Essays on macroeconomic implications of the Labour Market

The London School of Economics and Political Science

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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.

I declare that my thesis consists of approximately $20,000$ words.

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Abstract

This thesis examines some features of the labour market, and their macroeconomic consequences.

The first paper relates the observed flatter Phillips Curve to the rise in labour turnover and temporary employment. In a New Keynesian model of sticky wages, workers or unions discount future wage income with a low discount factor if there is a strong flow of job turnover. In the New Keynesian wage Phillips Curve, this implies that future inflation is discounted more heavily than without job turnover. In the long run, the Phillips Curve is much flatter, and is no longer vertical or near-vertical; in the middle and long run, the curve appears flatter as turnover creates a bias if it is not accounted for.

The second paper studies the impact of a rise in monopsony in the labour market: wages are set by employers instead of workers/unions. If rigid wages are set by monopsonistic employers and there is inflation, the fall in the real wage lowers the labour supply. In such a world, inflation is contractionary: the Phillips curve is inverted. The paper then examines a model where employers and employees both have market power, and use it to bargain over wages. The slope of the bargained Phillips Curve depends on each side's relative power. An increase in employers' power flattens the Phillips Curve.

The last paper accounts for the possibility of featherbedding (or overmanning) in the labour market. In such a case, unions are able to impose a level of employment above the firm's optimum. In other words, the wage is above the worker's marginal rate of substitution, and above the firm's marginal product of labour. In this case labour market rigidities act as a distortionary tax on profits rather than employment; this generates a different source of inefficiency. While these distortions are very costly in the long run, removing them can be detrimental to employment in the short run.

Contents

Chapter 1

Job Turnover and the slope of the Phillips Curve

1.1 Introduction

The Phillips Curve is central to macroeconomics but its shape has been questioned recently. The strong short run relationship between inflation and output (or unemployment) seems to have vanished in the aftermath of the 2008 financial crisis: unemployment increased and then fell sharply, while inflation remained low and positive. The relationship seems to have broken down. This would suggest that the short-run Phillips curve has become flatter, as evidenced by Blanchard et al. (2015) or Ball and Mazumder (2014).

The idea of a vertical, or near-vertical long-run Phillips Curve, has also been questioned. In a recent Peterson policy brief (2016), Blanchard argues that the long run Phillips curve has become flatter, largely due to inflation expectations anchoring at zero or low levels. As such, there would be a real trade-off between output and inflation in the long run. Some explanations such as menu costs and anchored expectations have been put forward, but they either lack microfoundations or tractability, which would be useful for welfare analysis. Others relate it to globalisation (see Carney, 2017).

This paper, instead, relates these evolutions to job turnover. The advantage of this microfoundation is that it is more observable and more tractable. As we shall see in the next subsection, there has been a secular trend in job turnover and other features of the labour market over the past decades (see Haldane, 2016). This paper shows how it can explain the evolution of the Phillips curve: a flatter long run curve which is no longer vertical or near vertical. And in the short run, the curve will look flatter than if turnover is properly accounted for. The optimal monetary policy, in terms of inflation target and stabilisation, are then derived.

Job turnover

In the New Keynesian wage Phillips curve models, such as the one pioneered by Erceg, Henderson and Levin (2000), workers (or unions) set staggered wages optimally. Current (wage) inflation depends on future (wage) inflation expectations as well as the output gap. In the log linear approximation, the coefficient of future inflation is β, the riskless discount factor.

However, when there is a significant probability that a worker quits, or that he will be fired and replaced by someone else, the net present value of his job will be discounted with a lower factor than the risk-less discount factor. It is important to distinguish layoffs and (personal) dismissals because persons who quit or are dismissed are replaced and hence count as turnover, while layoffs diminish employment and are not replaced by new hires. [1] This probability of turnover makes the wage setting decision, and hence the wage Phillips curve, less forward looking.

Figure 1.1 comes from the job tenure survey from the OECD, for people aged $25-54$. The proportion of people less than a year into their job is a good indicator of yearly job turnover, though temporary contracts probably overstate the figure. In most countries, there has been an increase in the *less than one year* proportion of workers, which indicates a rising turnover. This can also be seen with the increase of the *less than three years* proportion, which is less sensible to temporary employment. Last, the proportion of people *more than ten years* into thir job has fallen accross most countries. This is highly suggestive of an increased turnover.

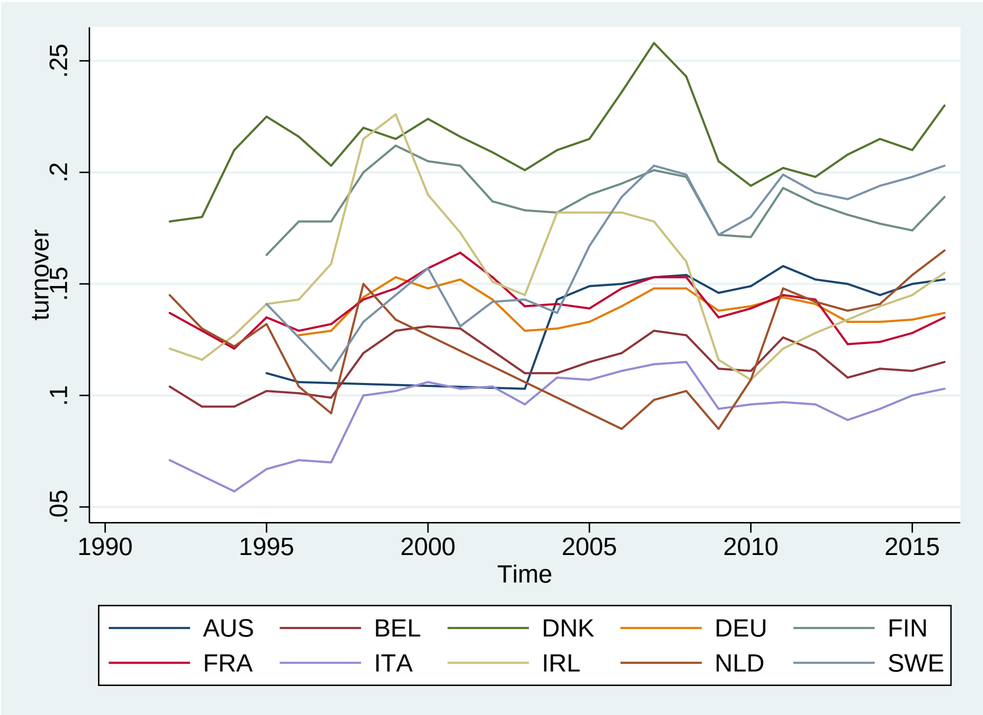


Figure 1.1: Turnover (OECD job tenure survey)

The increasing share of temporary contracts, and the recent rise in the

[1]The probability of being laid off should not matter for the worker, if the union acts as an insurance mechanism. Because the union is assumed to split the wage income between employed and unemployed members, the employee does not lose his income when he is laid off. But turnover relates to quits and personal dismissals, not layoffs. And it is not the purpose of the union to insure against these, so the turnover probability is a relevant discount factor.

“gig economy”(part time contracts, self-employed contractors, zero-hours in Britain) are also likely to weaken collective bargaining in favour of more individual bargaining, as suggested by Haldane (2017). This would suggest lower wages, but also less forward looking decisions, which is the point of this paper. Table 1.2 shows how the share of temporary contracts has evolved over time (again using OECD data). While the upward trend is not always monotonic and varies in magnitude accross countries, it is relatively strong, especially in countries like France, Italy or the Netherlands).

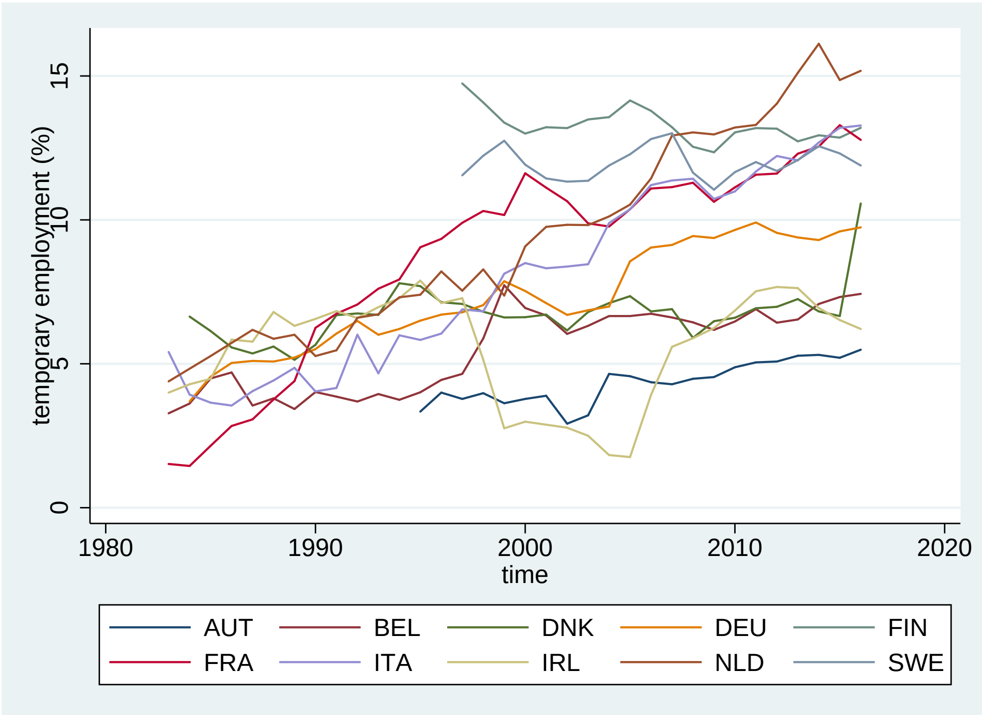


Figure 1.2: Share of temporary employment (OECD)

Calvo meets perpetual youth

A crucial assumption is that when a worker quits (or is dismissed) and is replaced by an entrant worker, the wage stickiness will be (at least partially) transmitted to the entrant. The entrant does not renegotiate its wage immediately, and has to abide by the wage of the previous incumbent it has replaced. Or equivalently, there is no difference between incumbents and entrants in their distribution of wages. Assuming wage rigidity for new hires is crucial in models such as Hall (2005) or Gertler and Trigari (2009), who combine wage and labour search frictions. Gertler, Huckfeldt and Trigari (2016) find no evidence that the wage of new hires is more cyclical than for existing workers. Galuscak et al. (2012) find similar results for 15 EU countries.

This model of entry has some perpetual youth flavour as in Blanchard (1985). As hinted by Weil (1989), the crucial feature in these models is as much the probability of death of the agent, as the stream of newborns, who don't have a say over decisions made before their birth. [2] Here, when a new worker starts a job, he is bound by the decisions of his predecessor. [3] The externality between existing and new agents creates the extra discounting.

Related literature

Snower and Tesfaselassie (2017) derive a positive optimal long run inflation target in the presence of job turnover, but they do not investigate the short run properties much. Bilbiie, Ghironi and Melitz (2012; 2016) as well as Bilbiie, Fujiwara and Ghironi (2014) look at the optimal long run monetary policy in similar setup: sticky prices with firm entry and exit. In their model, the exit probability affects the Phillips curve and the optimal long run Ramsey policy. While these papers use a Rotemberg instead of a Calvo framework, and inflation offsets different long run distortions, the intuition, as well as the assumption that new workers cannot reset their wage, is largely the same [4]. But this paper shows how turnover leads to a flatter long run Phillips curve, and a *perceived* flatter curve in the short run. It also explains how the optimality of *price targeting* is broken, compared to the classical result in Woodford (2003), Benigno and Woodford (2004), or Gali (2008). Last, it shows how optimal short run policies are affected.

Different explanations have been put forward for the recently flatter Phillips Curve. Ball and Mazumder (2011) suggest that with menu costs, price changes will be less frequent when inflation is low, and the resulting Phillips Curve will be flatter. Blanchard (2016) relies on anchored inflation expectations. My approach has the advantage of tractability and observable micro-foundations, which allow for a welfare analysis. While the labour market has been highlighted as a possible driver of the flatter Phillips Curve (see Haldane, 2017 or chapter 2 of the October 2017 World Economic Outlook), no proper model has been suggested yet. The idea of a global Phillips Curve – inflation reacting to global not domestic conditions – has also been floated

[2] In the positive sense, the death probability creates the lower discount factor, but in the normative sense, the externality is caused by the stream of new workers.

[3] Or if wages are set by a union, it only cares about the welfare of its *existing* members.

[4] In my Calvo framework, workers adopt the wage distribution of existing workers. In a Rotemberg setup, it is assumed that new workers (or firms) take the existing symmetric wage (or price), and are not free to choose their starting wage (price) optimally

(eg. Carney, 2017), but again without a proper underlying model.

This paper also belongs to the stream of literature that reassesses the New Keynesian model in light of the Great Recession and the Zero Lower Bound. While this paper introduces an extra discount factor in the Phillips curve, other papers have introduced a discount factor in the Euler equation instead, to explain the *forward guidance puzzle*. In McKay, Nakamura and Steinsson (2016) this is due to incomplete financial markets, while in Del Negro, Giannoni and Patterson (2013), it comes from a Blanchard-Yaari model of perpetual youth for households which is similar to this paper (where it applies to workers). The interaction between a discounted Phillips curve and a discounted Euler equation has been partially studied by Gabaix (2016).

Last, this paper is related to the literature on the optimal level of inflation, which does not solely rely on the Phillips curve. In their handbook chapter (2011), Schmitt-Grohe and Uribe document such other motives for positive inflation. If the price stickiness exhibits a quality bias (Schmitt-Grohe and Uribe, 2009), then a positive inflation will simply ensure that the hedonic price level remains constant. If wages are more rigid downwards than upwards, positive inflation will make relative wage adjustments easier (Olivera, 1964; Akerlof, Dickens and Perry, 1996; Kim and Ruge-Murcia, 2009). A positive amount of inflation might also be useful to increase the nominal interest rate safely above zero, in case the zero lower bound needs to be avoided (Adam and Billi, 2006; Reifschnieder and Williams, 2000).

The paper is organized as follows: Section 2 builds a New Keynesian model with sticky wages, as well as job turnover. The non linear Phillips curve is derived and linearly approximated. Section 3 investigates and estimates the prediction of a flatter Phillips curve in the short, middle and long run. Last, Section 4 solves the welfare maximization problem, both in the non linear (steady state inflation) and quadratic setups (optimal stabilisation).

1.2 The model

1.2.1 A microfounded model

The model of wage rigidities closely follows Gali's (2008) notations, with monopolistic competition in the labour market. There is a continuum of wage-setting worker types, indexed by $j \in [0, 1]$.

Households and firms

Let me first look at the household. A worker of type j maximizes a utility

$$\mathrm{E}_0 \sum_{t \geq 0} \beta^t U(C_t(j), N_t(j)) \tag{1.1}$$

The period utility function U is separable in consumption and labour. The utility of consumption C, $u(C)$, is a concave function with inverse elasticity of intertemporal substitution σ, while the disutility of labour N, $v(N)$ is convex with an inverse Frisch elasticity ϕ. The utility from consumption and disutility from labour are scaled by a parameter λ:

$$U(C_t(j), N_t(j)) = u(C_t) - v(N_t(j)) = \frac{C_t^{1-\sigma}}{1-\sigma} - \lambda \frac{N_t(j)^{1+\phi}}{1+\phi} \tag{1.2}$$

Perfect competition is assumed in the goods market. The production function has diminishing returns to labour N_t, with a labour elasticity $(1-\alpha)$:

$$Y_t = N_t^{1-\alpha}$$

Labour is a CES aggregate of the labour of each type j, with a wage elasticity of substitution ϵ:

$$N_t = \left[\int_0^1 N_t(j)^{1-1/\epsilon} dj\right]^{\frac{\epsilon}{\epsilon-1}}$$

The aggregate wage index W_t is

$$W_t = \left[\int_0^1 W_t(j)^{1-\epsilon} dj\right]^{\frac{1}{1-\epsilon}}$$

The amount of labour of type j employed by firm i is

$$N_t(j) = \left(\frac{W_t(j)}{W_t}\right)^{-\epsilon} N_t$$

Worker j maximizes the expected utility (1.1) subject to the budget constraint

$$P_t C_t(j) + Q_t B_t(j) = B_{t-1}(j) + (1-\tau_t) W_t(j) N_t(j) + D_t + T_t$$

where τ_t is a proportional labour tax (or subsidy) on his labour compensation $W_t(j)N_t(j)$, D_t is the dividend from owning a diversified portfolio of firms, and T_t is a lump sum transfer (or tax) from the government. New bonds $B_t(j)$ can be bought or sold at price Q_t, the stochastic discount factor of the household. Balanced government budget in each period ($T_t = \tau_t W_t N_t$), as well as zero net supply of bonds, ensures that consumption and output are equal in each period:

$$P_t C_t = W_t N_t + D_t = P_t Y_t$$

With perfect competition for goods, prices are equal to marginal costs, or

$$P_t = MC_t = W_t \frac{N_t^\alpha}{1-\alpha}$$

Hence the real wage is linked to output as

$$\Omega_t = (1-\alpha) Y_t^{-\frac{\alpha}{1-\alpha}}$$

With decreasing returns to scale, firms make a profit $D_t = \alpha P_t Y_t$.

As in Erceg et al. (2000) or Gali (2008), let us assume markets with complete contingent claims for consumption but not leisure. This ensures full consumption smoothing accross agents.

Lemma 1. *With complete markets, there is full consumption smoothing:*

$$\forall (t, j), \qquad C_t(j) = C_t = Y_t$$

The Euler equation of consumption pins down the riskless discount factor

$$Q_t = \mathrm{E}_t \beta \frac{P_t}{P_{t+1}} \frac{u'(C_{t+1})}{u'(C_t)} = \beta \frac{P_t}{P_{t+1}} \left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \tag{1.3}$$

The labour supply decision for a worker j in problem (1.1) is equivalent to maximizing the following quantity in each period

$$u'(Y_t) \frac{(1-\tau) W_t(j) N_t(j)}{P_t} - \lambda \frac{N_t(j)^{1+\phi}}{1+\phi} \tag{1.4}$$

Distortions and dispersions

Let us define the first-best and flexible outcomes. Using the utility and production function, the first-best level of output is

$$\bar{Y} = \left(\frac{1-\alpha}{\lambda} \right)^{\frac{1}{\sigma + \frac{\phi+\alpha}{1-\alpha}}}$$

Lemma 2. *In the flexible outcome, the real wage* $\Omega = \frac{W}{P}$ *is a markup* μ *above the marginal rate of substitution of the worker:*

$$\mu = \left(\frac{\epsilon}{(\epsilon - 1)(1 - \tau)}\right)$$

The flexible-wage output is

$$\tilde{Y} = \left(\frac{1-\alpha}{\lambda\mu}\right)^{\frac{1}{\sigma+\frac{\phi+\alpha}{1-\alpha}}} = \bar{Y}\left(\frac{1}{\mu}\right)^{\frac{1}{\sigma+\frac{\phi+\alpha}{1-\alpha}}}$$

The markups depend on the wage elasticity – with a high elasticity, the markup is close to 1. But it also depends on the wage tax τ. A positive tax creates an additional wedge, but a subsidy can offset the inefficiency caused by the finite wage elasticity. Unless the subsidies fully offset the wedges ($\mu = 1$), the flexible output will be inefficiently low as $\tilde{Y} < \bar{Y}$.

With staggered wages, the wage dispersion will be costly in terms of welfare. When wages are heterogeneous, the aggregate number of hours must increase to produce the same amount of goods.

