.344	35.446	-0.102
1669-W6	35.396	35.302	0.094
1669-W7	35.333	35.517	-0.184
1669-W8	35.328	35.462	-0.134
1669-W9	35.403	35.497	-0.094
1669-W10	35.500	35.429	0.071
1669-W11	35.410	35.386	0.024
1669-W12	35.396	35.187	0.209
1669-W13	35.333	35.124	0.209
1669-W14	35.292	35.162	0.130
1669-W15	35.302	35.069	0.233
1669-W16	35.271	35.035	0.235
1669-W17	35.250	35.025	0.225
1669-W18	35.323	34.950	0.372
1669-W19	35.375	34.982	0.393
1669-W20	35.375	35.398	-0.023
1669-W21	35.375	35.213	0.162
1669-W22	35.375	35.141	0.234
1669-W23	35.333	35.141	0.192
1669-W24	35.266	35.141	0.125
1669-W25	35.229	35.204	0.025
1669-W26	35.240	35.115	0.124
1669-W27	35.229	35.083	0.146
1669-W28	35.250	34.887	0.363
1669-W29	35.229	35.011	0.218
1669-W30	35.208	35.022	0.186
1669-W31	35.375	35.005	0.370
1669-W32	35.354	35.085	0.269
1669-W33	35.333	35.022	0.311
1669-W34	35.333	35.163	0.170
1669-W35	35.333	35.094	0.239
1669-W36	35.347	35.225	0.122
1669-W37	35.410	35.146	0.264
1669-W38	35.396	35.107	0.289
1669-W39	35.438	35.229	0.209
1669-W40	35.292	35.109	0.182
1669-W41	35.194	34.939	0.255
1669-W42	35.156	35.024	0.132
1669-W43	35.125	35.064	0.061
1669-W44	35.125	35.084	0.040
1669-W45	35.115	35.159	-0.044
1669-W46	35.115	35.156	-0.041

1669-W47	35.083	35.040	0.043
1669-W48	35.083	35.126	-0.043
1669-W49	34.958	34.990	-0.032
1669-W50	34.834	34.861	-0.027
1669-W51	34.542	34.805	-0.263
1669-W52	34.459	34.115	0.344
1670-W1	34.344	33.874	0.470
1670-W2	34.396	34.044	0.352
1670-W3	34.542	34.284	0.258
1670-W4	34.730	34.171	0.559
1670-W5	34.750	34.490	0.260
		1671-3	
1671-W14	35.833	35.716	0.117
1671-W15	35.833	35.718	0.115
1671-W16	35.787	35.700	0.087
1671-W17	35.771	35.691	0.080
1671-W18	35.646	35.554	0.092
1671-W19	35.646	35.382	0.264
1671-W20	35.625	35.101	0.524
1671-W21	35.701	35.498	0.203
1671-W22	35.726	35.610	0.115
1671-W23	35.750	35.714	0.036
1671-W24	35.708	35.748	-0.040
1671-W25	35.771	35.720	0.051
1671-W26	35.875	35.648	0.227
1671-W27	35.813	35.537	0.275
1671-W28	35.833	35.368	0.465
1671-W29	35.907	35.511	0.395
1671-W30	35.907	35.602	0.304
1671-W31	35.917	35.774	0.143
1671-W32	35.889	35.778	0.111
1671-W33	35.861	35.820	0.041
1671-W34	35.833	35.739	0.094
1671-W35	35.792	35.634	0.158
1671-W36	35.750	35.525	0.225
1671-W37	35.646	35.440	0.206
1671-W38	35.667	35.430	0.237
1671-W39	35.792	35.449	0.342
1671-W40	35.563	35.486	0.076
1671-W41	35.583	35.485	0.098
1671-W42	35.573	35.354	0.219
1671-W43	35.438	35.194	0.244
1671-W44	35.375	35.091	0.284
1671-W45	35.333	35.146	0.187
1671-W46	35.285	35.167	0.118
1671-W47	35.292	35.152	0.140
1671-W48	35.313	35.275	0.037
1671-W49	35.479	35.245	0.234
1671-W50	35.563	35.291	0.271
1671-W51	35.528	35.389	0.139
1671-W52	35.514	35.065	0.449