Lemma 3. *The aggregate utility function can be written*

$$\int_0^1 U(C_t, N_t(j))dj = \tilde{Y}^{1-\sigma}\left[\frac{\left(\frac{Y_t}{\tilde{Y}}\right)^{1-\sigma}}{1-\sigma} - \frac{\frac{1-\alpha}{1+\phi}\Delta_t\left(\frac{Y_t}{\tilde{Y}}\right)^{\frac{1+\phi}{1-\alpha}}}{\mu}\right] \tag{1.5}$$

with the wage dispersions

$$\Delta_t = \int_0^1 \left(\frac{W_t(j)}{W_t}\right)^{-\epsilon(1+\phi)} dj \geq 1 \tag{1.6}$$

1.2.2 Sticky wages and the Phillips Curve

Worker discounting

A fraction θ of workers have sticky wages, and a fraction δ keeps their job from one period to another; the two are independent. The discount factor accounts for the price and the firms survival probabilities θ and δ. Instead of maximizing the discounted sum of expression (1.4) with a discount factor β, the applicable rate of time preference will be $\beta\theta\delta$: the disutility of labour – attached to a wage and a worker – is discounted by $\beta\theta\delta$, while the labour compensation is discounted by $\theta\delta Q_t$.

It is assumed that when a worker is replaced, the new worker cannot automatically renegotiate his wage. Instead, he faces the same probability of sticky wages than existing workers. If they were completely free to choose new wages, the effect would die out; but as long as the new wage partly takes into account the wage of existing workers, the effect would be lessened but not die out. This gives a discrepancy between the joint survival probability $\theta\delta$ of the optimal wage setting decision, and the true wage stickiness θ that is featured in the dynamics of the aggregate wage and dispersion. This is the cause of the flatter wage Phillips curve[5]. As mentioned before, evidence in Gertler et al. (2016) or Galuscak et al (2012) tends to support this assumption.

It is also possible to think about the case where it is the union which sets the wage of workers of type j, and the union insures workers against layoffs but not quits or dismissals. When a worker quits, or is dismissed, we can assume that he leaves his labour type and finds a different occupation, where wages are set by a different union. As such, if the union maximizes the utility of its *existing* members, employed or not, it will have a short discounting horizon. And it will not take into account the utility of *future* members, because they do not belong to this union *yet.*

The non linear Phillips curve

When a worker is free to set a wage $w_t(j)$, he seeks to maximize the discounted sum of the wage compensation minus the disutility, defined in expression (1.4).

$$\mathrm{E}_t \sum (\theta\beta\delta)^{T-t} \left[u'(Y_T) \frac{(1-\tau_T) w_t(j) N_T(j)}{P_T} - \lambda \frac{N_T(j)^{1+\phi}}{1+\phi} \right]$$

Lemma 4. *The re-optimizing price w_t^* is :*

$$\left(\frac{w_t^*}{W_t}\right)^{1+\phi\epsilon} = \frac{\mathrm{E}_t \sum (\theta\beta\delta)^{T-t} \mu_t \left(\frac{W_t}{W_T}\right)^{-\epsilon(1+\phi)} \lambda N_T^{1+\phi}}{\mathrm{E}_t \sum (\theta\beta\delta)^{T-t} \left(\frac{W_t}{W_T}\right)^{1-\epsilon} \Omega_T u'(Y_T) N_T} = \left(\frac{K_t}{F_t}\right) \tag{1.7}$$

with recursive terms F_t and K_t

$$F_t = (1-\alpha) Y_t^{1-\sigma} + \theta\beta\delta \mathrm{E}_t F_{t+1} \Pi_{t+1}^{\epsilon-1} \tag{1.8}$$

$$K_t = \mu_t \lambda Y_t^{\frac{1+\phi}{1-\alpha}} + \theta\beta\delta \mathrm{E}_t K_{t+1} {\Pi_{t+1}}^{\epsilon(1+\phi)} \tag{1.9}$$

[5]. In their Rotemberg setup, Snower and Tesfaselassie (2017) (or Bilbiie Ghironi and Melitz, 2012;2016) assume that new workers (or firms) start with the symmetric wage (price) of existing workers (firms). It is similar to here: entrants are bound by incumbents

This is where the job survival probability, δ plays a role, compared to the standard model. δ is an extra factor, appearing here in the worker's discounting, through the recursive F_t and K_t. In the recursive equation, F_t depends on the expected future value $\mathrm{E}_t F_{t+1}$, multiplied by the inflation and a discount factor $\theta\beta\delta$. The exact same phenomenon occurs for the recursive term K_t. The δ makes these two terms less forward looking than in the standard model, and it makes the wage Phillips curve flatter, as we will see with the linear approximation.

In each period, only a fraction $(1-\theta)$ of wages are re-optimized at the value w_t^*, while a fraction θ still follows the previous distribution of wages, with an aggregate W_{t-1}.Using the definition of the aggregate wage, the wage level W_t is a weighted aggregate of the previous wage level W_{t-1} and the current optimal wage w_t^*: [6]

$$W_t^{1-\epsilon} = \theta W_{t-1}^{1-\epsilon} + (1-\theta)(w_t^*)^{1-\epsilon}$$

This provides the dynamics for the wage inflation and dispersion

$$\frac{1-\theta {\Pi_t}^{\epsilon-1}}{1-\theta} = w(\Pi_t) = \left(\frac{w_t^*}{W_t}\right)^{1-\epsilon} = \left(\frac{F_t}{K_t}\right)^{\frac{\epsilon-1}{1+\phi\epsilon}} \tag{1.10}$$

$$\Delta_t = \theta\Delta_{t-1}{\Pi_t}^{\epsilon(1+\phi)} + (1-\theta)w(\Pi_t)^{\frac{\epsilon(1+\phi)}{\epsilon-1}} \tag{1.11}$$

Linear quadratic setup

Although we will look at the optimal steady state level of inflation that the non linear model yields, it is useful to derive a linear quadratic approximation around a zero inflation steady state. In the flexible price steady state, there is no inflation ($\Pi = 1$), and no dispersion ($\Delta = 1$). The steady state values $\tilde{Y}$, $\bar{\Omega}$, $\bar{F}$ and $\bar{K}$ are easy to pin down. Let us define the percentage deviation of each variable: $\pi_t = \log \Pi_t$, and $d_t = \log \Delta_t$. Similarly y_t, ω_t, f_t and k_t denote log deviations of the capital-letter variables from the steady state.

Proposition 1. *The linear wage Phillips curve is*

$$\pi_t = \kappa y_t + \beta\delta \mathrm{E}_t\left[\pi_{t+1}\right] \tag{1.12}$$

with $\kappa = \left(\frac{\phi+\alpha}{1-\alpha} + \sigma\right)\frac{(1-\theta)(1-\theta\beta\delta)}{\theta}\frac{1}{1+\phi\epsilon}$

This linear wage Phillips curve is broadly similar with the standard wage Phillips curve in a model of price and wage stickiness. Current wage inflation

[6] Importantly, the new hires follow existing wages, so that turnover δ doesn't play a role in this law of motion of the aggregate wage

positively depends on the output gap and future expected wage inflation, and negatively on the real wage. However, two differences stand out. The coefficient κ is slightly different as it features the parameter δ. But most importantly, future inflation is discounted by $\beta\delta$ instead of simply β. In terms of intuition, this is because $\beta\delta$ is now the discount factor that is applicable to the job tenure of the worker.

1.3 A flatter Phillips curve

1.3.1 Predictions of the model

Non vertical long run Phillips curve

The long run version of (1.12) implies a flatter long-run Phillips curves, and it is no longer vertical or nearly vertical as without turnover:

$$\bar{\pi} = \frac{\kappa}{1 - \beta\delta}\tilde{Y}$$

When δ is smaller than 1, κ increases slightly. However the increasing effect on the denominator $(1 - \beta\delta)$ largely dominates. This means that long run inflation will depend less strongly on the long run output gap, and the curve is not as vertical.

Property 1. *In the long run Phillips curve between inflation and output of the form $\bar{\pi} = \chi\tilde{Y}$, the coefficient χ decreases with turnover (δ falls):*

$$\chi = \left(\frac{\phi + \alpha}{1 - \alpha} + \sigma\right) \frac{(1 - \theta)}{\theta(1 + \phi\epsilon)} \frac{1 - \theta\beta\delta}{1 - \beta\delta}$$

Because the linear equation is only an approximation of a highly non-linear model, it is useful to see the impact of turnover on the non linear long run Phillips Curve. In steady state the price and wage inflation must be equalized: $\Pi = \Pi$. Taking the steady state in equations (1.8), (1.9) and (1.10), output can be written in terms of inflation

Lemma 5. *The non linear long-run Phillips curve is*

$$\left(\frac{Y}{\bar{\tilde{Y}}}\right)^{\frac{\phi+\alpha}{1-\alpha}+\sigma} = \left[\frac{1 - \theta\beta\delta\Pi^{\epsilon(1+\phi)}}{1 - \theta\beta\delta\Pi^{\epsilon-1}} w(\Pi)^{-\frac{1+\phi\epsilon}{\epsilon-1}}\right] \tag{1.13}$$

Figure (1.3) displays the output level Y associated to a long run (annualized, price and wage) inflation Π. When $\Pi = 1$, $Y = 1$ (the flex price case).

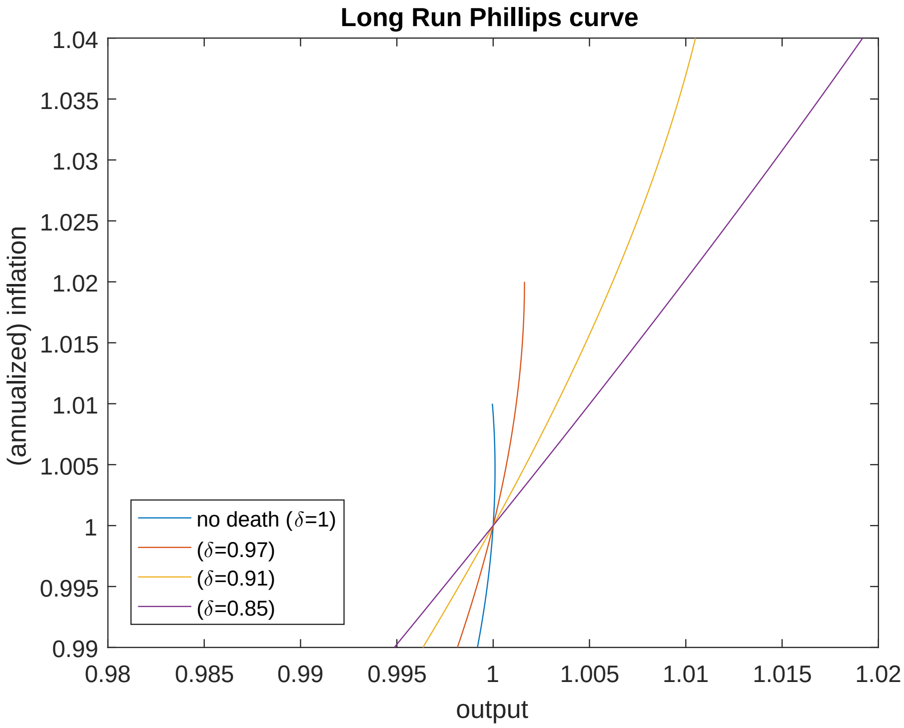


Figure 1.3: Non linear long run Phillips curve for different values of δ

As Π increases, there is a limited output gain, at least to the first order. With turnover ($\delta < 1$), the long run trade-off is flatter than in the normal case without. This was true for the linear approximation of the curves around zero inflation, and it is also true for the non linear case.

Short and middle run

In equation (1.12), the coefficient of the output gap does not fall with more turnover (a fall in δ). The coefficient κ is (slightly) decreasing in δ, so it increases when the survival probability falls. The intuition is that with a lower discount factor, more weight is put on current economic conditions, so inflation reacts more strongly to current output. However, let us look at two cases where the Phillips curve would be perceived as flatter. Equation (1.12) can be iterated forward:

$$\pi_t = \kappa y_t + \beta\delta \mathrm{E}_t\left[\pi_{t+1}\right] = \kappa \sum_{k\geq 0} \left(\beta\delta\right)^k \mathrm{E}_t y_{t+k}$$

Let us assume that the output gap is serially correlated:

$$y_t = \rho_y y_{t-1} + u_t$$

with u_t a mean-zero disturbance. Then we can write inflation as

$$\pi_t = \frac{\kappa}{(1-\rho_y \beta\delta)} y_t$$

Property 2. *The slope of a traditional Phillips Curve displaying only current inflation and output,* $\pi_t = \tilde{\kappa} y_t$ *, will depend on the ratio*

$$\frac{(1-\theta\beta\delta)}{(1-\rho_y \beta\delta)}$$

As long as $\rho_y > \theta$ *(the output gap being more persistent than wages), the slope will decrease when* δ *falls (turnover increases).*

Let us also look at an estimated New Keynesian Phillips curve with a restricted β, if the turnover is not accounted for. Using the assumptions above,

$$\pi_t - \beta \mathrm{E}_t [\pi_{t+1}] = \kappa y_t - \beta(1-\delta)\mathrm{E}_t [\pi_{t+1}]$$
$$\pi_t - \beta \mathrm{E}_t [\pi_{t+1}] = \kappa \left[y_t - \beta(1-\delta) \sum_{k\geq 1} (\beta\delta)^k \mathrm{E}_t y_{t+k} \right]$$

Property 3. *The estimated slope in this case will be*

$$\kappa^* = \frac{cov(\pi_t - \beta \mathrm{E}_t [\pi_{t+1}], y_t)}{var(y_t)} = \frac{(1-\beta\rho_y)}{(1-\rho_y \beta\delta)} \kappa$$

As long as $\rho_y > \theta$ *(the output gap being more persistent than wages), the slope will decrease when* δ *falls (turnover increases).*

This is the case in the empirical estimates of Gali and Gertler (1999), where they use marginal costs instead of the output gap. They estimate $\pi_t = \lambda mc_t + \beta E\pi_{t+1}$. The estimated coefficient of marginal costs, λ, depends on the assumption about the coefficient of future inflation, β. When this coefficient is restricted to $\beta = 1$, the estimated value of λ is smaller than when there is no restriction and β.takes a lower value.

Remark We have to assume here that the output gap is more persistent than sticky wages ($\rho_y > \theta$) in order to generate a downward bias in the traditional PC, and the restricted New Keynesian PC. This is not difficult as $\rho_y \approx 0.95$ in the US for example. However, such an assumption would not be necessary in a Rotemberg setup. In such a setup, the coefficient κ does not depend on turnover. Assuming $y_t = \rho_y y_{t-1} + u_t$ as before, $(1-\rho_y\beta\delta)$ increases when δ falls, so the traditional and restricted New Keynesian slopes are always smaller with turnover.

1.3.2 Empirical results

I rely on data from the OECD to test a wage Phillips curve between inflation and cyclical unemployment[7]. I have 21 countries, between 1996 and 2014 (or fewer years for some countries). Cyclical unemployment u_t is defined as unemployment minus the NAIRU, or structural unemployment. Wage growth is the yearly percentage increase in nominal compensation per worker. For turnover, I rely on the job tenure survey. While the proportion of worker who have been in their job for less than a year is not a perfect metrics for the rate of yearly job turnover, it is nevertheless a relatively good indicator. Therefore my turnover variable τ_t is the proportion of worker between 25 and 54 who have been in their job for a year or less.

I run two regressions.[8] The first is a short run expectation-based curve:

$$\pi_t = \gamma(\tau_t)u_t + \beta(\tau_t)\pi_{t+1} + v_t$$

where v_t is an error term. $\gamma(\tau_t)$ is expected to be negative, and decrease slightly with turnover τ_t (a slightly steeper curve). $\beta(\tau_t)$ is positive and smaller than 1, and it should decrease with τ_t. In order to test the effect of turnover on these coefficients, I add the cross terms $(\tau_t \times u_t)$ and $(\tau_t \times \pi_{t+1})$ in the regression. The two estimates are expected to be negative. I also add time and country fixed effects in the regression. Last, to rule out common trends in turnover and the coefficients, I also allow a trend in the coefficients. As such, the equation can be written

$$\pi_{n,t} = \begin{array}{c} \alpha_n + \alpha_t + \gamma_1 u_{n,t} + \gamma_2(\tau_{n,t} \times u_{n,t}) + \gamma_3(t \times u_{n,t}) \\ +\beta\pi_{n,t+1} + \beta_2(\tau_{n,t} \times \pi_{n,t+1}) + \beta_3(t \times \pi_{n,t+1}) + v_{n,t} \end{array}$$

The results are coherent with the predictions of the model. The effect of turnover on the coefficient of future inflation is negative and significant, as predicted. And allowing for a trend in the coefficient does not make turnover insignificant. Contrary to the prediction, the unemployment coefficient increases with turnover (which makes the curve flatter). But this effect was predicted to be small, and in the data the change is positive but insignificant. The flatter unemployment coefficient might be caused by less frequent wage changes as in the menu costs model of Ball and Mazumder (2011): changes

[7] It as long been argued (see, eg. Gali and Gertler, 1999; or Gali, 2011) that Phillips curve are easier to estimate with real marginal costs or unemployment than with output

[8] Consistency of my OLS approach requires that unemployment and turnover are exogenous. In particular, they cannot be correlated with any lead or lag of the error term v_t – which also captures variations of the desired wage markup. If there is such a correlation, OLS would be inconsistent, and models such as VAR or GMM could control for the endogeneity issue.

	(1)		(2)		(3)	
π_{t+1}	$.40^{***}$	0.96	1.26	0.96	110	0.96
	(.055)					
$\tau_t \times \pi_{t+1}$			$-.061^{***}$		$-.048^{**}$	
			(.017)		(.017)	
u_t	$-.30^{***}$	$-.089$	$-.57$	$-.53$	42	96
	(.073)	(.082)				
$\tau_t \times u_t$			.013	.026	.022	.027
			(.021)	(.024)	(.020)	(.024)
τ_t			.045	$-.18$	.006	$-.217$
			(.11)	(.11)	(.11)	(.11)
time trend					Yes	Yes
fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 1.1: The NK short run Phillips curve

in wage will be less frequent as inflation and volatility declined over the past decades.

It is also insightful to look at the case of a restricted β. If the on future inflation is restricted to the riskless discount factor (about 0.96 yearly), we can see that the coefficient on unemployment is reduced to less than a third, from -0.3 to -0.09. And the effect of turnover on the unemployment coefficient is magnified under this restriction – in line with my earlier predictions.

Now let us look at the medium run Phillips curve. If unemployment is serially correlated of order 1, we saw that the Phillips curve could also be written

$$\pi_t = \tilde{\gamma}(\tau_t)u_t + \tilde{v}_t$$

$\tilde{v}_t$ is the new error term, and $\tilde{\gamma}(\tau_t)$ is predicted to be negative and increasing (a flatter curve) with turnover τ_t. As before, I allow for time and country fixed effects, I include the term $(\tau_t \times u_t)$ in the regression, which is expected to be positive. To rule out common trends in turnover and the coefficient, I again allow a trend in the coefficient. As such, the equation can be written

$$\pi_{n,t} = \tilde{\alpha}_n + \tilde{\alpha}_t + \tilde{\gamma}_1 u_{n,t} + \tilde{\gamma}_2(\tau_{n,t} \times u_{n,t}) + \tilde{\gamma}_3(t \times u_{n,t}) + \tilde{v}_{n,t}$$

The effect of turnover on the coefficient is positive, which is consistent with the predictions. It is not significant at the 10% level, but it is not less significant when a trend effect is allowed. As such, these results are consistent with the idea that turnover creates a flatter middle run Phillips curve.

	(1)	(2)	(3)
u_t	$-.38^{***}$	$-.93$	-27
	(.07)		
$\tau_t \times u_t$		.035	.032
		(.020)	(.020)
τ_t		$-.15$	$-.14$
		(.09)	(.095)
time trend			Yes
fixed effects	Yes	Yes	Yes

Table 1.2: The NK middle run Phillips curve

1.4 Price or inflation targeting?

1.4.1 Turnover and price targeting

As we will see, introducing turnover into a standard New Keynesian model has strong implications for the optimal Ramsey policy. Let us first define the aggregate welfare function.

Welfare function

While workers discount future wages with the probability of job turnover, individuals do not die in my model. Therefore, the aggregate utility function of the social planner is simply the aggregation of each household's utility given in equation (1.1). Using equation (1.5), this is

$$\mathrm{E}_0 \sum_{t\geq 0} \beta^t U(C_t, N_t(j)) = \mathrm{E}_0 \sum_{t\geq 0} \beta^t \tilde{Y}^{1-\sigma} \left[\frac{\left(\frac{Y_t}{\tilde{Y}}\right)^{1-\sigma}}{1-\sigma} - \frac{\frac{1-\alpha}{1+\phi} \Delta_t \left(\frac{Y_t}{\tilde{Y}}\right)^{\frac{1+\phi}{1-\alpha}}}{\mu} \right] \tag{1.14}$$

In terms of intuition, it is easier to look at the optimality of price targeting in a quadratic setup. Whens steady state distortions are small, the approximation of (1.14) and (1.11) bring a quadratic approximation that is not different from the case without turnover. This is because turnover plays no direct role in the utility function, or the dynamics of the dispersions.

Lemma 6. *The second order approximation of the aggregate utility is*

$$U = -\sum_{t\geq 0} \beta^t \left[\widetilde{\kappa} \frac{(y_t - \bar{Y})^2}{2} + (1-\alpha)\epsilon_w \frac{\pi_t^2}{2} \right]$$

with $\bar{Y} = \log \frac{\bar{Y}}{\tilde{Y}}$ *and* $\widetilde{\kappa} = \left(\sigma + \frac{\phi+\alpha}{1-\alpha}\right) \frac{(1-\theta^w)(1-\theta^w \beta)}{\theta^w} \frac{1}{1+\phi\epsilon_w} \neq \kappa$

Contrary to κ, δ does not appear in $\widetilde{\kappa}$, which is exactly the same coefficient as in the case with no turnover. This is because the distortion is discounted with the discount factor of the household, where the death shocks play no role.

Let us also assume cost push shocks in the Phillips curve:

$$\pi_t = \kappa y_t + \beta\delta \mathrm{E}_t \pi_{t+1} + u_t$$

with u_t the cost push shock, an error term. We allow it to be an $AR(1)$ process with autocorrelation ρ_u ($\rho_u = 0$ denoting the white noise case).

The optimality of price targeting

Proposition 2. *When $\delta = 1$, price targeting is optimal for the Ramsey policy: even with steady state distortions, the long run optimal level of inflation is zero; while inflation reacts to cost push shocks in the short run, this is accompanied by deflation in the future, so that there is full mean reversion of the price level. In other words, there is long-run price targeting in response both to long term distortions and short term cost push shocks*

When $\delta < 1$, price targeting is no longer optimal: long run inflation is non zero if there are steady state distortions; in response to cost push shocks, some deflation in the future offsets the initial response of inflation, but there is no longer full mean reversion of the price level. In other words, price targeting does not hold anymore.

The intuition is as follows: in the benchmark, by committing to give up some discretion in the future, the planner has some extra discretion in the present correct cost push shocks, or an inefficient steady state. So that price stability is optimal from today's perspective, but there is an incentive to renege tomorrow. With the death shock, firms are less responsive to commitments, so that the current gain in terms of commitment no longer offsets the inefficiency in the future. Thus, even with a credible commitment, inflation will always be used to offset cost push shocks or steady state inefficiencies.

To better grasp the logic, it is useful to compare the Ramsey policy, which is *history dependent*, to an optimal *state dependent* policy. While such a solution is not Ramsey optimal, it features no dynamic inconsistency. We can call this solution *Markovian*, or *Recursively Pareto Optimal* as in Brendon and Ellison (2015). Let us assume that the optimal inflation is a function of the first-best rate of output and the current cost push shock: $\pi_t = \bar{\pi} + \gamma_\pi u_t$.

In such a Markovian setup, the optimal inflation is not zero even without turnover. This is because the long run Phillips Curve is not vertical without turnover, and a very little amount of inflation is welfare improving. On the other hand, the Ramsey policy in this case is to allocate the current and future inflation differently. A high inflation is used in the short run, in exchange for no inflation in the long run. While this is not time-consistent, it is optimal from today's point of view. With turnover, the Markov optimal inflation is higher due to the flatter long run curve. And the Ramsey policy still uses more inflation in the short run, but not zero in the long run.

In response to cost push shocks, the difference between the Markov and Ramsey policy is more important. The Ramsey policy commits to offset current inflation with future disinflation in response to cost push shocks, and this commitments improves the trade off in the short run. Because the Markov policy is not history dependent, it cannot promise future disinflation, and hence mean reversion of the price level. When turnover is introduced, there is no longer full mean reversion of the price level, but it does not impact the Markov policy much.

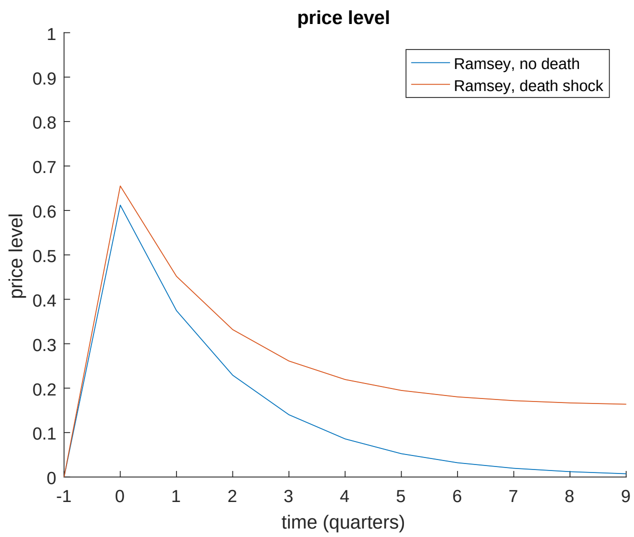


Figure 1.4: Ramsey and Markov policy in response to wage cost-push shocks

1.4.2 Long run optimal inflation

In this subsection, we derive the optimal steady state inflation implied by the non-linear model. While a closed form expression was available for the long run Phillips curve, the optimal level of steady-state inflation (for a given amount of steady state distortions) can only be defined implicitly. As such, it is useful to calibrate most of the parameters, to provide a graphical illustration. As in Gali, let us calibrate $\alpha = 0.25$, $\beta = 0.99$, $\epsilon = 8$, $\theta = 0.66$,

$\phi = 0.11$ and $\sigma = 0.16$. Now we need to find values for δ. Let us consider a low turnover scenario ($\delta = 0.95$, or an average duration of 5 years) and an intermediate scenario with $\delta = 0.90$.

It is a well known feature that in the presence of steady state distortions, the optimal Ramsey policy of the New Keynesian model does not bring a constant level of inflation. While there is a small output-inflation trade-off, the Ramsey policy dictates to front-load some of the inflation at the beginning, with a reduced inflation in the future. This brings the classical time inconsistency problem: it is optimal to promise zero or low inflation in the future, while having a higher rate of inflation temporarily. But in the future, there is an incentive to renege on past promises of low inflation

Thus we have two ways to define the optimal long run inflation. One is to look at the long run solution of the Ramsey policy: we solve the dynamic Ramsey problem, with the discounted utility function and the dynamic Phillips curve constraints, and look at the long run solution. But this runs into the issue of inconsistency, and the long run rate of inflation is not optimal for the current period.

If the aim is to have a constant rate of inflation that is applicable both to the short and long run, we can instead look at the long run constraints, and maximize utility subject to them. As such, we are restricting ourselves to the set of constant inflation rates. Instead of solving the dynamic problem and restrict to the time-invariance solution, we impose time-invariance before solving the maximization.

In the case of the time invariant solution, one simply maximizes the per-period objective function of the social planner (1.5), subject to the long run output inflation Phillips curve (1.13) and the expression of the long run dispersion

$$\Delta = \frac{(1-\theta)w(\Pi)^{\frac{\epsilon(1+\phi)}{\epsilon-1}}}{1-\theta\Pi^{\epsilon(1+\phi)}}$$

Intuitively, inflation helps to bring output closer to its first-best level – but too much inflation reduces output as the curve is non linear – but it increases the price and wage dispersions, which reduce utility.

$$L = \left\{ \begin{array}{c} \frac{1}{1-\sigma}Y^{1-\sigma} - \frac{1}{\mu}\frac{1-\alpha}{1+\phi}\Delta Y^{\frac{1+\phi}{1-\alpha}} \\ +\Phi_1\left[\ln\left(\frac{1-\theta\beta\delta\Pi^{\epsilon(1+\phi)}}{1-\theta\beta\delta\Pi^{\epsilon-1}}w(\Pi)^{-\frac{1+\phi\epsilon}{\epsilon-1}}\right) - \left(\frac{\phi+\alpha}{1-\alpha}+\sigma\right)\ln Y\right] \\ +\Phi_2\left[\left(1-\theta\Pi^{\epsilon(1+\phi)}\right)\Delta - (1-\theta)w(\Pi)^{\frac{\epsilon(1+\phi)}{\epsilon-1}}\right] \end{array} \right\}$$

As illustrated in figure (1.5), this brings a positive amount of inflation, even when $\delta = 1$. The optimal inflation increases as δ decreases.

For the timeless Ramsey policy, we write the full dynamic Lagrangian (with Y_t, Ω_t, K_t and F_t renormalized to flex price values).

The social planner maximizes the discounted sum of the per period utilities (1.5), subject, in each period, to the recursive expressions of F_t and K_t (equations 1.8 and 1.9), the ratio $\frac{K_t}{F_t}$ (equation 1.10), as well as the dynamics of Δ_t (equations 1.11).

Intuitively the trade-offs are similar to the time invariant problem: inflation increases output at the first order, but increases the costly price and wage distortions. However, the fully dynamic setting is different from the previously static one. The Lagrangian of the problem writes

$$L = \sum \beta^t \begin{pmatrix} \left[\frac{1}{1-\sigma} Y_t^{1-\sigma} - \frac{1}{\mu_t} \frac{1-\alpha}{1+\phi} Y_t^{\frac{1+\phi}{1-\alpha}} \Delta_t\right] \\ +\phi_{1,t} \left[K_t w(\Pi_t)^{\frac{1+\phi\epsilon}{\epsilon-1}} - F_t\right] \\ +\phi_{2,t} \left[F_t - Y_t^{1-\sigma} - \theta\beta\delta \mathrm{E}_t F_{t+1} \Pi_{t+1}^{\epsilon-1}\right] \\ +\phi_{3,t} \left[K_t - Y_t^{\frac{1+\phi}{1-\alpha}} - \theta\beta\delta \mathrm{E}_t K_{t+1} {\Pi_{t+1}}^{\epsilon(1+\phi)}\right] \\ +\phi_{4,t} \left[\Delta_t - \theta \Delta_{t-1} {\Pi_t}^{\epsilon(1+\phi)} - (1-\theta) w(\Pi_t)^{\frac{\epsilon(1+\phi)}{\epsilon-1}}\right] \end{pmatrix}$$

After taking the first order conditions, we look at the steady state value of each constraint and multiplier. Figure (1.5) displays the optimal rate of inflation depending on the amount of steady state distortions, for different values of δ. When $\delta = 1$, we have the classic result of zero inflation in the long run, but it increases as this parameter decreases.

Figure 1.5 displays the constant and timeless Ramsey steady state inflation depending on the first-best output $\bar{Y} > 1$, for different values of δ^w. The constant policy is in blue while the Ramsey policy is in dashed red. With more frequent death shocks, the optimal level of constant inflation is higher.

When $\delta = 1$, there is a small level of inflation for the constant policy, but no inflation for the timeless Ramsey policy: this is the optimality of price stability. However, when death shocks are introduced, the optimal level of inflation increases with the output gap, for both the constant and timeless cases. For a large output gap ($\bar{Y} >> 1$) and large death shocks, the optimal annual level of inflation is in the order of $1 - 3\%$ annually.

1.5 Conclusion

This paper constructed a New Keynesian model with Calvo wage stickiness, as well as job turnover. I show how this leads to a Phillips Curve that is

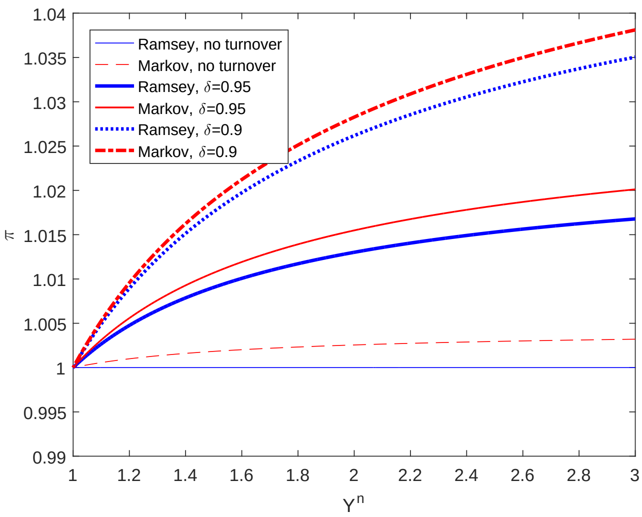


Figure 1.5: Steady state information without and with turnover

far less forward looking. When looking at a medium run Phillips Curve, with persistent output or unemployment disturbances, this can account for a flatter curve. If the coefficient of future inflation is restricted in a standard NK Phillips Curve, this creates a bias on the estimate of the slope of the Phillips Curve, and this bias increases with more turnover. This prediction is tested on OECD data and is not rejected empirically. In the long run, the Phillips Curve is also flatter, and no longer vertical or near-vertical.

I show how turnover breaks the optimality of price stability. Price stability is no longer optimal, and inflation expectations are more anchored than in traditional Phillips curves. As such the optimal Ramsey policy no longer targets the price level in response to cost push shocks. If this turnover is large, and if the steady state distortions are high enough, the optimal level of inflation can reach $1 - 2\%$ annually. In fact, if there was partial price and wage indexation, the optimal inflation would be higher, or a same amount of inflation would be rationalized by a lower turnover or steady state distortion.

One fruitful avenue of future research would be to investigate the empirics in greater details. Phillips curves can be more informative if we don't impose the restriction that they are vertical or quasi vertical in the long run. Also, a cross section of different sectors, and different types of workers - eg, temporary vs. permanent employees - could provide additional evidence. Another fruitful avenue could be to endogenise this turnover. In such a case, it might be affected by the central bank's decision, and become a policy target.

Chapter 2

Monopoly, Monopsony, and the Phillips Curve

2.1 Introduction

After the 2008 financial crisis, unemployment increased and then fell sharply, while inflation remained low and positive. The correlation between inflation and unemployment – the Phillips Curve – is not as strong empirically as it was before. The Phillips Curve has become flatter, as evidenced by Blanchard et al. (2015) or Ball and Mazumder (2014).

Policymakers such as Haldane (2016), Kuroda (2017) or the IMF (WEO, Oct 2017) are hinting towards the labor market as a possible cause for this. The bargaining power of workers and unions has declined over time in most countries. As a result, their ability to obtain wage increases might be reduced. The gig economy, temporary employment, work agencies, and more generally the increased bargaining power of employers, might be causes of the weaker link between employment and wage inflation. It is however unclear whether the impact of these trends is permanent or temporary. To the extent that this can affect the real wage, are we simply observing a temporary lower nominal wage growth while the real wage slowly falls? Is this simply a temporary deflationary pressure? Or does this gig economy have a more fundamental impact on inflation and the way we think monetary policy?

The interplay between structural reforms – in the goods and labour market – and monetary policy has also been debated in the Eurozone. At Sintra in 2015, ECB President Mario Draghi famously pushed for market reforms and flexibility as a complement to monetary policy: *"Any reforms undertaken now will in fact have an improved interaction with macroeconomic stabilisation policies."* Is there a role for structural policies to stabilize economic activity and inflation, alongside fiscal and monetary policy? Did the New Deal's "codes of fair competition" simply create inflationary pressure by raising prices and wages, or did the reduced competition interact with the monetary and fiscal expansions? Did market deregulation and the weakening of unions and collective bargaining in the US and the UK in the 1980s play a role in their disinflation? By shifting power from workers to firms, did the German Hartz reforms change the German Phillips curve for good?

This paper argues that the rise in monopsony power – the bargaining power of employers in the labour market – not only influences the limited wage growth that has been observed recently, but also has a more profound impact on the Phillips Curve and on monetary policy.

Monopsony in the labour market

Literally, monopsony is *a market situation in which there is only one buyer*, as opposed to monopoly with only one seller. More generally, it encompasses the case of an individual buyer facing an elastic supply curve. This could be the result of a pure monopsony with only one buyer, or a limited number of buyers (oligopsony). But modern theories of monopsony emphasize the role of other frictions in the market. In the same way that a one percent increase in a firm's price is unlikely to crowd out all consumption, a one percent reduction in the wage it pays will not crowd all employment.

The candidates for monopsonistic frictions are the same as those for monopolistic frictions. If workers cannot observe the wage offered by every firm, or if a supplier cannot observe the price paid by all downstream buyers, there will be a search friction where it takes time, effort or money to find a new employer or customer – in the same way that finding a new worker or supplier can be costly in monopolistic models. In terms of mobility costs, the canonical Salop or Hotelling model can be used for either monopoly or monopsony. But one can also assume that employers or buyers are differentiated along meaningful characteristics, so that they are imperfect substitutes.

Any market, goods or services, could be monopsonistic in theory. In the goods market, the most common examples are agriculture, mining and forestry. Cattle, corn, fruits, wood logs are very homogeneous commodities, used as intermediate inputs for food processing or manufacturing. While the commodity is very homogeneous, with little room for product differentiation, and with a large number of small producers, food processing and manufacturing firms are much bigger and more differentiated, giving them more market power both for their output and input goods.

Traditionally, only a few labour markets were considered monopsonic. Nurses, policemen, teachers may have only one potential employer: the local or national government. Even with local governments, monopsony will be strong if pay is decided at the national or regional level. Company towns of the Industrial Revolution were another example of monopsonic employers, providing employment, housing and amenities for the whole town.

But some labour economist have recently argued that monopsony is pervasive in other employment markets. With the fall in unionization and collective bargaining, monopoly is losing relevance as a description of the labour market. The increase in self-employment, flexible and part-time work – the so called *gig economy* – has made work more divisible and insecure (Haldane 2017). This divisibility and insecurity is a likely further shift in market power from workers to employers, making monopsony even more relevant to understand the labour market.

Monopsony and the Phillips Curve

This paper formalizes the policymakers' insight of a link between the gig economy and the Phillips Curve, by looking at the role that monopsonic employers can have in the determination of wages and inflation. The New Keynesian model usually assumes that wages are set by workers or unions having monopoly power. Individual workers face a labor demand curve that is not perfectly elastic. Here, I relax the assumption that wages are set by employees, and I look at the effect of employers setting wages for their employees. Individual employers face a labor supply curve that is not perfectly elastic: they have monopsony power.

In the normal wage Phillips Curve with monopoly power, wages are set by employees (or unions) who face nominal rigidities. When there is inflation, the nominal wage cannot be fully adjusted. The real wage falls, and labour demand – hence output – increases. This provides the positive correlation between inflation and output under the classical monopoly case.

But if wages are set by firms who face nominal rigidities, and there is inflation, firms cannot adjust their wages fully. The real wage falls, and labour supply hence output decreases. This provides a Phillips Curve where the output gap is negatively correlated with wage inflation.

The same would be true in the goods market. If sticky prices are set by producers, and there is inflation, the markup falls, and demand increases. But if sticky prices are set by monopsonic consumers (or, possibly, by large retailers and supermarkets), then the supply of goods by producers will fall when inflation lowers the price compared to nominal costs.