1672-W1	35.583	35.488	0.096
1672-W2	35.601	35.311	0.290
1672-W3	35.618	35.285	0.334
1672-W4	35.653	35.470	0.183
1672-W5	35.688	35.353	0.334
1672-W6	35.528	35.287	0.241
1672-W7	35.500	35.272	0.228
1672-W8	35.500	35.315	0.185
1672-W9	35.500	35.265	0.235
1672-W10	35.625	35.081	0.544
1672-W11	35.427	35.094	0.334
1672-W12	35.438	35.124	0.314
1672-W13	34.083	34.752	-0.669
1672-W14	33.125	33.204	-0.079
1672-W15	33.458	33.169	0.289
1672-W16	33.500	33.205	0.295
1672-W17	33.583	33.128	0.455
1672-W18	33.667	33.395	0.272
1672-W19	33.521	33.491	0.029
1672-W20	33.526	33.602	-0.076
1672-W21	33.552	33.582	-0.030
1672-W22	33.583	33.340	0.243
1672-W23	33.573	33.134	0.439
1672-W24	33.583	34.708	-1.125
1672-W25	37.708	38.672	-0.963
1672-W26	37.125	37.528	-0.403
1672-W27	35.533	33.944	1.589
1672-W28	35.319	34.393	0.926
1672-W29	35.521	34.533	0.988
1672-W30	35.500	34.807	0.693
1672-W31	35.417	34.720	0.697
1672-W32	35.209	34.588	0.620
1672-W33	34.861	34.364	0.497
1672-W34	34.333	34.354	-0.021
1672-W35	33.729	34.149	-0.420
1672-W36	33.875	33.881	-0.006
1672-W37	33.875	33.859	0.016
1672-W38	34.271	33.816	0.454
1672-W39	34.239	34.045	0.194
1672-W40	34.208	34.101	0.107
1672-W41	34.264	34.005	0.258
1672-W42	34.063	33.799	0.264
1672-W43	34.021	33.720	0.301
1672-W44	33.833	33.664	0.169
1672-W45	33.719	33.469	0.250
1672-W46	33.833	33.384	0.449
1672-W47	33.833	33.533	0.300
1672-W48	33.854	33.615	0.239
1672-W49	33.834	33.508	0.326
1672-W50	33.958	33.631	0.327
1672-W51	33.938	33.664	0.274

1672-W52	34.083	33.799	0.284
1673-W1	34.236	34.190	0.046
1673-W2	34.167	33.948	0.219
1673-W3	34.194	34.042	0.153
1673-W4	34.250	34.103	0.147
1673-W5	34.292	34.189	0.103
1673-W6	34.208	33.937	0.271
1673-W7	34.167	34.002	0.165
1673-W8	34.083	34.023	0.060
1673-W9	34.000	33.939	0.061
1673-W10	34.000	33.854	0.146
1673-W11	34.000	33.826	0.174
1673-W12	33.938	33.750	0.187
		1674-80	
1674-W50	34.215	34.062	0.153
1674-W51	34.212	34.154	0.058
1674-W52	34.167	34.053	0.114
1675-W1	34.229	34.036	0.194
1675-W2	34.302	34.112	0.190
1675-W3	34.296	34.096	0.200
1675-W4	34.375	34.220	0.155
1675-W5	34.370	34.041	0.329
1675-W6	34.417	34.099	0.318
1675-W7	34.459	34.170	0.289
1675-W8	34.667	34.311	0.356
1675-W9	34.604	34.290	0.314
1675-W10	34.583	34.285	0.298
1675-W11	34.589	34.446	0.142
1675-W12	34.594	34.509	0.084
1675-W13	34.526	34.403	0.123
1675-W14	34.552	34.357	0.195
1675-W15	34.569	34.476	0.093
1675-W16	34.604	34.540	0.064
1675-W17	34.708	34.593	0.115
1675-W18	34.778	34.427	0.351
1675-W19	34.917	34.670	0.247
1675-W20	34.833	34.702	0.131
1675-W21	34.833	34.826	0.007
1675-W22	34.833	34.836	-0.003
1675-W23	34.792	34.845	-0.053
1675-W24	34.771	34.718	0.053
1675-W25	34.833	34.719	0.115
1675-W26	34.833	34.747	0.086
1675-W27	34.875	34.700	0.175
1675-W28	35.000	34.828	0.172
1675-W29	34.990	34.835	0.154
1675-W30	35.000	34.881	0.119
1675-W31	35.083	34.850	0.233
1675-W32	35.083	34.859	0.224
1675-W33	35.083	34.837	0.246
1675-W34	35.042	34.760	0.282