This paper also studies the interplay of monopoly and monopsony power in the same market: workers and firms both have limited market power to set a wage. Instead of one agent choosing the level of employment in response to the wage set by the other agent, there is a two-stage process for determining the wage and employment, and there is Nash bargaining in the two stages.

The result is different from monopoly pricing, monopsony pricing or perfect competition. As such it can be thought of the general case encompassing these particular cases. This setup can be used to study a gradual shift in bargaining power from workers to firms. As the bargaining power of firms increases, the Phillips Curve flattens, up to a point when the slope is inverted.

Related literature

While different authors have studied and provided explanations for the recently observed flatter Phillips Curve, this paper is the first attempt to link it with monopsony power. Ball and Mazumder (2011) suggest that with menu costs, price changes will be less frequent when inflation is low, and the resulting Phillips Curve will be flatter. Blanchard (2016) relies on anchored inflation expectations. The idea of a global Phillips Curve – inflation reacting to global not domestic conditions – has also been floated (eg. Carney, 2017). While the labour market has been highlighted as a possible driver of the flatter Phillips Curve (see Haldane, 2017 or chapter 2 of the October 2017 World Economic Outlook), no proper model has been suggested yet. This paper attempts to provide a sound theoretical link between employment conditions and the Phillips Curve.

In the labour market, monopsony (or oligopsony) has been highlighted as a a possible explanation for different observed features. Monopsony can offer a simple explanation for the size-wage correlation (Brown and Medoff, 1989; Green, Machin and Manning 1996): large firms have to pay higher wages to attract a larger labour supply, since the labour supply is not perfectly elastic. Also, under monopsony, minimum wage laws are not necessarily detrimental to employment, because a higher wage will increase labour supply.[1] For example, Manning (1996) found that equal pay laws in the UK significantly increased women's earnings, but without any fall in their employment level.

Monopsony has also been studied outside of the labour market. Food processing industries, and saw mills are typical example of oligopsonic buyers (see, among others, Schroeter 1988, Just and Chern 1980, Murray 1995 or Bergman and Brännlund, 1995). Recently, Morlacco (2018) documented that French firms exercise significant buyer power in their foreign input market: they curb the demand of foreign inputs in order to keep prices low. However, no paper has studied the impact of monopsony on the Phillips Curve.

This paper is organised as follows. Section 2 builds a model of monopsony: workers do not substitute perfectly from one firm to another and this gives market power to firms. A Phillips Curve with monopsony is then derived. Section 3 combines monopoly power and monopsony power in a model of bargaining, so as to build a generalised Phillips Curve. Section 4 discusses the results: their robustness to alternative assumptions, as well as the historical and current relevance for monetary policy.

[1] With monopsony there is no notion of unemployment where workers would like to work more given the prevailing wage. Instead there is rationing: firms could hire more given the low real wage but choose not to. Nevertheless it leads to underemployment.

2.2 The Phillips curve with monopsony

Before introducing a full model of bargaining, I develop a smaller toy model of *monopsonistic competition*, as the analogue of monopolistic competition.

2.2.1 Flexible steady state

Households

I assume a continuum of firms on the interval $[0,1]$, indexed by i. A worker (or a household) can allocate its time (or the time of its members) across different employers. By allocating L_i to each employer i, the total wage received is $\int_{i=0}^{1} W_i L_i$ with W_i the wage in firm i. [2]

The consumptions good C_t is assumed to be homogeneous at a price P_t. The representative households maximizes a separable utility function

$$\max \mathrm{E}_0 \sum_{t=0}^{+\infty} \beta^t \left[u(C_t) - v(L_t)\right]$$

Disutility of work depends on an aggregate *effective* labour supply L_t. L_t is a convex function of each $L_t(i)$, the labour supplied to each firm i :

$$L_t = \left[\int_0^1 L_t(i)^{1+1/\eta}.di\right]^{\frac{1}{1+1/\eta}}$$

$\eta = \frac{\partial \ln L_i}{\partial \ln W_i}|_{L,C}$ is the wage elasticity of labour supply. [3]

The household faces a budget constraint

$$P_t C_t + Q_t B_t = B_{t-1} + \int_0^1 W_t(i) L_t(i) di + \int_0^1 D_t(i) di$$

From every firm i, the household receives a dividend $D_t(i)$, and a wage compensation $W_t(i)L_t(i)$ for supplying $L_t(i)$ to firm i. New bonds B_t can be bought or sold at price Q_t, the stochastic discount factor of the household.

The Euler equation pins down the stochastic discount factor

$$Q_t = \mathrm{E}_t \beta \frac{P_t}{P_{t+1}} \frac{u'(C_{t+1})}{u'(C_t)} \tag{2.1}$$

[2]Assuming that agents share their time across different employers is a simplification. But it can be rationalised if agents have a probability to work for one employer or another. In Section 5, I formalize this probabilistic micro-foundation

[3]See Section 5 for a robustness check on non constant elasticities

The first order condition for each $L_t(i)$ brings

$$\frac{u'(C)}{P} W_i = \left(\frac{L_i}{L}\right)^{1/\eta} v'(L) \tag{2.2}$$

If we introduce the wage aggregate $W = \left[\int_0^1 W_i^{1+\eta}.di\right]^{\frac{1}{1+\eta}}$, this pins down the aggregate labour supply and firm i's own labour supply curve

$$\frac{W}{P} = \frac{v'(L)}{u'(C)} = MRS \qquad\qquad \left(\frac{L_i}{L}\right) = \left(\frac{W_i}{W}\right)^{\eta}$$

Firms

The representative firm i takes prices as given, and has a production function $Y_i = F(L_i)$. It maximizes its profits $P.Y_i - W_i.L_i$ subject to the labour supply curve $\left(\frac{L_i}{L}\right) = \left(\frac{W_i}{W}\right)^{\eta}$. The FOC with respect to L_i is $P.F'(L_i) - (1+1/\eta)W_i = 0$. The optimal wage is a markup below the marginal product of labour:

$$W_i = \frac{P.F'(L_i)}{1+1/\eta} \qquad\qquad \frac{W}{P} = \frac{MPL}{1+1/\eta}$$

Let us look at flexible prices and wages. Under monopolistic competition, the wage is equal to the MPL and is a markup over the MRS. Here, the wage is equal to the MRS and is a markup below the MPL. Hence this is not a state of unemployment where workers would like to work more given the current wage. Instead, jobs are rationed and firms could hire more given the wage. While there is technically no unemployment, there is still underemployment.

To some extent, it is more similar to monopolistic competition in the goods market, where the real wage would the MRS and below the MPL (since prices are a markup over marginal costs in that case).

2.2.2 Calvo wage rigidity

Let me assume that the firm faces a Calvo fairy when setting its wage: only a fraction $(1-\theta)$ of firms can reset their wage in each period. The wage is set to maximize the discounted profits subject to the labour supply curve:

$$\max_{W_t^*(i)} \mathrm{E}_t \sum_{k=0}^{+\infty} (\theta\beta)^k \frac{u'(C_{t+k}}{P_{t+k}} \left[P_{t+k} F(L_{t+k}(i)) - W_t^*(i) L_{t+k}(i)\right] \tag{2.3}$$

$$st. \left(\frac{L_{t+k}(i)}{L_{t+k}}\right) = \left(\frac{W_t^*(i)}{W_{t+k}}\right)^{\eta} \tag{2.4}$$

Around a zero-inflation steady state, the log linear approximation of the optimal Calvo wage (dropping the markup) is

$$w_t^* = (1-\beta\theta)\sum_{k=0}^{+\infty}(\beta\theta)^k[p_t + mpl_{t+k|t}]$$

From the worker's problem, $mrs = w - p$ and since $F(L_i) = L_i^{1-\alpha}$,

$$mpl_{t+k|t} = -\alpha l_{t+k|t} = mpl_{t+k} + \alpha\eta(w_{t+k} - w_t^*)$$

Using this expression of the real wage, and standard algebra (see appendix), an expression for the wage inflation π_t can be derived:

Theorem 1. ***Monopsonic Phillips Curve:*** *With monopsony, there is a negative correlation between inflation and real economic activity*

$$\pi_t = \frac{(1-\beta\theta)(1-\theta)}{\theta}\left(\frac{-1}{1+\alpha\eta}\right)(mrs_t - mpl_t) + \beta\mathrm{E}[\pi_{t+1}] \qquad (2.5)$$

$\frac{(1-\beta\theta)(1-\theta)}{\theta}$ comes from the Calvo modeling, while $(mrs_t - mpl_t)$ is a measure of real economic activity that is also standard in New Keynesian models. Monopsony only plays a role through η and the *negative sign*.[4]

In the normal wage Phillips Curve with monopoly power, wages are set by employees who face nominal rigidities. When there is inflation, they cannot adjust their wage fully. The real wage falls, and labour demand hence output increases. This provides the positive correlation between inflation and output under the classical monopoly case.

But if wages are set by firms who face nominal rigidities, and there is inflation, firms cannot adjust their wages fully. The real wage falls, and labour supply hence output decreases. This provides a Phillips Curve where the output gap is negatively correlated with wage inflation.

In a sense, monopoly and monopsony can be thought of two limiting cases of a bargaining between a union with some monopoly power and a firm with some monopsony power. Monopoly could be the limiting case where all the

[4]The monopolistic New Keynesian Phillips Curve with sticky wages is typically written

$$\pi_t = \frac{(1-\beta\theta)(1-\theta)}{\theta}\left(\frac{1}{1+\phi\epsilon}\right)(mrs_t - mpl_t) + \beta\mathrm{E}[\pi_{t+1}]$$

with ϕ the disutility curvature and ϵ the elasticity of substitution between labour types.

power and surplus accrues to the union/workers, while monopsony would be the situation where all the power and surplus accrues to the firm. Looking at the intermediate case can then provide insights about what happens when there is a gradual shift of power from one side to the other.

In the next section, I attempt to build such a *generalised* bargaining model that encompasses monopoly and monopsony as the two limiting cases.

2.3 Phillips curve with Nash bargaining

I construct a model with both monopoly power for workers and monopsony power for firms. I assume that a firm employs a continuum of workers, and a worker works with a continuum of firms. Each pair of worker and firm is a match. I assume a two-stage process: in the second stage, there is bargaining over the match-specific surplus, while the first-stage bargaining shares the total surplus of the worker and the firm. The imperfect substitutability of firms and workers takes place in the second stage but not the first stage. The result of the second stage is to create a labour bargain curve $L(w)$ that shares the surplus of the match. In the first stage, the bargaining maximizes the joint aggregate surplus, subject to the labour bargain curve. [5]

I assume a modified version of Manning's (1987) model:[6] In the first stage, the firm and worker bargain over the wage, and in the second stage they bargain over employment. Hence the second stage provides a function $L(w)$: for each wage there is a bargained level of employment. But Nash bargaining is most often done over a payment or a rate, not a quantity. It makes more sense to assume that the agents in the second stage behave *as if* they were bargaining over the wage, *for a given employment*.

If there is a project of size L, the firm and worker bargain over the wage compensation WL over a wage or a payoff makes more sense than bargaining over quantities. This provides a function $w(L)$, a wage for each amount of work, which implicitly defines the reciprocal function $L(w)$.

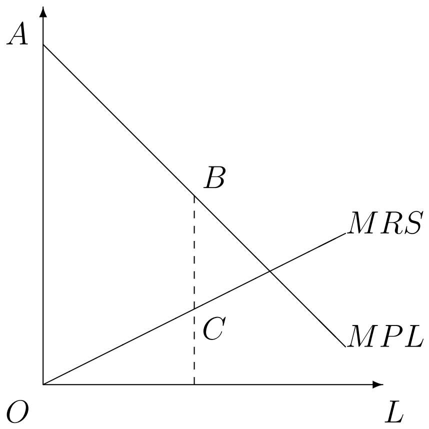
[5] There is no commitment between the two stages because the agents bargain over a different surplus in each stage, and it is as if the agents were different in the two stages. From the first stage point of view, the second stage is done by a representative firm and worker not the the first stage agents. One way to think about it could be that the second stage features an individual worker and an individual employer, while the first stage would be conducted by a sectoral union and a sectoral business group.

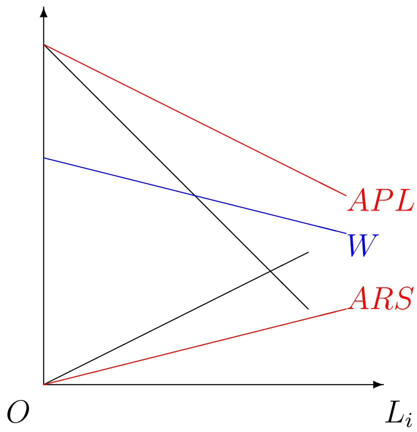
[6] See section 5 for a critical discussion of this model, and a comparison with the literature on collective bargaining in general, and in particular the differences with Manning's model.

The surplus of the match

I need to define the default option for the firm and the union. If they disagree, I assume that they do not work at all with each other. When a union decides on a strike, the ultimate default option is the indefinite strike, and the ultimate default option of the employer is to shut down the company completely. Hence they will bargain over the total employer and employee surpluses, not merely $(MPL - W)$ and $(W - MRS)$.[7] [8]

The figure below illustrates this. The figure plots the marginal product of labour and marginal rate of substitution of the employer and employee. For a given L, the wage W is not set to split the surplus $B - C$. Instead, the wage bill WL is set to to split the total surplus represented by the area $OABC$ (left figure). In other words, the wage does not split the difference between the marginal product of labour and marginal rate of substitution, but the difference between the average product of labour and the average rate of substitution (right figure). The wage curve (in blue) lies between the average product of labour and average rate of substitution curves.





[7]This alternative possibility would be more likely in an anonymous market where agents do not observe the total effort, hence the default option of their opponent. See Section 5, for a discussion of the alternative modeling.

[8]This issue of total vs marginal surplus is often muted in the matching literature when the production and disutility functions are assumed to be linear.

2.3.1 Model and flexible equilibrium

I introduce the representative production and disutility functions

Assumption 1. *(1) Production is a function of a concave labour aggregate*

$$F(L) = L^{1-\alpha} \qquad \textit{with} \qquad L^{1-1/\epsilon} = \int_{i=0}^{1} L_i^{1-1/\epsilon} di \tag{2.6}$$

(2) Labour disutility is a function of a convex labour aggregate

$$v(L) = L^{1+\phi} \qquad \textit{with} \qquad L^{1+1/\eta} = \int_{j=0}^{1} L_j^{1+1/\eta} dj \tag{2.7}$$

(3) Concavity of the production function requires $1 > \alpha > 1/\epsilon > 0$*;*
Convexity of the disutility requires $\phi > 1/\eta > 0$ [9]

payoff functions in the two stage

I can now introduce the payoff functions of the agents in the two stages.

Lemma 7. *First Stage*

In the first stage, the payoffs of the firm and worker depend on the aggregate labour L_i *and wage* W_i *that they agree together. Respectively,*

$$p_f(L_i, W_i) = F(L_i) - \frac{W_i L_i}{P} \qquad \textit{and} \qquad p_w(L_i, W_i) = \frac{W_i L_i}{P} - \frac{v(L_i)}{u'(C)} \tag{2.8}$$

A worker working an aggregate L has a marginal disutility of working L_i with firm i: $\frac{\partial v}{\partial L_i} = \left(\frac{L_i}{L}\right)^{1/\eta} v'(L)$ while a firm employing an aggregate L and L_i from worker i has a marginal product with him writing $\frac{\partial F}{\partial L_i} = \left(\frac{L_i}{L}\right)^{-1/\epsilon} F'(L)$

Hence, conditional on aggregate L, the total surplus of the match is

$$S(L_i|L) = \int_{l=0}^{L_i} \left[\left(\frac{l}{L}\right)^{-1/\epsilon} MPL - \left(\frac{l}{L}\right)^{1/\eta} MRS \right] .dl$$

$$S(L_i|L) = \frac{\epsilon}{\epsilon - 1} \frac{L_i^{1-1/\epsilon}}{L^{-1/\epsilon}} MPL - \frac{\eta}{\eta + 1} \frac{L_i^{1+1/\eta}}{L^{1/\eta}} MRS$$

Let me now write the second stage payoffs, which depend on match specific employment L_i and wage W_i, as well as aggregate labour L

[9] This provides the concavity/convexity of the production/disutility with respect to each L_i or L_j, but also with respect to the number of varieties

Lemma 8. *Second Stage*

In the second stage, the payoff of the firm (in real terms) is

$$\tilde{P}_f(L_i, W_i|L) = \frac{\epsilon}{\epsilon - 1} \frac{L_i^{1-1/\epsilon}}{L^{-1/\epsilon}} MPL - \frac{W_i L_i}{P} \tag{2.9}$$

The worker's payoff in the second stage is, in terms of the goods

$$\tilde{P}_w(L_i, W_i|L) = \frac{W_i L_i}{P} - \frac{\eta}{\eta + 1} \frac{L_i^{1+1/\eta}}{L^{1/\eta}} MRS \tag{2.10}$$

Second stage bargaining

In each match, the wage bargaining is as follows: for each level of employment L_i in the match, the wage bill $W_i L_i$ maximizes the Nash product

$$\max_{W_i} \tilde{P}_w(L_i, W_i|L)^{\gamma} \tilde{P}_f(L_i, W_i|L)^{1-\gamma}$$

γ and $(1 - \gamma)$ are the bargaining power of the employee and the firm respectively. As a result, the wage bill is a weighted average of the total production and disutility in the match.

Theorem 2. *Labour bargain curve*

The second stage defines the relationship between W_i and L_i in the match, for a given level of employment L (and hence given MRS and MPL).

$$\frac{W_i}{P} = (1 - \gamma) \frac{\eta}{\eta + 1} \left(\frac{L_i}{L} \right)^{1/\eta} MRS + \gamma \frac{\epsilon}{\epsilon - 1} \left(\frac{L_i}{L} \right)^{-1/\epsilon} MPL \tag{2.11}$$

and the labour bargain elasticity is $e = \frac{\partial \ln L_i}{\partial \ln W_i}|_{W,L}$

This model does not boil down exactly to the usual model of monopoly, or the monopsony one I have introduced previously, when $\gamma = 1$ or $\gamma = 0$.

When $\gamma = 1$, $\frac{W_i}{P} = \frac{\epsilon}{\epsilon-1} \left(\frac{L_i}{L}\right)^{-1/\epsilon} MPL = \frac{\epsilon}{\epsilon-1} MMPL(L_i)$. In a classical model of monopolistic unions, the firm would take the wage and equalize the marginal match product of labour with the wage. However, here, the worker is able to extract more than his $MMPL$, because he is able to capture the surplus that he generates for the firm. From a contract theory point of view, this is price discrimination instead of linear pricing.

Similarly, when $\gamma = 0$, $\frac{W_i}{P} = \frac{\eta}{\eta+1} \left(\frac{L_i}{L}\right)^{1/\eta} MRS = \frac{\eta}{\eta+1} MMRS(L_i)$. The wage is below the worker's $MMRS$, because the firm captures the total surplus generated by the match.

First stage bargaining

Having derived a match specific labour bargain curve, I can now turn to the first stage of the bargaining. In the match bargaining, each worker is facing one type of firm, and each firm is facing one type of worker. However, in the first stage, when the wage and employment is decided, workers are now facing the continuum of firms, and firms face the continuum of workers.