1675-W35	35.083	34.728	0.355
1675-W36	35.083	34.819	0.264
1675-W37	35.167	34.953	0.214
1675-W38	35.167	34.987	0.180
1675-W39	35.188	34.830	0.357
1675-W40	35.292	34.935	0.357
1675-W41	35.135	35.011	0.124
1675-W42	35.132	35.026	0.105
1675-W43	35.128	35.184	-0.056
1675-W44	35.125	35.238	-0.113
1675-W45	35.153	35.109	0.043
1675-W46	35.181	35.116	0.065
1675-W47	35.209	35.157	0.051
1675-W48	35.292	35.215	0.077
1675-W49	35.250	35.050	0.200
1675-W50	35.261	34.989	0.272
1675-W51	35.463	35.171	0.292
1675-W52	35.667	35.791	-0.124
1676-W1	35.634	35.357	0.276
1676-W2	35.600	35.792	-0.192
1676-W3	35.567	35.591	-0.024
1676-W4	35.533	35.710	-0.177
1676-W5	35.500	35.698	-0.198
1676-W6	35.583	35.568	0.015
1676-W7	35.625	35.620	0.005
1676-W8	35.667	35.167	0.500
1676-W9	35.708	35.646	0.062
1676-W10	35.698	35.648	0.050
1676-W11	35.688	35.831	-0.143
1676-W12	35.695	35.616	0.078
1676-W13	35.660	35.546	0.114
1676-W14	35.625	35.580	0.045
1676-W15	35.687	35.573	0.115
1676-W16	35.750	35.558	0.192
1676-W17	35.729	35.539	0.190
1676-W18	35.708	35.654	0.054
1676-W19	35.719	35.791	-0.072
1676-W20	35.750	35.677	0.073
1676-W21	35.865	35.874	-0.010
1676-W22	35.818	35.806	0.012
1676-W23	35.771	35.546	0.225
1676-W24	35.922	35.699	0.223
1676-W25	35.903	35.773	0.130
1676-W26	35.969	35.891	0.078
1676-W27	36.114	35.735	0.379
1676-W28	36.100	36.212	-0.112
1676-W29	36.167	36.044	0.123
1676-W30	36.111	35.877	0.234
1676-W31	36.056	35.667	0.388
1676-W32	36.000	35.674	0.326
1676-W33	36.250	36.211	0.039

1676-W34	36.215	36.036	0.180
1676-W35	36.167	36.266	-0.099
1676-W36	36.208	36.140	0.068
1676-W37	36.333	36.235	0.099
1676-W38	36.333	36.513	-0.180
1676-W39	36.333	36.345	-0.011
1676-W40	36.271	36.278	-0.007
1676-W41	36.208	36.023	0.185
1676-W42	36.188	36.005	0.182
1676-W43	36.188	35.988	0.200
1676-W44	36.208	35.942	0.266
1676-W45	36.219	36.098	0.121
1676-W46	36.229	36.292	-0.063
1676-W47	36.302	36.238	0.064
1676-W48	36.391	36.321	0.070
1676-W49	36.479	36.360	0.119
1676-W50	36.542	36.360	0.182
1676-W51	36.521	36.326	0.195
1676-W52	36.500	36.379	0.121
1677-W1	36.500	36.342	0.158
1677-W2	36.396	36.138	0.258
1677-W3	36.385	35.984	0.402
1677-W4	36.375	35.830	0.545
1677-W5	36.271	36.306	-0.035
1677-W6	36.260	36.178	0.083
1677-W7	36.250	36.210	0.040
1677-W8	36.167	36.064	0.103
1677-W9	36.167	36.122	0.045
1677-W10	36.167	36.191	-0.024
1677-W11	36.167	36.209	-0.042
1677-W12	36.167	36.168	-0.001
1677-W13	36.181	36.164	0.017
1677-W14	36.194	36.138	0.057
1677-W15	36.208	36.198	0.010
1677-W16	36.215	36.017	0.198
1677-W17	36.143	35.937	0.206
1677-W18	36.072	35.933	0.139
1677-W19	36.000	35.929	0.071
1677-W20	36.031	35.911	0.120
1677-W21	36.063	35.852	0.211
1677-W22	36.031	35.878	0.153
1677-W23	36.000	35.860	0.140
1677-W24	35.917	35.826	0.091
1677-W25	35.917	35.793	0.124
1677-W26	35.917	35.716	0.201
1677-W27	35.917	35.704	0.213
1677-W28	35.948	35.768	0.180
1677-W29	35.917	35.771	0.146
1677-W30	36.083	35.915	0.168
1677-W31	36.109	35.994	0.115
1677-W32	36.136	36.074	0.062

1677-W33	36.083	36.096	-0.013
1677-W34	36.083	36.032	0.051
1677-W35	36.083	36.098	-0.015
1677-W36	36.000	36.034	-0.034
1677-W37	35.938	35.842	0.095
1677-W38	35.896	35.750	0.146
1677-W39	35.903	35.658	0.245
1677-W40	35.910	35.542	0.368
1677-W41	35.917	35.628	0.289
1677-W42	35.875	35.563	0.312
1677-W43	35.834	35.627	0.207
1677-W44	35.792	35.606	0.186
1677-W45	35.719	35.578	0.141
1677-W46	35.646	35.549	0.097
1677-W47	35.573	35.530	0.043
1677-W48	35.500	35.388	0.112
1677-W49	35.536	35.475	0.061
1677-W50	35.573	35.304	0.269
1677-W51	35.576	35.205	0.371
1677-W52	35.646	35.443	0.203
1678-W1	35.750	35.588	0.162
1678-W2	35.729	35.556	0.173
1678-W3	35.552	35.557	-0.005
1678-W4	35.500	35.508	-0.008
1678-W5	35.186	35.333	-0.146
1678-W6	34.875	34.955	-0.080
1678-W7	34.333	34.621	-0.288
1678-W8	34.417	34.482	-0.066
1678-W9	34.271	33.939	0.332
1678-W10	34.125	33.512	0.613
1678-W11	34.167	33.969	0.198
1678-W12	34.021	34.007	0.014
1678-W13	33.875	33.931	-0.056
1678-W14	33.792	33.792	0.000
1678-W15	33.833	33.729	0.104
1678-W16	33.958	33.633	0.326
1678-W17	34.042	33.537	0.504
1678-W18	34.313	33.558	0.754
1678-W19	33.958	33.552	0.406
1678-W20	34.125	33.611	0.514
1678-W21	34.198	33.583	0.615
1678-W22	34.286	33.645	0.641
1678-W23	34.375	33.751	0.624
1678-W24	34.441	33.903	0.538
1678-W25	34.508	34.404	0.104
1678-W26	34.574	34.558	0.016
1678-W27	34.641	34.729	-0.088
1678-W28	34.708	34.648	0.060
1678-W29	34.750	34.604	0.146
1678-W30	34.708	34.470	0.238
1678-W31	34.708	34.805	-0.097