The payoff of the worker now is $\frac{W_i L_i}{P} - \frac{v(L_i)}{u'(C)}$ and the payoff of the firm is $F(L_i) - \frac{W_i L_i}{P}$. The Nash bargaining maximizes the joint product, subject to the labour bargain curve:

$$\max_{W_i, L_i} \left[\gamma \ln \left(\frac{W_i L_i}{P} - \frac{v(L_i)}{u'(C)} \right) + (1-\gamma) \ln \left(F(L_i) - \frac{W_i L_i}{P} \right) \right] \tag{2.12}$$

$$st \qquad \frac{W_i}{P} = (1-\gamma) \frac{\eta}{\eta+1} \left(\frac{L_i}{L} \right)^{1/\eta} MRS + \gamma \frac{\epsilon}{\epsilon - 1} \left(\frac{L_i}{L} \right)^{-1/\epsilon} MPL$$

This yields an efficient, symmetric equilibrium when prices are flexible

Theorem 3. *Irrespective of γ, the flexible symmetric equilibrium always has*

$$MPL = MRS = \left(1 + \frac{1}{e}\right) \frac{W}{P} \tag{2.13}$$

$e = \frac{\partial \ln L_i}{\partial \ln W_i}|_{W,L}$*, the labour bargain elasticity around the steady state, satisfies*

$$\frac{1}{e} = \frac{\frac{(1-\gamma)}{\eta+1} - \frac{\gamma}{\epsilon-1}}{(1-\gamma)\frac{\eta}{\eta+1} + \gamma \frac{\epsilon}{\epsilon-1}} \qquad or \qquad \frac{1}{e+1} = \frac{(1-\gamma)}{\eta+1} - \frac{\gamma}{\epsilon-1}$$

We can look at three particular values for γ

Property 4. *(1) When $\gamma = 1$, $e = -\epsilon$ and we have perfect monopoly:*

$$MPL = MRS = \left(1 - \frac{1}{\epsilon}\right) \frac{W}{P} \qquad and \qquad \frac{W_i}{W} = \left(\frac{L_i}{L}\right)^{-1/\epsilon}$$

(2) When $\gamma = 0$, $e = \eta$ and we have perfect monopsony:

$$MPL = MRS = \left(1 + \frac{1}{\eta}\right) \frac{W}{P} \qquad and \qquad \frac{W_i}{W} = \left(\frac{L_i}{L}\right)^{1/\eta}$$

(3) When $\frac{\gamma}{\epsilon-1} = \frac{(1-\gamma)}{\eta+1}$, the bargain is isomorphic to perfect competition: $\frac{W}{P} = MPL = MRS$ and labour in a match is perfectly elastic: $\frac{1}{e} = 0$

It is first worthy to note that the MPL and MRS are equal, but can differ from the wage. This is due to the assumption of bargaining over the total surplus. As a result, since the wage lies between the average product of labour and average disutility of work, it can be above or below. Of course, this might no longer be efficient with capital or entry in the labour market: the incentives to invest or search for a job would be altered. But here, as we abstract from this, the outcome is always efficient.

Second, this model, which allows the bargaining power to vary between the union and the firm, is able to encompass monopoly and monopsony as the two limiting cases. As the bargaining shifts smoothly in the interior of the interval, the slope of the Phillips curve smoothly changes sign. Also, with this model, perfect competition and flexible prices can be thought as the case where the relative bargaining power of employers and employees exactly offsets their relative market power coming from the imperfect substitutability.

2.3.2 The wage bargain Phillips curve

Under flexible wages, the timing of the game didn't really matter. The second stage featured a bargaining over the wage W_i (or compensation W_iL_i) in the atomistic match i, *for a given match labour* L_i. Since wages were flexible, they could be agreed on in the second stage as a normal wage bargaining.

However, this isn't as straightforward in the case of rigid wages. I have to assume that agents in the second stage behave *as if* they could bargain over the wage, despite the sticky wage having been decided in the first stage. So the second stage bargaining described previously will still apply when wages are rigid, and the bargained wage is a weighted average of the MPL and MRS. Since it provides a relationship between the wage and the labour in the match, this relationship can then be used to provide a level of employment L_i *for each wage* W_i. [10]

Payoff functions and Nash problem

With Calvo wage rigidity, the firm and worker maximize a joint product of payoffs. The discounted payoff of the worker and the firm are, respectively

$$P_w = \sum_{k=0}^{+\infty} (\beta\theta)^k \left(\frac{u'(C_{t+k})}{P_{t+k}} W_t L_{t+k|t} - v(L_{t+k|t}) \right)$$
$$P_f = \sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} \left(P_{t+k} F(L_{t+k|t}) - W_t L_{t+k|t} \right)$$

[10]See section 5 for a further discussion of this assumption

Hence the maximization problem is[11]

$$\max_{W_t} P_w^{\gamma} P_f^{1-\gamma} \qquad \text{st} \qquad \frac{\partial \ln W_i}{\partial \ln L_i}|_{W,L} = \frac{1}{e}$$

First order approximation

I take the first order condition with respect to W_t, and around a zero inflation equilibrium, I can use $MRS = MPL = \left(1+\frac{1}{e}\right)\frac{W}{P}$. (see appendix)

The log linear approximation around the steady stare becomes

$$\begin{aligned}&\gamma \sum_{k=0}^{+\infty} (\beta\theta)^k \frac{(w_t^* - p_{t+k} - mrs_{t+k|t})}{\sum_{k=0}^{+\infty} (\beta\theta)^k \left(1 - \frac{Pv(L)}{u'(C)WL}\right)} \\ =&(1-\gamma) \sum_{k=0}^{+\infty} (\beta\theta)^k \frac{(w_t^* - p_{t+k} - mpl_{t+k|t})}{\sum_{k=0}^{+\infty} (\beta\theta)^k \left(\frac{PF(L)}{WL} - 1\right)}\end{aligned} \tag{2.14}$$

Around the steady state, the denominators in the previous equations are constant, and can be greatly simplified under the assumption of constant curvature for the production and disutility function. This constant curvature is also helpful for an expression of the labour supplied at time $t+k$ to a firm whose wage was set at time t (and the labour demanded at $t+k$ from a worker whose wage was set at time t).

Lemma 9. *Under the assumption that $F(L) = L^{1-\alpha}$ and $v(L) = L^{1+\phi}$,*
(1) The steady state labour satisfies

$$\frac{PF(L)}{WL} - 1 = \frac{\frac{1}{e} + \alpha}{1-\alpha} \qquad \text{and} \qquad 1 - \frac{Pv(L)}{u'(C)WL} = \frac{\phi - \frac{1}{e}}{1+\phi}$$

(2)At time $(t+k)$, the log linear approximation of the MRS and MPL is

$$\begin{aligned} mrs_{t+k|t} &= mrs_{t+k} + e\phi(w_t^* - w_{t+k}) \\ mpl_{t+k|t} &= mpl_{t+k} - e\alpha(w_t^* - w_{t+k}) \end{aligned}$$

Taking logs of equation (2.13) in theorem 2, the log of the real wage is

$$w_{t+k} - p_{t+k} = (1-\tilde{\gamma}) mrs_{t+k} + \tilde{\gamma} mpl_{t+k}$$

with $\tilde{\gamma} = \frac{\gamma\frac{\epsilon}{\epsilon-1}}{(1-\gamma)\frac{\eta}{\eta+1} + \gamma\frac{\epsilon}{\epsilon-1}} = \frac{\gamma\frac{\epsilon}{\epsilon-1}}{\frac{e}{e+1}}$

All this combined, the log linear approximation provides a Phillips Curve

[11] Gertler and Trigari (2009) also have a model of bargaining with staggered wage adjustments, and their bargaining also maximizes a joint product of two discounted payoffs

Theorem 4. *Nash Bargaining Phillips Curve*

$$\pi_t = \frac{(1-\beta\theta)(1-\theta)}{\theta}\lambda\left(mrs_t - mpl_t\right) + \beta\pi_{t+1} \tag{2.15}$$

with a slope coefficient

$$\lambda = \frac{\frac{\gamma^2(1+\phi)(1+1/e)}{\phi-1/e}\frac{\epsilon}{\epsilon-1} + \frac{(1-\gamma)^2(1-\alpha)(1+1/e)}{\alpha+1/e}\frac{\eta}{\eta+1}}{\gamma\left(1+\phi\right)+\left(1-\gamma\right)\left(1-\alpha\right)}\left(\frac{-1}{e}\right)$$

The coefficient $\frac{(1-\beta\theta)(1-\theta)}{\theta}$ simply comes from Calvo rigidities, and is common in any Calvo New Keynesian model. $(mrs_t - mpl_t) = (\phi l_t + \sigma c_t) + \alpha l_t$ the measure of real economic activity, is also standard in monetary models. Here the relative power of monopoly and monopsony is in the coefficient λ.

Property 5. *From property (1), we have $\phi > 1/\eta$ and $\alpha > 1/\epsilon$, so $-\alpha < 1/e < \phi$. Hence the slope of the Phillips Curve solely depends on*

$$\frac{-1}{e} = \frac{\frac{\gamma}{\epsilon-1} - \frac{(1-\gamma)}{\eta+1}}{(1-\gamma)\frac{\eta}{\eta+1} + \gamma\frac{\epsilon}{\epsilon-1}}$$

(1) If $\frac{\gamma}{\epsilon-1} > \frac{(1-\gamma)}{\eta+1}$ (monopolistic competition), $\frac{-1}{e} > 0$, the slope is positive
(2) If $\frac{(1-\gamma)}{\eta+1} > \frac{\gamma}{\epsilon-1}$ (monopsonistic case), $\frac{-1}{e} > 0$, the slope is negative
(3) When $\frac{\gamma}{\epsilon-1} = \frac{(1-\gamma)}{\eta+1}$, the Phillips curve is flat

This model provides a tractable reduced-form Phillips Curve that encompasses both monopoly and monopsony power, and depends on the relative bargaining power of workers and firms. With both monopoly and monopsony power, the sign of the slope depends on the relative bargaining power of the two sides, as well as the built-in market power that arises from the imperfect substitutability of employees for firms and jobs for workers. [12]

It is easy to verify that the cases $\gamma = 1$ and $\gamma = 0$ give the normal monopoly and monopsony Phillips curves respectively. As with other Calvo models of the Phillips Curve, this is only an approximation valid around a zero inflation steady state where output is equal to its natural level. [13]

[12] If one side does not have market power at all (ϵ or η is infinite), then a shift of bargaining power would not change the sign of the slope, but only its magnitude

[13] But here the natural rate of output around which the log linear approximation is done is also the first-best efficient outcome

2.4 Applications

2.4.1 Interpretation

This paper has focused on monopsony in the labour market rather than the goods market, because it is likely to be more prevalent, and has been more documented in the micro literature. But there is little doubt that large supermarket chains have monopsony power over some producers. After all, some are franchise networks with a large central purchasing body – which gives them a larger bargaining power with producers. Monopsony power has also been documented between producers and suppliers in some industries.

Mathematically, it would give very similar predictions as monopsony in the labour market: if the buyers sets a rigid price, inflation will lower the real price, and sellers will reduce their supply. It would also be possible to have monopsony and bargaining both in the goods and labour market. As in a New Keynesian model with nominal rigidities in monopolistic goods and labour market, a monopsonistic version would have price and wage inflation depending on the output gap and the real wage.

Structural reforms and inflation

While there is a strong sense among policymakers that structural reforms can have lasting impacts on inflation, this is not a direct feature of the standard New Keynesian model. In the standard NK model, pro-competitive reforms in the goods and labour market tend to reduce the price and wage markup. While this reduces inflation in the short run as real prices and real wages fall with the markups, there is no long term effect when the markups have fallen. On the contrary, anti-competitive reforms will be inflationary, but only in the short run as the price or wage markups increase. Unless these reforms affect structural elasticities of substitution, a boom (or a downturn) will always have the same inflationary (or deflationary) effects.

This article provides a link between structural reforms and inflation. From a situation where sellers (workers and producers) have relatively more power, pro-competitive reforms will make the Phillips Curve flatter. Hence, booms and bust will be less inflationary (or deflationary). Starting from a monopsonic situation where buyers have more powers, shifting even more power to buyers makes the economy more monopsonic and less competitive. At the same time, this would steepen a negatively sloped Phillips Curve where booms are deflationary. It is unlikely that a predominantly monopsonic situation would ever occur, hence a shift of power from sellers to buyers would always be pro-competitive and flatten the Phillips Curve.

Some historic events tend to document this link between structural policies and long term inflation

The New Deal in the US famously featured anti-competitive policies, alongside monetary and fiscal expansions. The National Recovery Administration aimed at eliminating cut-throat competition. In each sector, industry, labour and the government would write "codes of fair competition" to reduce "destructive competition". This included minimum wages, maximum hours, and minimum prices and standards for sold prices. The National Labor Relations Act also increased the bargaining power of unions in the private sector, guaranteeing a right to collective action and requiring employers to engage with unions. While it has been argued by some that these policies slowed down the economic recovery, there is little doubt over their inflationary effect.

Disinflation in the 1980s was largely due to monetary and/or fiscal contraction, but it did coincide with large, pro-competitive deregulation reforms. These reforms effectively removed many of the neo-corporatist policies implemented in European countries after World War II, where unions, producers and governments tended to weaken competition. Large sectors were privatized or deregulated in countries like the US, the UK or France. In the labour market, the UK was the most prominent in reducing the power and influence of unions: Margaret Thatcher broke the Coal Miners' strike, and unions became more heavily regulated. Union power was also weakened under Ronald Reagan in the US.

More recently, Germany in the 2000s has seen the impact of structural reforms on inflation. The Hartz IV reform lowered long term unemployment benefits, and imposed stricter job search condition on the claimants, while the Hartz II package created minijobs that were paid substantially less than normal jobs. These minijobs, often part time jobs or secondary jobs, facilitate gig employment, and has shifted the bargaining power towards employers in some sectors. At the same time, Germany has seen very low wage inflation compared to its neighbours, despite high output and very low unemployment. The idea of adopting the Hartz reforms in southern Europe is regularly floated, to improve its competitiveness and lower wage inflation.

This tends to suggest that structural reforms, by reducing the power of producers and sellers, makes the Phillips Curve flatter, making booms (bust) less inflationary (deflationary). Hence this is likely to be beneficial in normal times, especially combined with monetary or fiscal expansions, because it lowers their cost in terms of inflation. However, if an economy is at or close to the Zero Lower Bound, structural reforms will not only put deflationary pressure in the short run. It also makes fiscal and monetary policy less inflationary, so that it is harder to steer the economy away from the ZLB.

2.4.2 Monetary policy in a world of monopsony

How is monopsony power relevant for monetary policy? What would happen of the Phillips Curve became flat, or if its slope coefficient became negative?

It is possible to look at this question using reduced form equations. For simplicity, I assume monopsony in the goods market instead in this subsection, because standard Euler equations and Taylor rules rely on price – not wage – inflation[14]. Since monopsony in the goods market is the symmetric analogue of the labour market, the negatively sloped Phillips Curve remains.

The Euler equation (2.1) can be approximated in log linear terms:

$$y_t = -\frac{1}{\sigma}(i_t - \mathrm{E}_t\pi_{t+1} - \rho) + \mathrm{E}_t y_{t+1} \tag{2.16}$$

while the monopsony Phillips curve, in reduced form, is

$$\pi_t = -\kappa y_t + \mathrm{E}_t\pi_{t+1} + u_t \tag{2.17}$$

We can also assume a Taylor rule in inflation and output:

$$i_t = \rho + \phi_\pi \pi_t + \phi_y y_t + v_t \tag{2.18}$$

Combining them in matrix form

$$\begin{bmatrix} y_t \\ \pi_t \end{bmatrix} = A_T \begin{bmatrix} \mathrm{E}_t y_{t+1} \\ \mathrm{E}_t\pi_{t+1} \end{bmatrix} + B_T \begin{bmatrix} u_t \\ v_t \end{bmatrix}$$

with $A_T = \Omega \begin{bmatrix} \sigma & 1-\beta\phi_\pi \\ -\sigma\kappa & -\kappa+\beta(\sigma+\phi_y) \end{bmatrix}$, $B_T = \Omega \begin{bmatrix} -\phi_\pi & -1 \\ \sigma+\phi_y & -\kappa \end{bmatrix}$ and $\Omega = \frac{1}{\sigma+\phi_y-\kappa\phi_\pi}$

Determinacy requires that the two eigenvalues of A_T are lower than 1,[15] or alternatively that the eigenvalues of $(A_T - Id)$ are negative. As in Bullard and Mitra (2002), the trace and determinant conditions for a 2x2 matrix are

$$-\Omega\left[(\phi_y + \sigma(1-\beta) - \kappa\phi_\pi) + (\phi_y(1-\beta) - \kappa(\phi_\pi - 1))\right] < 0 \tag{2.19}$$

$$\Omega\left(\phi_y(1-\beta) - \kappa(\phi_\pi - 1)\right) > 0 \tag{2.20}$$

Because of the minus sign in front of κ, the conditions for determinacy of the equilibrium are more complicated compared to the normal monopoly case studied in Bullard and Mitra, and can be reversed. There are two cases.[16]

[14] If the utility function is such that the MRS is constant, then the two inflation rates are equalized. But in general it is not the case and expressions would be more complicated.

[15] Blanchard and Kahn (1980)

[16] With a positive sign, $\Omega = (\sigma + \phi_y + \kappa\phi_\pi)^{-1} > 0$. If $[\phi_y(1-\beta) + \kappa(\phi_\pi - 1)] > 0$ is satisfied, then $[(\phi_y + \sigma(1-\beta) - \kappa\phi_\pi) + \phi_y(1-\beta) - \kappa(\phi_\pi - 1)] > 0$ is also always satisfied, hence $[\phi_y(1-\beta) + \kappa(\phi_\pi - 1)] > 0$ is a sufficient condition for determinacy

(1) If κ is not too high, Ω is positive and the determinacy conditions are

$$\phi_\pi < 1 + \frac{1-\beta}{\kappa}\phi_y \qquad\qquad \phi_\pi < \frac{1}{2} + \frac{\phi_y + (1-\beta)(\phi_y + \sigma)}{2\kappa} \tag{2.21}$$

The interpretation of the $\left(\phi_\pi < 1 + \frac{1-\beta}{\kappa}\phi_y\right)$ condition is the exact reverse of the normal monopoly case. Under monopoly, the condition implies that if the inflation permanently increased by one point, the nominal interest rate through the the ϕ_π and ϕ_y coefficient increases by more than 1, hence the real interest rate increases, and this creates a self correcting deflationary pressure.

With monopsony, a permanent increase inflation by one percent has to lead to a smaller increase in the nominal interest rate, so that the real interest falls. The fall in the real interest rate is expansionary in terms of output in the Euler equation, but because of the negatively-slopped Phillips Curve, the increased output is deflationary and stabilizes inflation.

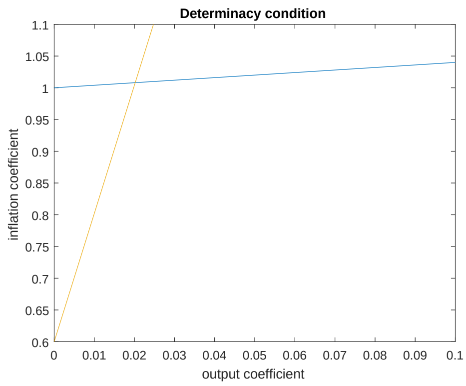


Figure 2.1: Determinacy zone: the inflation coefficient is the lower right zone

The other condition has a less straightforward interpretation. If the central bank does not react to the output gap ($\phi_y = 0$), then the inflation coefficient in the Taylor rule has to be very low: $\phi_\pi < \frac{1}{2} + \frac{(1-\beta)\sigma}{2\kappa}$. The coefficient is much lower than 1. On the other hand, if the central bank responds to output ($\phi_y > 0$), higher values of ϕ_π, potentially above 1, can be sustained.

While monopsony probably isn't a good description for the economy as a whole, monetary policy after the Great Recession has been much more output-sensitive than inflation-sensitive, in line with the model's predictions.

(2) For a very high κ, then $\Omega < 0$ and the inequalities in eq (2.21) are flipped: $\phi_\pi > 1 + \frac{1-\beta}{\kappa}\phi_y$ and $\phi_\pi > \frac{1}{2} + \frac{\phi_y+(1-\beta)(\phi_y+\sigma)}{2\kappa}$

For $\kappa \to \infty$, this becomes $\phi_\pi > 1$ and $\phi_\pi > 1/2$. Hence the flexible limit of the model has the same determinacy conditions as a normal flexible model.

2.5 Robustness of the model

2.5.1 Labour aggregates

Microfoundations for constant elasticities

How can we model monopsony in the labour market? There needs to be imperfect substitutability between different firms or occupations. Of course most employees only work with one company – the gig economy where an employee faces many employers is still a tiny fraction of the workforce.

But even if individuals perfectly substitute, there can still be imperfect aggregate substitutability. Take the Hotelling or Salop model: firms are located on a line or a circle, and a mass of consumers is evenly distributed on the line or circle. Workers can choose where they want to work, but face a transportation cost linked to their distance from the firm. Each worker only works for a single firm, but since workers are distributed over a continuous interval, some will work for one company and others for another company. A firm will attract more labour by paying a higher wage, but this will not attract the whole mass of workers: there is imperfect substitutability.

Instead of using the Salop or Hotelling model, I will try to remain as close as possible to the usual monopolistic CES setup, because a CES can be modeled as the aggregate of probabilistic individuals. Assume N firms. An individual j can allocate his time among the N firms. But for each firm i, he has a particular distaste $a_{i,j}$ for the job. The disutility of working is

$$v\left(\sum_{i=1}^{N} a_{i,j} L_{i,j}\right)$$

where $L_{i,j}$ is labour supplied by j to firm i. There is perfect substitutability across jobs. The worker maximizes a separable utility

$$u\left(\frac{\sum_{i=1}^{N} w_i L_{i,j}}{P}\right) - v\left(\sum_{i=1}^{N} a_{i,j} L_{i,j}\right)$$

Worker j chooses to work (only) for the company with the highest $(w_i/a_{i,j})$. If the $(a_{i,j})$ are independent random variables, then the number of workers in firm i is the probability that it has the highest ratio for one individual:

$$L_i = P[w_i/a_{i,j} > \max_{k\neq i}(w_k/a_{k,j})]$$

Now, if the $(a_{i,j})$ follow an appropriate Frechet distribution as in Eaton and Kortum (2002), this can provide a CES structure: $\frac{L_i}{L_k} = \left(\frac{W_i}{W_k}\right)^{\eta}$ with a one to one mapping between η and the parameters of the Frechet distribution.

Labour aggregates with non constant elasticities

Assuming a constant elasticity of substitution for the labour aggregates, the production function and the disutility function makes the model more tractable, but it is not essential. I can assume the more general form for the production function and its corresponding labour aggregate:[17] $Y = F(L)$ with

$$L = g^{-1}\left[\int_{i=0}^{1} g(L_i)di\right]$$

I can assume a general labour disutility function with its corresponding labour aggregate:[18] $v(L)$ with

$$L = h^{-1}\left[\int_{j=0}^{1} h(L_j)dj\right]$$

The match product of labour and match rate of substitution are now

$$TMPL(L_i) = \frac{g(L_i)}{g'(L)}MPL \qquad \text{and} \qquad TMRS(L_j) = \frac{h(L_j)}{h'(L)}MRS$$

Property 6. *Define* $\left(\eta, \epsilon, \bar{\alpha}, \bar{\phi}, \tilde{\alpha}, \tilde{\phi}\right)$ *locally by* $\frac{1}{\eta} = \frac{Lh'(L)}{h(L)} - 1$, $\frac{1}{\epsilon} = 1 - \frac{Lg'(L)}{g(L)}$, $\bar{\alpha} = 1 - \frac{LF'(L)}{F(L)}$, $\bar{\phi} = \frac{Lv'(L)}{v(L)} - 1$, $\tilde{\alpha} = -\frac{LF''(L)}{F'(L)}$ *and* $\tilde{\phi} = \frac{Lv''(L)}{v'(L)}$

(1) Theorem (3) is unaffected: the steady state expression of the wage and the labour bargain elasticity with η *and* ϵ *remain unchanged*

(2) The Phillips curve in eq (2.15) simply has a modified slope coefficient

$$\bar{\lambda} = \frac{\frac{\gamma^2\left(1+\bar{\phi}\right)}{\bar{\phi}-1/e}\frac{1+1/e}{1-1/\epsilon} + \frac{(1-\gamma)^2(1-\bar{\alpha})}{\bar{\alpha}+1/e}\frac{1+1/e}{1+1/\eta}}{\gamma\left(1+\bar{\phi}\right)\frac{\tilde{\phi}-1/e}{\bar{\phi}-1/e} + (1-\gamma)\left(1-\bar{\alpha}\right)\frac{\tilde{\alpha}+1/e}{\bar{\alpha}+1/e}}\left(\frac{-1}{e}\right)$$

Since $\left(\bar{\phi} - 1/e\right)$, $\left(\tilde{\phi} - 1/e\right)$, $(\bar{\alpha} + 1/e)$ *and* $(\tilde{\alpha} + 1/e)$ *are all strictly positive*[19]*, the sign of the slope still only depends on* $\left(\frac{-1}{e}\right)$.

2.5.2 The bargaining assumptions

relation with the literature and the Manning model

While there is no existing model that combines monopolistic and monopsonistic power together, the labour literature on collective bargaining has some

[17] Both $F(\cdot)$ and $g(\cdot)$ are increasing, concave function satisfying $F(0) = g(0) = 0$. Concavity of production requires that $F(g^{-1}(\cdot))$ is also concave, which is a stronger condition

[18] Both $v(\cdot)$ and $h(\cdot)$ are increasing, convex function satisfying $v(0) = h(0) = 0$. Convexity of disutility requires that $v(h^{-1}(\cdot))$ is also convex, which is a stronger condition

[19] Concavity and convexity assumptions on production and disutility require $\bar{\phi} > 1/\eta$, $\tilde{\phi} > 1/\eta$, $\bar{\alpha} > 1/\epsilon$ and $\tilde{\alpha} > 1/\epsilon$

related elements, in micro models with just one firm and one union. Sometimes called a *bilateral monopoly* it is de-facto a monopoly and a monopsony.

In the *right-to-manage* model of Nickell and Andrews (1983), the union and the firm bargain over a wage in the first stage, but in the second stage the firm is free to choose employment as it sees fit. But this implies that the second-stage labour demand curve gives no role to bargaining. McDonald and Solow (1981) consider a model where the union and the firm bargain simultaneously over wages and employment, but the simultaneity doesn't allow for a second stage *labour curve*. Manning (1987) builds a two stage model where the firm and the union first bargain over the wage, and over employment in the second stage. Given a wage w, the firm would like to demand $L^d(w)$ while the union would like to supply $L^s(w)$. The bargained employment $L^*(w)$ will maximize a Nash product of the payoffs.

While Manning's two-stage timing is very appealing, this model does feature some dubious axiomatic properties that come from the way the second-stage modeled. First, the Nash bargaining is done over employment, for a given wage, while Nash bargaining is most often done over a price or payment. More importantly, since the bargained labour $L^*(w)$ is some form of average of the labour demand and the labour supply, the labour bargain curve will end up *steeper* than the demand or supply curve. Applied to the context of monopoly and monopsony power with imperfect substitutability, the resulting labour bargain curve when bargaining power is more or less balanced will be steeper, as if substitutability was lower than under either pure monopoly or monopsony. The labour bargain curve could be perfectly inelastic, which would be very problematic in the first stage of the bargaining. Last, if either the labour demand or supply is perfectly elastic (with a linear production function or a linear disutility from labour), the labour bargain curve would also be perfectly elastic, irrespective of the bargaining power.

Instead of bargaining over employment, *for a given wage*, I assumed that the firm and union behave *as if* they were bargaining over the wage, *for a given employment*. This has a few advantages. First, this labour bargain curve will always be more elastic than the pure monopoly or monopsony curve, and cannot be inelastic. In a sense, when the bargaining power is balanced between the firm and union, this is *as if* there was perfect competition. Hence perfect competition can be thought as a well-balanced market.

Alternative bargaining

I have assumed that there are two stages of Nash bargaining, and the worker and firm have the same relative bargaining power in the two stages. This is however not crucial. If the bargaining power were different in the two stages, this would imply minimal changes for the coefficient λ. Crucially, what matters for the elasticity e, and hence the sign of the slope of the Phillips curve, is the bargaining power in the second stage match bargaining.

I have assumed that a firm and a worker share the total surplus of their match, because the default option is to not work with each other at all. If instead, I assume that the default option is to work one hour less with each other, the labour bargain curve would be

$$\frac{W_i}{P} = (1-\gamma)\left(\frac{L_i}{L}\right)^{1/\eta} MRS + \gamma\left(\frac{L_i}{L}\right)^{-1/\epsilon} MPL$$

One consequence is that the flexible steady state is no longer efficient: in general: $MRS \neq MPL$. For low and high values of γ, we have $MPL > MRS$, which ensures that the surplus of a match is positive. But for intermediate values this is not the case, so that the match "surplus" would be negative. In the range where bargaining occurs, it is possible to define an appropriate steady state and labour bargain elasticity. The log linear approximation around the (new) steady state is the same as equation (2.14):

$$\gamma \frac{\sum_{k=0}^{+\infty}(\beta\theta)^k\left[w_t^* - p_{t+k} - mrs_{t+k|t}\right]}{\sum_{k=0}^{+\infty}(\beta\theta)^k\left(1-\frac{Pv(L)}{u'(C)WL}\right)} = (1-\gamma)\frac{\sum_{k=0}^{+\infty}(\beta\theta)^k\left[w_t^* - p_{t+k} - mpl_{t+k|t}\right]}{\sum_{k=0}^{+\infty}(\beta\theta)^k\left(\frac{PF(L)}{WL}-1\right)}$$

Lemma (1) still holds and provides a log linear MRS and MPL

Now however, since $MPL \neq MRS$ in steady state, the log linear approximation of the real wage in equation (2.13) is slightly modified:

$$w_{t+k} - p_{t+k} = \frac{(1-\gamma)(MRS)mrs_{t+k} + \gamma(MPL)mpl_{t+k}}{(1-\gamma)MRS + \gamma MPL}$$

A Phillips Curve can still be built, by adjusting the coefficient λ

2.6 Conclusion

This paper first introduced a tractable model of monopsony power that closely resembles the monopolistic competition model of Dixit and Stiglitz (1979). This model has the advantage of being tractable and symmetric, and it allows for a close comparison with monopoly power, which almost always uses the Dixit-Stiglitz framework. While the monopolistic competition model features imperfect substitution of employers between workers or worker types – a love of variety – monopsonistic competition features imperfect substitutability of workers across different employers or job types. Workers prefer to work for different employers because the disutility from working is lower when working with multiple employers – the love of variety comes from a reduced distaste for work. Having introduced this CES model of monopsony, it is easy to build a New Keynesian model with wages set by monopsonic employers. The crucial difference with the classical monopoly Phillips Curve is that the output-inflation correlation becomes negative.

Then this paper provides a model of bargaining over sticky wages, with both monopoly and monopsony power for workers and employers respectively. Because of the imperfect substitutability of workers and firms, a surplus can be shared through Nash bargaining by the two agents. This process brings an efficient outcome: depending on the worker's and firm's relative bargaining power, the wage will be above or below the worker's MRS and the firm's MPL, but the MRS and MPL are always aligned. When introducing wage stickiness, the slope of the Phillips Curve also depends on the relative bargaining power of the two agents. Thus, a shift of power from workers to firms can explain a flattening of the Phillips Curve. Finally, the paper explores the robustness of the result to different assumptions about the production and disutility function, as well as the bargaining process. The predictions of the model are compared with some past events where structural reforms seemed to have strongly complemented monetary policy: the New Deal, the 1980s disinflation and liberalisation, and the German Hartz reforms in the early 2000s. I also compare some of the prediction to how monetary policy has been conducted recently, the nominal interest rate being more responsive to output than inflation.

Looking at heterogeneity is an obvious avenue for future research. The balance of power between workers and employers can be quite different across countries and sectors – and possibly even across firms and regions. On the empirical side, it would allow to test the prediction using this heterogeneity. On the theoretical side, it would be useful to understand the impact of monetary shocks (and possibly other shocks) in an economy where some sectors are more monopolistic while other are more monopsonistic.

Chapter 3

Featherbedding, wage bargaining, and labour market reforms

3.1 Introduction

Labour market reforms in Europe have been discussed for at least two decades, but the topic has gained large prominence since the 2008 financial crisis. While there is a consensus on the long term gains of such policies, there is more disagreement on their short run impact, and whether or not they should be implemented in a downturn. While there might have been a political need for these reforms, in exchange for more dovish monetary and fiscal policies within the Eurozone, the economic soundness remains a hotly debated topic.

In a famous speech at the 2015 forum in Sintra, ECB chairman Mario Draghi even argued that the crisis was – in fact – the best moment to implement structural reforms. On the one hand the very accommodative policy would accelerate the gains from the reforms and mitigate any negative short term impact. On the other hand, structural reform would arguably make the economy more resilient and less sensitive to nominal rigidities. Long term gains could induce extra investment, increase the natural rate of interest, and hence shift the economy away from the Zero Lower Bound in the short run.

In contrast, increasing labour force participation and search effort – for example through a reduction in unemployment benefits or postponing of retirement age – will have negative aggregate demand effects in the short run, which can worsen the crisis. It has also been argued that structural reforms in the goods and labour market tend to reduce prices and wages. Hence, in an environment of zero or low inflation, these reforms would amount to internal devaluation, and worsen or lengthen the crisis (Eggertson et al., 2014). Using a matching model of the labour market, Cacciatore et al. (2016) find that the short run costs of reducing matching frictions is higher in crisis than in good times. More unproductive jobs are severed when firing costs are low, while hirings will be more gradual as the economy slowly recovers.

In this context, the comparison between Germany and southern Europe is extremely telling. Germany implemented labour market reforms in 2003-2005 before the crisis, and the unemployment rate has (almost steadily) been falling since. In Spain, Italy or Greece, structural reforms were only implemented after the sharp post-crisis increase in unemployment; unemployment kept increasing nevertheless and remains at high levels. As a result, implementation and timing of reforms has remained contentious. Using detailed administrative labour market data in Germany and Spain, Gehrke and Weber (2017) document that reforms of the matching process have weaker effects when implemented in recessions. This does of course caution against introducing reforms to mitigate the short-run impact of crisis.

What is the effect of labour market rigidities?

Labour market rigidities – and hence labour market reforms that aim to offset or mitigate them – can take many forms. Some relate to hours and wages in a given job (maximum hours, minimum wage, centralized collective bargaining). Other frictions relate to the hiring process (limits and costs on dismissals and redundancies, mandatory qualifications for a job) or the labour supply (availability and generosity of unemployment benefits). While these three classes of labour market rigidities could in theory be independent of each other (and conceptually they are most often modeled independently), it is reasonable to assume that hiring and firing frictions, as well as supply side frictions, have an indirect impact on what employees can bargain for.

Hence many DSGE macro models with labour market rigidities often use the reduced form interpretation that labour rigidities affect bargaining by increasing the wage markup. This is the analog of monopolistic competition in the goods market. In the goods market a producer has some monopoly power over his own variety, and he charges a uniform price in an anonymous market. The consumer is a price-taker, but chooses quantity freely. Hence, the demand curve for the product is unaffected, while the price markup shifts the supply curve inwards. As a result prices are necessarily higher and quantities lower. Transposed to the labour market, this means that the labour supply curve is shifted inwards due to a wage markup, while the demand curve is unaffected, increasing wages and lowering employment.

It is sensible to assume linear pricing in the goods market (especially retail): in an anonymous market, firms cannot observe demand characteristics to conduct *first-best* price discrimination. However, this assumption can be less sensible for the labour market. Labour isn't hired by anonymous firms. Workers or unions have more information about the company in which they work, as opposed to producers who often know little over their customers.

Hence I will argue that first-best price discrimination can be a more adequate model of wage setting in some labour markets. In that case a worker or a union is able to extract all the surplus that he generates, and not just his marginal product. The wage will be equal to the average product of labour, above the marginal product. This shifts the labour demand curve out, as the union forces a higher labour demand at any level of wages.

Wage bargaining has two counteracting effects on the labour market. By setting a wage above the worker's marginal rate of substitution, employment is inefficiently low. But since the wage is also above the marginal product of labour, this tends to increase employment. The two effects can cancel each other or not. They also provide a more realistic model of unions: they try to maximize wages, but this is not necessarily at the cost of lower employment.

Related literature

Following Blanchard and Giavazzi (2003), the literature on structural reforms has studied the best strategies to implement these policies, in order to reduce the short-term costs and improve the long-run gains. Blanchard and Giavazzi showed that reforms should be synchronized across the labour, product and service markup, with an early emphasis on the product and service market to boost wages and build political support for the reform. Krause and Uhlig (2012) analyse the German Hartz reforms in a DSGE macro model.

Bayoumi et al. (2004) use the IMF's *Global Economy Model* (a calibrated multi-country DSGE) to analyze the spillover effects of greater competition in the Euro area, for growth in the rest of the world. Everaert and Schule (2006) use the same model to emphasize the importance of coordinating reforms across the Eurozone.

More recently, some DSGE models have focused on time-varying reform effects. Cacciatore et al. (2016) study product and labour market reforms in a DSGE model with labour market frictions and find that the timing of the reform relative to the business cycle greatly matters for the short-run. Eggertsson et al. (2014) study the deflationary effects of markup reductions in product and labour markets at the zero lower bound in a New Keynesian DSGE model, and caution about the possible negative consequences. Michaillat (2012) argues that if jobs are rationed in recessions, labour market frictions are less important in explaining unemployment during recessions.

This paper is also related to the labour economics literature on collective bargaining. The model of a union as a monopolist wage setter – the firm being free to choose employment – dates back to Dunlop (1944), and was generalised by Nickell and Andrews (1983) as the *right-to-manage* model. In contrast, McDonald and Solow (1981) developed a model where unions bargain over both wages and employment, and in Manning (1987) they can also bargain over aspects. These models have been dubbed, respectively, *weakly efficient* and *strongly efficient* bargaining.

Finally, this paper has links with the literature on the degree of centralisation of collective bargaining. This literature tended to show that collective bargaining should either be fully centralised or fully decentralised. With a centralised wage bargaining process, unions tend to ask for higher wages, but if the process is centralised enough, they internalise the negative externalities of having excessive wages. On the other hand, if bargaining is conducted at intermediate levels like regions or industries, unions will not internalize as much their decision and ask for excessive wages (the Calmfors and Drifill hypothesis, see Calmfors and Drifill, 1988 or Layard et al., 1991).

The paper is organised as follows. Section 2 develops a model of differentiated workers/unions with monopoly power over employers. If they engage in monopoly pricing, they charge a price and the firm chooses employment. But there is another possibility, that I call featherbedding, where the firm can be forced to hire more labour than what it wishes given the wage. I show that given the stock of capital, featherbedding can be efficient, but as it acts as a tax on profits, it vastly reduces 8investment and the level of capital in the economy. Section 3 looks at structural reforms that reduce the extent of featherbedding in an economy. The reforms are welfare enhancing because they increase the capital stock, but the impact on employment is ambiguous.

3.2 The model

Dunlop's *monopoly union* model (1944) considered a union setting a wage unilaterally, knowing the labor demand of the firm. This assumption that the union can only set a wage, and the firm can choose employment freely, has been generalised by Nickell and Andrews (1983), and is often referred as *right-to-manage*: hiring and firing is the prerogative of the manager. In contrast, McDonald and Solow (1981) consider a model where the union and the firm bargain simultaneously over wages and employment. If the union is able to enforce a level of employment above the firm's own labour demand, this leads to over-employment, also referred to as featherbedding. This can however lead to an efficient contract where over-employment does offset the negative employment effect of the wage markup.