1678-W32	34.750	34.619	0.131
1678-W33	34.916	34.800	0.116
1678-W34	35.083	35.093	-0.010
1678-W35	35.125	35.200	-0.075
1678-W36	35.166	35.361	-0.195
1678-W37	35.208	35.429	-0.221
1678-W38	35.208	35.452	-0.244
1678-W39	35.229	35.461	-0.232
1678-W40	35.126	35.530	-0.404
1678-W41	35.036	35.371	-0.335
1678-W42	35.044	35.238	-0.194
1678-W43	35.051	35.118	-0.067
1678-W44	35.098	34.719	0.379
1678-W45	34.993	34.816	0.177
1678-W46	34.995	34.766	0.229
1678-W47	34.917	34.658	0.259
1678-W48	34.917	34.652	0.265
1678-W49	34.917	34.689	0.228
1678-W50	34.917	34.783	0.134
1678-W51	35.125	34.863	0.262
1678-W52	35.167	34.848	0.319
1679-W1	35.042	34.976	0.066
1679-W2	35.104	35.096	0.009
1679-W3	35.167	35.129	0.038
1679-W4	35.167	35.149	0.018
1679-W5	35.167	35.284	-0.117
1679-W6	35.167	35.231	-0.064
1679-W7	35.167	35.183	-0.016
1679-W8	35.208	35.281	-0.073
1679-W9	35.354	35.222	0.132
1679-W10	35.458	35.256	0.202
1679-W11	35.500	35.392	0.108
1679-W12	35.458	35.406	0.052
1679-W13	35.482	35.552	-0.070
1679-W14	35.507	35.569	-0.062
1679-W15	35.531	35.521	0.010
1679-W16	35.507	35.392	0.115
1679-W17	35.627	35.363	0.264
1679-W18	35.616	35.479	0.137
1679-W19	35.569	35.564	0.005
1679-W20	35.546	35.693	-0.147
1679-W21	35.716	35.673	0.043
1679-W22	35.750	35.629	0.121
1679-W23	35.750	35.607	0.143
1679-W24	35.750	35.470	0.280
1679-W25	35.750	35.489	0.261
1679-W26	35.792	35.852	-0.060
1679-W27	35.833	35.750	0.083
1679-W28	35.861	35.747	0.114
1679-W29	35.889	35.760	0.129
1679-W30	35.917	35.662	0.255

1679-W31	36.042	35.657	0.385
1679-W32	36.034	35.630	0.404
1679-W33	36.026	35.685	0.341
1679-W34	36.063	35.613	0.449
1679-W35	36.000	35.646	0.354
1679-W36	36.042	35.721	0.321
1679-W37	36.021	35.703	0.318
1679-W38	36.000	35.691	0.309
1679-W39	35.979	35.690	0.289
1679-W40	35.958	35.800	0.158
1679-W41	36.042	35.959	0.083
1679-W42	36.035	36.076	-0.041
1679-W43	35.875	35.874	0.001
1679-W44	36.029	35.669	0.360
1679-W45	35.980	35.475	0.505
1679-W46	35.879	35.371	0.508
1679-W47	36.013	35.432	0.581
1679-W48	35.951	36.035	-0.084
1679-W49	35.917	36.189	-0.272
1679-W50	35.927	36.132	-0.205
1679-W51	35.938	35.952	-0.015
1679-W52	35.917	35.935	-0.018
1680-W1	35.924	35.946	-0.022
1680-W2	35.910	35.957	-0.047
1680-W3	35.896	35.967	-0.071
1680-W4	35.906	35.816	0.090
1680-W5	35.917	35.795	0.122
1680-W6	36.083	35.855	0.228
1680-W7	36.083	35.766	0.317
1680-W8	36.083	35.903	0.180
1680-W9	36.083	35.979	0.104
1680-W10	36.083	36.055	0.028
1680-W11	36.073	36.141	-0.068
1680-W12	36.000	36.119	-0.119
1680-W13	36.000	36.090	-0.090