This paper will compare the *right-to-manage* and *featherbedding* models. In the first the union sets a wage, subject to a labour demand curve. In the second, the union sets both the wage and the level of employment. Of course, the wage and employment need to be compatible with the firm not making a loss, otherwise the plant could simply be shut down entirely. In the following subsection I detail the participation constraint of this problem.

3.2.1 Featherbedding: labour demand

I model the wage bargaining between a worker and a firm as a principal-agent problem. There are N workers (or worker types), indexed by i. The representative firm has a production function $F(L)$. The aggregate labour supply L is an aggregate of the labour supplied by each worker i, implicitly defined by:

$$g(L) = \frac{1}{N}\sum_{i=1}^{N} g(L_i)$$

Both $F(\cdot)$ and $g(\cdot)$ are increasing, concave function satisfying $F(0) = g(0) = 0$. Concavity of production requires that $F(g^{-1}(\cdot))$ is also concave, which is a stronger condition.[1]

If the firm observes a wage W_i and is free to choose the amount of labour L_i, the firm's optimal choice equalizes the marginal surplus with the wage. The marginal *surplus* product of type-i labour is

$$MS(L_i) = \frac{\partial F}{\partial L_i} = \frac{1}{N}\frac{g'(L_i)}{g'(L)}F'(L) = \frac{1}{N}\frac{g'(L_i)}{g'(L)}MPL \tag{3.1}$$

On the other hand, if the worker or union of type i is able to choose the wage and employment together, there is a participation constraint: the firm must be better off accepting W_i and L_i than not employing type i at all. The participation constraint is that the total surplus is higher than the wage bill:

$$\begin{aligned} TS(L_i) &= F(L_1, \ldots, L_i, \ldots, L_N) - F(L_1, \ldots, L_{i-1}, 0, L_{i+1}, \ldots, L_N) \\ &= F\left[g^{-1}\left(\frac{1}{N}\sum_{k=1}^{N} g(L_k)\right)\right] - F\left[g^{-1}\left(\frac{1}{N}\sum_{k\neq i} g(L_k)\right)\right] \geq W_i L_i \end{aligned}$$

When N is large, the *binding* participation constraint can be approximated:

$$TS(L_i) = \frac{1}{N}\frac{g(L_i)}{g'(L)}F'(L) = \frac{1}{N}\frac{g(L_i)}{g'(L)}MPL = W_i L_i$$

In other words, the wage is the *average surplus* product of labour

$$W_i = AS(L_i) = \frac{TS(L_i)}{L_i} = \frac{1}{N}\frac{g(L_i)}{g'(L)L_i}MPL \tag{3.2}$$

Property 7. *(1) Under perfect competition and linear pricing, the firm observes the wages (W_i) and chooses its labour demands (L_i) to maximize its profits. The marginal surplus product of worker i is equal to the wage.*

$$W_i = MS(L_i) = \frac{1}{N}\frac{g'(L_i)}{g'(L)}MPL \qquad \frac{\partial \ln W_i}{\partial \ln L_i} = \frac{g''(L_i)L_i}{g'(L_i)}$$

(2) Under price discrimination, the worker of type i is able to capture all of the total surplus that he generates for the firm, $W_i L_i = TS(L_i)$, or

$$W_i = AS(L_i) = \frac{1}{N}\frac{g(L_i)}{g'(L)L_i}MPL \qquad \frac{\partial \ln W_i}{\partial \ln L_i} = \frac{g'(L_i)L_i}{g(L_i)} - 1$$

[1] For constant elasticities in the production function and labour aggregate, $F(L) = L^{1-\alpha}$ and $L = \left(\frac{1}{N}\sum_{i=1}^{N} L_i^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}$, these conditions imply $1/\epsilon < \alpha < 1$

From the concavity of $g(\cdot)$, $\frac{g(L_i)}{g'(L_i)L_i} > 1$ *hence* $AS(L_i) > MS(L_i)$

The labour demand elasticity, $\epsilon = -\frac{\partial \ln L_i}{\partial \ln W_i}$ *is equal under (1) and (2) if* $g(\cdot)$ *has a constant elasticity of substitution.*

Under the featherbedding case, the wage is higher for every level of employment. Or put differently, there is a higher labor demand for every level of wage. The union imposes a higher demand curve to the firm.

3.2.2 Labour supply

The household of type i maximize the representative utility function

$$\max \mathrm{E}_0 \sum_{t=0}^{+\infty} \beta^t \left[u(N.C_t(i)) - v(L_t(i)) \right]$$

subject to a budget constraint

$$C_t(i) + Q_t B_t(i) = B_{t-1}(i) + W_t(i) L_t(i) + \frac{D_t}{N}$$

The numeraire is the homogeneous consumption good C_t.[2] The household receives a dividend D_t from a diversified equity portfolio, and a wage compensation $W_t(i)L_t(i)$. New bonds B_t can be bought or sold at price Q_t, the stochastic discount factor of the household. As in Erceg et al. (2000) or Gali (2008), let us assume markets with complete contingent claims for consumption but not leisure. This ensures full consumption smoothing accross agents.

Lemma 10. *With complete markets, there is full consumption smoothing:*

$$\forall (t,i) \qquad C_t(i) = \frac{C_t}{N}$$

$$Q_t = \mathrm{E}_t \beta \frac{u'(C_{t+1})}{u'(C_t)} \tag{3.3}$$

The labour supply decision for a worker i is equivalent to maximizing the following quantity in each period

$$u'(C_t) W_t(i) L_t(i) - v(L_t(i)) \tag{3.4}$$

subject to the labour demand curve defined in property (1)

[2]The factor N is simply introduced for scaling reasons as in the labour aggregate previously. With N symmetric agents, each consumes $1/N$ of the available total consumption, $C_t(i) = C_t/N$ but the MRS will feature the marginal utility of *aggregate* consumption

Property 8. *(1) Under perfect competition, the wage is equal to the marginal rate of substitution,* $W_i = \frac{MRS_i}{N} = \frac{1}{N}\frac{v'(L_i)}{u'(C)}$

(2) Under both linear pricing and price discrimination, the wage is a markup over the MRS, with the elasticity $\epsilon = -\frac{\partial \ln L_i}{\partial \ln W_i}$ *defined in property (1)*

$$W_i = \frac{1}{N}\frac{\epsilon}{\epsilon - 1} MRS_i = \frac{1}{N}\frac{\epsilon}{\epsilon - 1}\frac{v'(L_i)}{u'(C)}$$

As a result, both the competitive market and featherbedding case have an efficient level of employment, since the MPL is equal to the MRS. With linear pricing, employment is inefficiently low.

I now assume a continuum of workers/unions, to get rid of the factor N:

Theorem 5. *In the symmetric equilibrium*

(1) Under perfect competition $W = MPL = MRS$

(2) Under linear pricing $W = MPL = \frac{\epsilon}{\epsilon-1} MRS$ *with* $\epsilon = -\frac{g'(L)}{g''(L)L}$

(3) Under featherbedding $MPL = MRS = \frac{\epsilon-1}{\epsilon} W$ *with* $\epsilon = \frac{1}{1-\frac{g'(L)L}{g(L)}}$

Featherbedding is efficient even though the wage is above the MPL and MRS. However, dividends are abnormally low in this economy:

$$D = Y - WL = F(L) - \frac{\epsilon}{\epsilon - 1} MPL.L < F(L) - MPL.L$$

discussion

Labour market rigidities are usually modeled as an employment tax, as it creates a wedge between the demand and supply of labour. But here, these rigidities are acting instead as a capital income tax. Instead of having a wedge between the marginal product of labour and the marginal rate of substitution, featherbedding creates a wedge between the marginal product of capital and the returns to capital, and can be thought of as a tax.

Under featherbedding, unions are not detrimental to employment but to profits. Conditional on the MPL and MRS curves, featherbedding provides an efficient level of employment and output. But this efficiency is conditional on a fixed amount of capital. This is no longer the case when I introduce investment. Featherbedding makes firms' profits abnormally low, and this reduces the steady state level of capital in the economy. Firms under invest, because they will be "held up" once capital is installed (Grout, 1984). The wedge between the MPK and returns to capital acts as a capital income tax.

3.2.3 Capital intensity

Let me now introduce capital. The production function is homogeneous in capital and labour, $Y = F(K, L)$ and capital accumulation writes

$$K_{t+1} = Y_t - C_t + (1 - \delta)K_t$$

δ is the rate of capital depreciation. Since the firm is not free to use capital and labour freely, capitalists earn the residual profits of the firm which can be lower than the marginal product of capital:

$$RK = F(K, L) - WL$$

If workers are paid their MPL, capital will be paid its MPK since F is homogeneous. But if the wage is higher, the returns to capital will be lower.[3]

Lemma 11. *(1) Under perfect competition and linear pricing, the firm chooses labour competitively, hence the rate of return is the marginal product of capital. The marginal surplus product of worker i is equal to the wage.*

$$R = \frac{\partial F}{\partial K}$$

(2) Under price discrimination, the wage is above the MPL, hence returns are lower. There is wedge between the MPK and the returns to capital

$$R = \frac{Y}{K} - \frac{\epsilon}{\epsilon - 1} \frac{L}{K} \frac{\partial F}{\partial L} = \frac{\partial F}{\partial K} - \frac{1}{\epsilon - 1} \left(\frac{Y}{K} - \frac{\partial F}{\partial K} \right)$$

comparison

In steady state, the interest rate, net of depreciation, is equal to the rate of time preference: $R = \rho + \delta$ with $\rho = 1/\beta - 1$.

Using lemmas 1–3 as well as $C = Y - \delta K$ in steady state, I can solve the equilibrium employment, capital and consumption under perfect competition, linear pricing and price discrimination

[3] It is important to note that wages are only bargained *after* capital has been installed, so that it leads to a hold up problem of firms by unions. This hold up problem could in theory be avoided if firms and unions were to bargain over both capital and wages, before investment takes place (see Grout, 1984). Since firms are stuck once investment takes place, this requires a commitment that unions will not extract higher wages at this stage.

But here, I have a continuum of atomistic workers/unions. Hence, even if every other worker was upholding its commitment to secure higher investments, any single worker would renege and ask for a higher wage, since his own individual action do not affect the overall level of investments. Hence commitment cannot be an equilibrium here.

Theorem 6 (proof in appendix)**.** *(1) Under linear pricing, L, C and K are lower than under perfect competition, due to the markup*

(2) Under featherbedding, C and K are lower than under perfect competition. The effect on employment L is ambiguous

(3) C and K are higher under linear pricing than under featherbedding. The comparative impact on employment L is ambiguous

The intuition is as follows. With linear pricing, the MRS markup reduces the labour supply and consumption. This reduced labour supply lowers returns to capital hence capital itself, which further reduces the labour supply and consumption. Under featherbedding, the abnormally low returns to capital greatly reduce capital and hence output and consumption. For labour, there is a negative substitution effect (low wages due to low capital) and a positive income effect (due to the lower consumption). A high elasticity of consumption in the utility function makes the income effect bigger.

Hence, when the consumption elasticity σ is very low, there is little or no income effect, so that the substitution effect of lower capital and lower wages brings the featherbedding employment below the competitive and linear pricing outcome. For very high values of σ, the high income effect dominates and there is more work than under the two alternatives. For intermediate values of σ, people work more under featherbedding than linear pricing, but less than under perfect competition.

Calibration and illustration

As an illustration, I use an isoelastic production function $Y = K^{\alpha}L^{1-\alpha}$ and an isoelastic, separable utility function $u(C) - v(L) = \frac{C^{1-\sigma}}{1-\sigma} - \lambda\frac{L^{1+\phi}}{1+\phi}$

Here and in the rest of the paper, I will assume $\epsilon = 10$, so that the wage markup is $\mu = 1.1$. I assume a capital elasticity $\alpha = 0.4$, so that the labour share, including featherbedding, is $\mu(1-\alpha) = 0.66$. The remaining parameters are the Frisch elasticity, and relative risk aversion. The Frisch elasticity is not crucial: it does affect the scale of the effect but not the sign nor the general profile. In line with other macro models, I assume a relatively high Frisch elasticity, equal to 2. As I have argued before, the income effect is crucial, hence the coefficient of relative risk aversion is critical. Reasonable values in the literature tend to lie between 0.5 and 2, hence I will look at different values in that interval to illustrate the differences it can generate.

Figure 1 illustrates this, by comparing capital, consumption and labour under linear pricing and featherbedding (as a ratio of the competitive value). Conditional on the level of capital, featherbedding is more efficient than linear pricing, and as efficient as perfect competition. However, once capital is endogenous, featherbedding is less efficient than the other two outcomes.

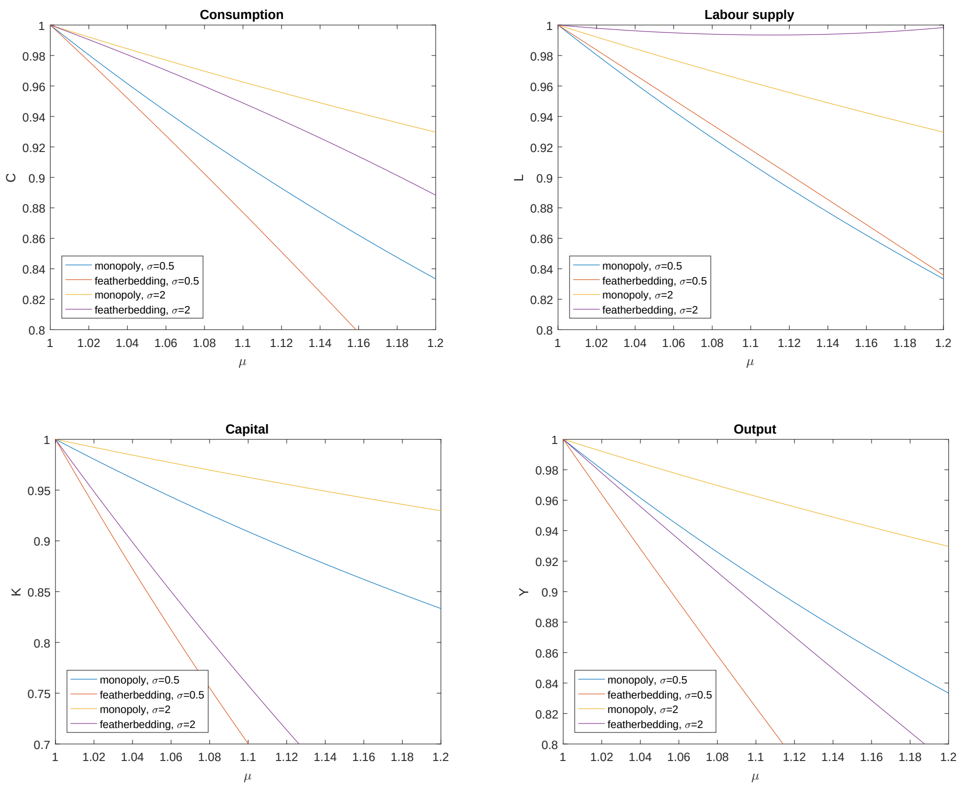


Figure 3.1: consumption, labour, capital and output under featherbedding and linear pricing, as ratio to flexible outcome, depending on σ

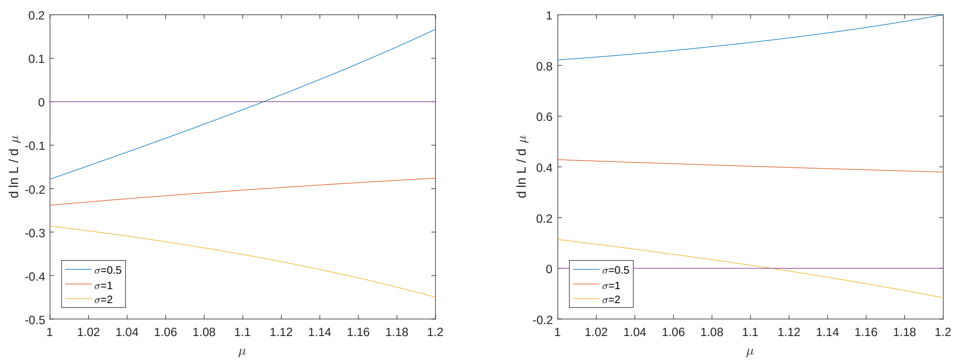
3.3 Application: labour market reforms

This framework is useful to analyse structural labour market reforms. I assume that the economy starts from a featherbedding situation, with a markup both on the MPL and MRS side. The structural reform can lower either the MPL markup alone, or both markups together. These two cases can be interpreted as two different kinds of reforms, that either preserve insider/outsider dynamics, or are more inclusive.

One reform provides flexibility to firms by allowing them to choose employment more freely, below what the union would like, but it doesn't restrict the ability of workers to ask for higher wages. Hence the MPL markup is lowered but not the MRS markup. Employment falls but wages are still above the MRS. This can be thought of as flexibility at the cost of duality in the labour market, with high wage insiders and unemployed outsiders.

The other reform affects both the hiring decision of the firm and the wage demand of workers. While firms have more freedom to choose a lower level of employment (the fall in MPL markup), the wage demands of workers also fall (with the MRS markup). Hence this is a more inclusive reform which doesn't protect wages at the cost of employment.

Allowing the MPL or both markups to fall has immediate consequences on employment, but it also leads to higher investment driven by higher expected profits. Hence in the long run capital increases, which improves the efficiency of the economy. This improved efficiency has two effects on employment: the higher capital increases the real wage while increased consumption will lower the labour supply. For a very high relative risk aversion, the income effect can be stronger then the substitution effect.



(a) MPL markup only

(b) Both markups

Figure 3.2: Marginal (long term) percentage increase in labour with a reduction in one or two of the markups, depending on the relative risk aversion σ

Figure 2 shows the long run percentage change in employment caused by a marginal reduction in one or two of the markups. Not surprisingly, an inclusive reform is better at reducing unemployment. In fact, reducing only the MPL markup will often lead to a fall in employment in the long run. This fall in employment is not welfare deteriorating, especially since consumption does increase in the long run hence households consume more and work less. But this does illustrate that not all structural reforms are beneficial to employment in the long run.

But in a dynamic model, investment demand will have an additional effect on employment. The rest of the section studies when and how these structural reforms are beneficial or not to employment in the short run.

3.3.1 The dynamic equilibrium

I assume an isoelastic production function

$$Y_t = K_t^{\alpha} L_t^{1-\alpha} \tag{3.5}$$

The utility function is also isoelastic:

$$\sum_{t=0}^{+\infty} \beta^t [u(C_t) - v(L_t)] = \sum_{t=0}^{+\infty} \beta^t \left[\frac{C_t^{1-\sigma}}{1-\sigma} - \lambda \frac{L_t^{1+\phi}}{1+\phi} \right]$$

I assume that the economy starts in a steady state with labour market rigidities, corresponding to what I have described above: the wage is above the MRS and the MPL (the two markups being potentially different[4])

$$W_t = \mu_t^1 MRS_t = \mu_t^1 L_t^{\phi} C_t^{\sigma} \tag{3.6}$$

$$W_t = \mu_t^2 MPL_t = (1-\alpha)\mu_t^2 \left(\frac{K_t}{L_t}\right)^{\alpha} \tag{3.7}$$

The returns to capital is not the MPK, but the residual profits: $R_t = \frac{Y_t - W_t L_t}{K_t}$ If capital can be invested freely, the budget constraint and Euler equation are, respectively

$$K_{t+1} = (1-\delta)K_t + Y_t - C_t \tag{3.8}$$

$$C_t^{-\sigma} = \beta E_t \left[\left(1 - \delta + \frac{Y_{t+1} - W_{t+1}L_{t+1}}{K_{t+1}} \right) C_{t+1}^{-\sigma} \right] \tag{3.9}$$

I also look at quadratic costs of adjusting capital. The budget constraint and Euler equation now become

$$K_{t+1} = (1-\delta)K_t + Y_t - C_t - \psi \frac{(K_{t+1} - K_t)^2}{2K_t} \tag{3.10}$$

$$C_t^{-\sigma} = \beta E_t \left[\begin{array}{c} \left(1 - \delta + \frac{Y_{t+1} - W_{t+1}L_{t+1}}{K_{t+1}} - \psi \frac{K_{t+1} - K_t}{K_t} \right) C_{t+1}^{-\sigma} \\ + \beta\psi \frac{K_{t+2} - K_{t+1}}{K_{t+1}} C_{t+2}^{-\sigma} \end{array} \right] \tag{3.11}$$

Equations 3.6, 3.7, and 3.5, combined with 3.8 and 3.9 (or eqs 3.10 and 3.11) are a system of 5 equations in Y, K, L C and W. Starting from steady state values for μ^1 and μ^2, it is possible to observe the response to a structural reform shock that would lower either or both of these markups.