Source: Appendix 4.A and 4.B

Note: The exchange rates are quoted at variable number of schelling-Vlaamsch for £1 sterling. The Amsterdam-Hamburg-London cross exchange rates are calculated on the following formula, $E_t^{AHL} = \frac{E_{t-4}^{HL}}{32} * E_t^{AH}$, where E^{AH} and E^{AHL} are the Amsterdam-Hamburg and Amsterdam-Hamburg-London exchange rates, respectively.

Appendix 4.E The interest rates calculated from exchange rates quoted on price currents of Amsterdam

	London		Rouen		Paris	
	Monthly (%)	Annual (%)	Monthly (%)	Annual (%)	Monthly (%)	Annual (%)
1668-05-28	0.36	4.32	0.44	5.23	0.44	5.22
1668-07-23	0.24	2.87	0.49	5.93	0.25	2.94
1668-10-01	0.24	2.85	0.44	5.22	0.31	3.72
1669-01-21	0.35	4.25	0.25	3.00	0.25	2.99
1669-02-11	0.41	4.96	0.25	3.00	0.19	2.24
1669-02-18	0.59	7.10	0.25	2.99	0.25	2.99
1669-02-25	0.41	4.94	0.25	2.99	0.37	4.48
1669-03-25	0.47	5.62	0.38	4.52	0.38	4.51
1669-04-15	0.29	3.54	0.31	3.78	0.19	2.25
1669-04-29	0.47	5.69	0.19	2.26	0.31	3.75
1669-05-27	0.47	5.67	0.13	1.51	0.31	3.76
1669-06-03	0.35	4.24	0.25	3.02	0.25	3.02
1669-06-17	0.41	4.97	0.25	3.02	0.31	3.77
1669-09-09	0.47	5.67	0.25	3.04	0.25	3.03
1669-09-16	0.29	3.53	0.38	4.60	0.38	4.60
1669-09-30	0.47	5.62	0.25	3.05	0.25	3.05
1669-10-07	0.41	4.97	0.25	3.05	0.25	3.05
1669-10-14	0.47	5.69	0.26	3.06	0.25	3.05
1669-10-21	0.47	5.66	0.26	3.06	0.25	3.05
1669-10-28	0.48	5.71	0.26	3.08	0.26	3.07
1669-11-04	0.65	7.83	0.26	3.08	0.38	4.61
1669-11-11	0.60	7.15	0.26	3.11	0.26	3.10
1669-11-18	0.48	5.71	0.26	3.12	0.26	3.11
1669-11-25	0.36	4.28	0.26	3.13	0.26	3.13
1670-01-06	0.49	5.84	0.53	6.33	0.26	3.16
1671-04-20	0.47	5.61	0.38	4.59	0.25	3.04
1671-05-04	0.35	4.21	0.32	3.81	0.38	4.55
1671-05-11	0.35	4.22	0.25	3.04	0.38	4.56
1672-02-08	0.35	4.23	0.52	6.30	0.52	6.27
1672-03-14	0.47	5.62	0.53	6.38	0.53	6.35
1672-05-09	0.59	7.07	0.52	6.28	0.52	6.25
1674-06-04	0.37	4.44	0.26	3.15	0.26	3.14
1674-07-16	0.12	1.46	0.26	3.14	0.91	10.95
1674-07-23	0.25	2.95	0.13	1.57	0.26	3.13
1674-08-06	0.25	2.95	0.52	6.25	0.39	4.67
1674-08-20	0.37	4.41	0.26	3.10	0.13	1.54
1674-08-27	0.37	4.41	0.26	3.09	0.38	4.62
1674-09-03	0.36	4.36	0.51	6.15	0.26	3.06
1674-09-10	0.36	4.37	0.38	4.60	0.38	4.57
1674-09-24	0.24	2.92	0.51	6.12	0.38	4.58
1674-10-01	0.49	5.88	0.51	6.12	0.51	6.09
1674-10-08	0.37	4.39	0.38	4.56	0.25	3.02
1674-10-22	0.49	5.86	0.50	6.00	0.31	3.74
1674-10-29	0.37	4.38	0.51	6.09	0.51	6.06
1674-11-05	0.43	5.12	0.26	3.07	0.51	6.15
1674-11-12	0.48	5.81	0.52	6.25	0.52	6.22

1675-10-14	0.48	5.71	0.50	6.03	0.31	3.74
1676-04-20	0.35	4.20	0.38	4.59	0.51	6.09
1677-02-01	0.46	5.53	0.25	3.02	0.19	2.26
1677-04-12	0.46	5.53	0.63	7.60	0.51	6.06
1679-02-20	0.24	2.86	0.53	6.35	0.33	3.95
1679-12-18	0.23	2.77	0.26	3.08	0.51	6.12
Average	0.40	4.81	0.35	4.20	0.35	4.16

Source: PRO: C114/69-78, NEHA: Bijzondere Collecties 674

Appendix 4.F The traveling time for commercial letters between Amsterdam and London, 1668-80

The date of delivery*	The date of receive	# of days
1668-03-13	1668-03-16	3
1668-03-28	1668-03-30	2
1668-05-22	1668-05-25	3
1668-06-12	1668-06-16	4
1668-07-24	1668-07-27	3
1668-10-02	1668-10-06	4
1668-11-03	1668-11-06	3
1668-11-06	1668-11-10	4
1669-01-18	1669-01-26	8
1669-03-19	1669-03-23	4
1669-07-23	1669-07-30	7
1669-08-17	1669-08-21	4
1671-03-31	1671-04-03	3
1671-05-05	1671-05-08	3
1671-06-27	1671-07-03	6
1671-07-08	1671-07-12	4
1671-07-18	1671-07-21	3
1671-09-12	1671-09-19	7
1672-01-19	1672-01-23	4
1672-01-23	1672-01-29	6
1672-03-29	1672-04-03	5
1672-04-02	1672-04-08	4
1672-04-09	1672-04-16	7
1672-06-11	1672-06-18	7
1672-06-14	1672-06-20	6
1672-06-18	1672-06-22	4
1672-08-23	1672-08-30	7
1672-10-15	1672-10-19	4
1672-11-29	1672-12-03	4
1675-01-15	1675-01-25	10
1675-02-12	1675-02-19	7
1675-03-19	1675-03-29	10
1675-05-07	1675-05-11	4
1675-07-20	1675-07-26	6
1675-08-24	1675-08-30	6
1675-09-24	1675-09-28	4
1675-12-14	1675-12-23	9
1676-01-18	1676-01-24	6
1676-02-01	1676-02-08	7
1676-02-04	1676-02-10	6
1676-04-04	1676-04-08	4
1676-04-21	1676-04-24	3
1676-09-15	1676-09-19	4
1676-10-17	1676-10-20	3
1676-11-17	1676-11-24	7
1677-01-16	1677-01-20	4
1677-03-16	1677-03-20	4

1677-03-30	1677-04-09	10
1677-07-13	1677-07-17	4
1677-07-24	1677-07-30	6
1677-07-31	1677-08-06	6
1677-08-28	1677-09-01	4
1677-09-04	1677-09-07	3
1677-12-11	1677-12-15	4
1677-12-14	1677-12-17	3
1678-02-12	1678-02-18	6
1678-02-26	1678-03-02	4
1678-04-02	1678-04-06	4
1678-04-05	1678-04-10	5
1678-04-26	1678-04-30	4
1678-07-23	1678-07-27	4
1678-08-16	1678-08-21	5
1678-11-15	1678-11-20	5
1679-03-11	1679-03-15	4
1679-04-08	1679-04-12	4
1679-09-05	1679-09-09	4
1679-09-23	1679-09-27	4
1679-12-02	1679-12-06	4
1680-03-02	1680-03-10	8
		Average 4.96

Source: H. Roseveare, *Markets and Merchants of the Late Seventeenth Century: The Marescoe-David Letters, 1668-1680* (Oxford, 1987)

Note: Due to the different system of calendar, the date of the letters from the Dutch Republic was 10 days later than the date used in London. In order to calculate the traveling days, the date of delivery (presented in the first column) was put backwards for 10 days.

Appendix 4.G. The traveling time for commercial letters between Hamburg and London, 1668-80

The date of delivery	The date of receive	# of days
1668-02-22	1668-03-10	16
1668-04-21	1668-05-06	15
1668-05-16	1668-05-23	7
1668-07-11	1668-07-20	9
1668-08-08	1668-08-17	9
1668-12-11	1688-12-21	10
1669-01-08	1669-01-18	10
1669-02-09	1669-02-18	9
1669-02-12	1669-02-22	10
1669-03-09	1669-03-16	7
1669-05-14	1669-05-21	7
1669-05-18	1669-05-24	6
1669-07-16	1669-07-26	10
1669-07-16	1669-07-30	14
1669-08-31	1669-09-08	8
1669-11-12	1669-11-20	8
1669-11-13	1669-11-20	7
1669-11-30	1669-12-13	13
1670-01-14	1670-01-25	11
1671-04-28	1671-05-08	10
1671-05-09	1671-05-17	8
1671-07-27	1671-08-09	13
1671-19-12	1671-19-19	7
1671-09-19	1671-09-26	7
1671-10-20	1671-10-30	10
1671-11-14	1671-11-27	13
1672-03-15	1672-03-23	8
1672-04-05	1672-04-17	12
1672-05-10	1672-05-17	7
1672-05-21	1672-05-31	10
1672-07-12	1672-07-20	8
1672-08-02	1672-08-10	8
1672-08-30	1672-09-11	12
1672-09-06	1672-09-17	11
1672-10-01	1672-10-11	10
1672-10-11	1672-10-19	8
1672-10-18	1672-10-29	11
1675-01-08	1675-01-25	17
1675-05-18	1675-05-27	9
1675-06-04	1675-06-11	7
1675-06-08	1675-06-14	6
1675-06-25	1675-07-02	7
1675-09-28	1675-10-04	6
1675-12-14	1675-12-27	13
1676-01-14	1676-01-24	10
1676-04-07	1676-04-14	7

1676-06-09	1676-06-17	18
1676-06-10	1676-06-21	11
1676-08-08	1676-08-16	8
1676-09-15	1676-09-25	10
1676-10-10	1676-10-18	8
1677-01-23	1677-02-05	13
1677-02-23	1677-03-01	6
1677-04-10	1677-04-17	7
1677-04-27	1677-05-05	8
1677-07-30	1677-08-10	11
1677-09-25	1677-10-02	7
1677-10-02	1677-10-09	7
1677-12-18	1677-12-25	7
1678-01-15	1678-01-26	11
1678-02-26	1678-03-07	9
1678-03-05	1678-03-15	10
1678-04-23	1678-04-30	7
1678-07-16	1678-07-24	8
1678-07-19	1678-07-27	8
1678-10-01	1678-10-14	13
1678-10-18	1678-10-25	7
1678-11-20	1678-11-30	10
1679-01-14	1679-01-21	7
1679-04-08	1679-04-14	6
1679-04-25	1679-05-03	8
1679-04-29	1679-05-08	9
1679-07-08	1679-07-15	7
1679-08-08	1679-08-16	8
1679-09-05	1679-09-12	7
1679-09-19	1679-09-27	8
1679-09-26	1679-10-03	7
1680-01-09	1680-01-19	10
1680-01-27	1680-02-09	13
1680-02-03	1680-02-16	13
		Average 9.35

Source and note: See Appendix 4.F