[4]Perfect competition corresponds to the two markups being equal to 1, and linear pricing has the MPL markup equal to 1

fall of MPL markup

I will consider first a sudden fall in the MPL markup at time t. This is an unanticipated *"MIT shock"*. The economy was at steady state before, and will converge to the new steady state without facing any additional shock. But the MRS markup is unaffected: $\mu^2_{t-1} = \mu^1_{t-1} = \mu$ and

$$\forall T \geq t, \qquad \mu^2_T = \mu - u_t \qquad and \qquad \mu^2_T = \mu$$

I consider the case of flexible investment, as well as medium ($\psi = 3$) and high ($\psi = 10$) quadratic costs of adjusting capital. In a downturn, investment is arguably hindered and these high adjustment costs reflect this.

gradual fall of both markups

Later I look at a structural reform that lowers both the MPL and MRS markups. However, I assume that these two markups do not fall at the same speed because realistically, some changes can only be gradual. In particular, even if a policy aims at reducing the two wage markups, it is likely that the MPL markup will fall more rapidly than the MRS markup. From a situation of featherbedding, if right-to-manage is introduced (for example by liberalizing layoffs and reducing the scope of tools available to union), the effects are likely to be rapid. On the other hand, resisting a fall in the MRS markup would likely be easier, so that this markup would fall more slowly.

This is not a model of sticky wages. There is a downward rigidity on one of the wage markups, not on the wage itself. I simply assume that it takes time for workers to accept that their wage markup is falling. Apart from the markup, the wage does adjust to market changes like capital or investment.

Hence, I modify the previous set of equations as follows. There is a long term, permanent markup shock u_t and the MPL markup falls immediately

$$\forall T \geq t, \qquad \mu^2_T = \mu - u_t$$

However, the MRS markup does fall more gradually: $\mu^1_{t-1} = \mu$ and

$$\forall T \geq t, \qquad \mu^1_T = \theta \mu^1_{T-1} + (1-\theta)(\mu - u_t)$$

$\theta \in (0,1)$ is a parameter for the persistence of the MRS markup. I assume a relatively high $\theta = 0.95$, that corresponds to strong resistance to a fall in the wage markup, that is likely to occur if there is downward wage rigidity, particularly in a downturn with low inflation. As with the MPL-only case, I consider flexible investment and quadratic costs with $\psi = 3$ and $\psi = 10$.

3.3.2 A reduction in featherbedding only

Figures 3.3, 3.4a and 3.4b display the impulse response function to a 1% fall in the MPL markup, for different values of σ equal to 0.5, 1 and 2 respectively.[5]

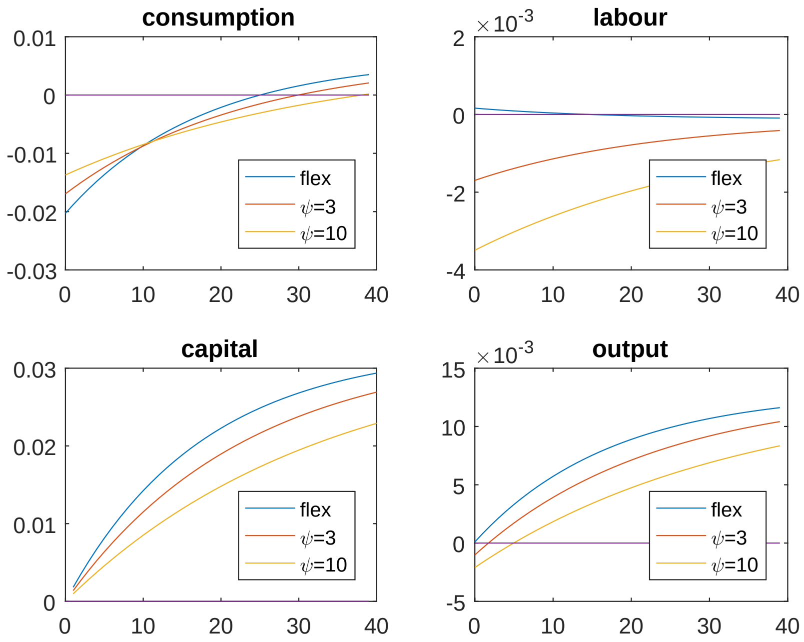
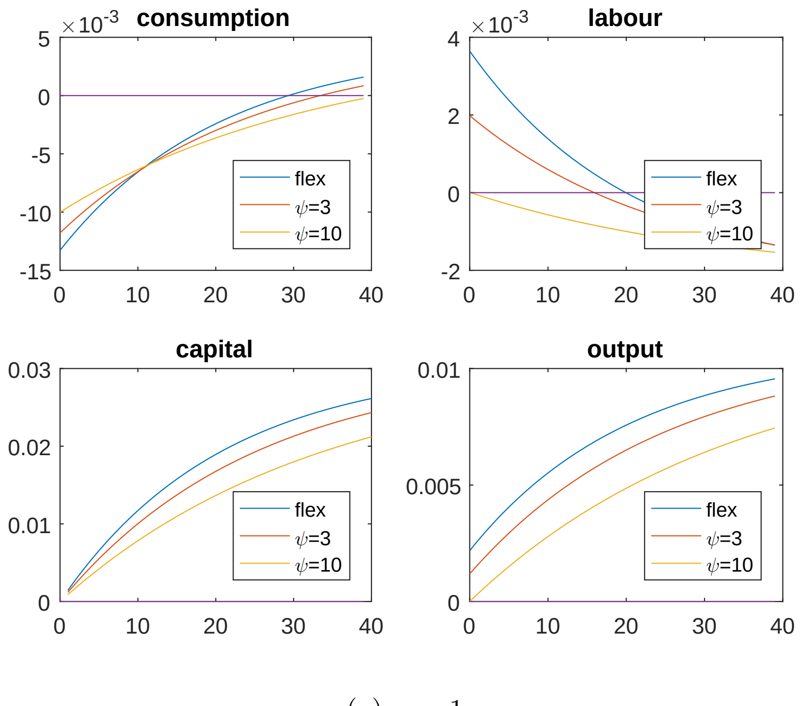


Figure 3.3: IRF to a 1% fall in the MPL markup, $\sigma = 0.5$

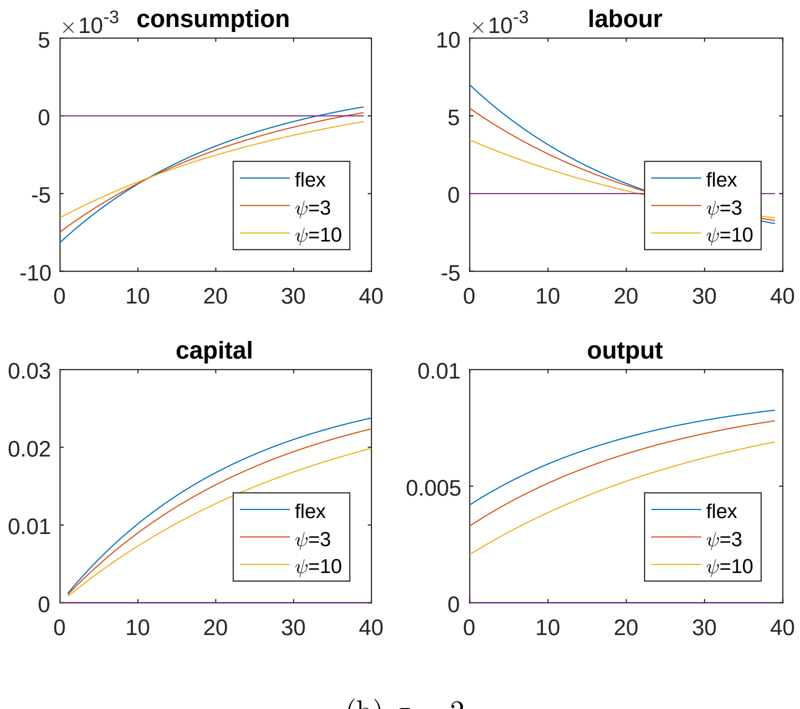
For $\sigma = 0.5$, we had seen before, in figure (3.2a) that the long term impact on employment was virtually zero. In the short run, the impact on employment is driven negatively by the markup, and positively by additional investment. But since the relative risk aversion is low, most of the investment is done by consuming less rather than working more, as the fall in consumption is less costly than the increase in labour. When investment is flexible, the increased demand for investment virtually cancels the lower demand from the fall in the MPL markup, but with costly capital adjustment, investment is not strong enough to offset the lower MPL markup.

For higher values of σ, the long run effect on employment is negative. But in the short run, consumption falls less, hence the extra investment is mainly done through extra work not reduced consumption. There is a small positive impact on employment in the short run, but it can be reduced or canceled out if capital adjustment costs are strong and slow down investment.

[5]see appendix for for more extreme values of σ, equal to 0.2 and 4



(a) $\sigma = 1$



(b) $\sigma = 2$

Figure 3.4: IRF to a 1% fall in MPL markup, $\sigma = 1$ and $\sigma = 2$

3.3.3 Fall in both markups

Figures 3.5, 3.6a and 3.6b display the impulse response function to a 1% fall in the both markups, for different values of σ equal to 0.5, 1 and 2 respectively.[6] While the fall in the MPL markup is immediate, the MRS markup only falls gradually, with a persistence factor θ as argued previously.

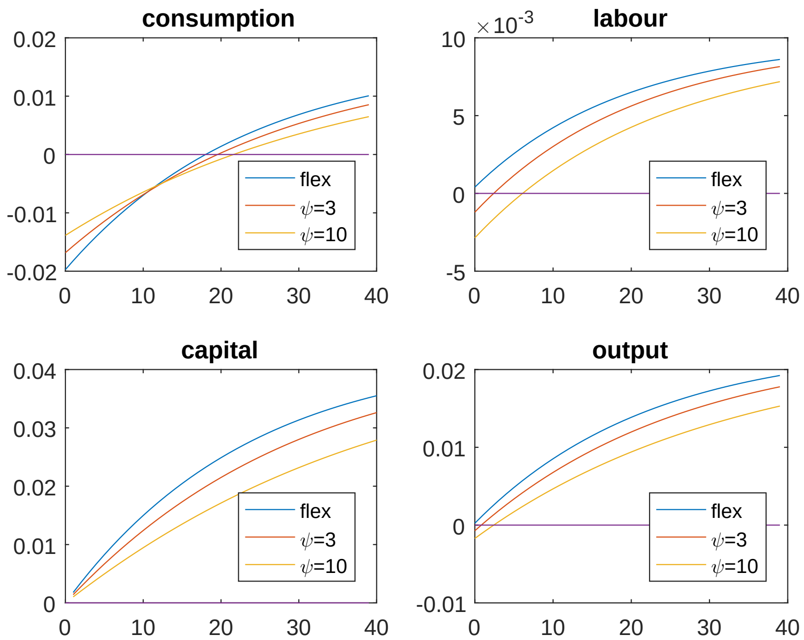


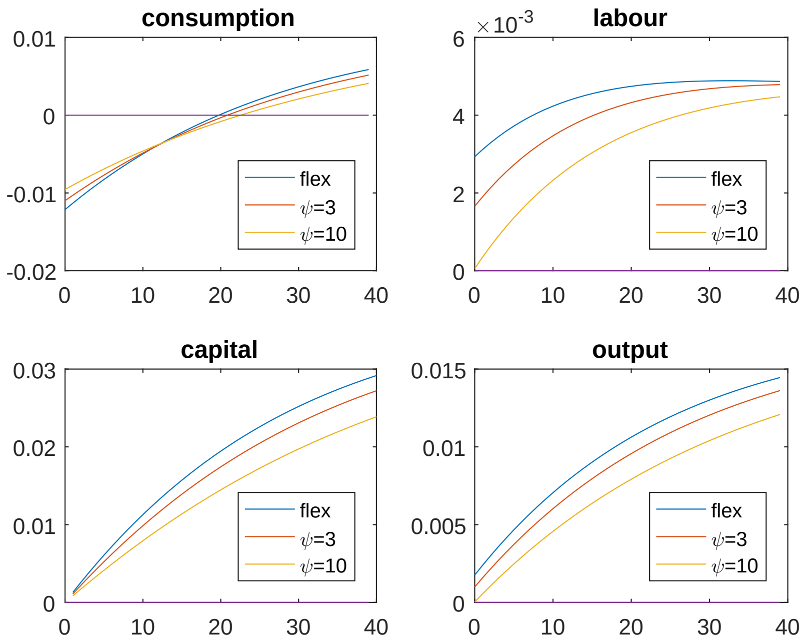
Figure 3.5: IRF to a 1% fall in both markups, $\sigma = 0.5$

Now, employment always increases in the long run, although it increases more for lower values of σ. Since the MPL markup falls immediately after the reform while the MRS markup falls much more gradually, the initial impact of these falls in markups is negative, similar to the fall of only one markup.

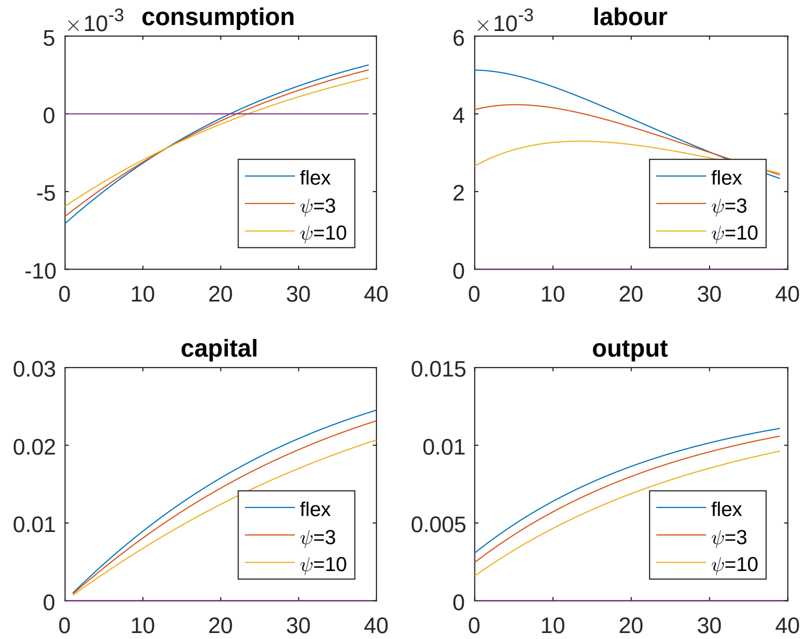
At the same time, there is also a bigger increase in capital, which triggers more investment in the short run. Hence employment in the short run is higher in this case than under the fall of only one markup, especially with a high relative risk aversion when the investment demand is addressed by higher employment rather than smaller consumption.

However, it is only on the long run that this more inclusive reform shows its true superiority compared to the other, in terms of boosting employment.

[6] see appendix for for more extreme values of σ, equal to 0.2 and 4



(a) $\sigma = 1$



(b) $\sigma = 2$

Figure 3.6: IRF to a fall in both markups, $\sigma = 1$ and $\sigma = 2$

3.4 Conclusion

In this paper I have built a model of featherbedding in the labour market, and I have argued that it can be a good description of some sectors or industries where labour unions are relatively strong. I have shown that with featherbedding, the wage is a markup over workers' marginal rate of substitution (MRS), but the wage is also a markup over firms' marginal product of labour. If these two markups are equal, the MPL and MRS are equalised, in contrast to monopoly pricing where there is a markup on the MRS but not the MPL. However, since the wage is above the MPL, firms' profits are abnormally low. Hence when capital is introduced, this leads to an inefficiently low level of capital, with ambiguous effect on employment depending on agents' relative risk aversion. I argue that with featherbedding labour market rigidities act as a tax on capital and not as a tax on labour.

I than considered the impact – particularly on employment – of structural reforms that aim to reduce the featherbedding rigidity. If the reform only allows firm to choose employment more freely without reducing the monopoly markup of unions, welfare improves, but the short and long term effects on employment are small or negative. This has resemblance to the insider-outsider literature where reforms that only affect new entrants in the labour market tend to be less effective. On the other hand, if the reform lowers both markups at the same time, welfare improves more, and employment does increase more, or at least fall less. In the short and middle run, the effect of these two kind of reforms strongly depends on the relative speed of adjustment of the two markups, and on the easiness with which investment demand for labour can offset any negative short term effect.

Using this framework in larger DSGE models is an obvious possibility of future research. This paper did not introduce nominal rigidities per se, and has no role for a central bank. But a larger model would enable me to see how a central bank can accompany the structural reform and ease any negative effect in the short run. Introducing entry by firms would also make capital adjustment more gradual, so that short term pain might be lengthened.

While featherbedding is likely more prevalent in the labour market, some similar can exist in the market for goods and services. In sectors with very little competition, it is not uncommon that consumers have little choice about the amount of goods or services that they can buy, and are forced to buy more than what they would wish. One of the first effects of liberalisation, in such cases, is that new entrants break the one-size-fit-all equilibrium and cater more closely to the needs of the consumer, by selling in more divisible quantities, or by creating low cost products. The framework of this paper could hence also be used in the goods and labour market.

Appendix A

Appendix of Chapter 2

First order approximation

The first order condition with respect to W_t^* is

$$0 = \gamma \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k \left(\frac{u'(C_{t+k})}{P_{t+k}} (1+e) L_{t+k|t} - e \frac{L_{t+k|t}}{W_t^*} v'(L_{t+k|t}) \right)}{\sum_{k=0}^{+\infty} (\beta\theta)^k \left(\frac{u'(C_{t+k})}{P_{t+k}} W_t^* L_{t+k|t} - v(L_{t+k|t}) \right)}$$
$$+ (1-\gamma) \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} \left(e \frac{L_{t+k|t}}{W_t^*} P_{t+k} F'(L_{t+k|t}) - (1+e) L_{t+k|t} \right)}{\sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} \left(P_{t+k} F(L_{t+k|t}) - W_t^* L_{t+k|t} \right)}$$

or $LHS = RHS$ with

$$LHS = \gamma \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} L_{t+k|t} \left[(1+e) W_t^* - e P_{t+k} MRS_{t+k|t} \right]}{\sum_{k=0}^{+\infty} (\beta\theta)^k u'(C_{t+k}) \left(\frac{W_t^* L_{t+k|t}}{P_{t+k}} - \frac{v(L_{t+k|t})}{u'(C_{t+k})} \right)}$$
$$RHS = (1-\gamma) \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} L_{t+k|t} \left[(1+e) W_t^* - e P_{t+k} MPL_{t+k|t} \right]}{\sum_{k=0}^{+\infty} (\beta\theta)^k u'(C_{t+k}) \left(F(L_{t+k|t}) - \frac{W_t^* L_{t+k|t}}{P_{t+k}} \right)}$$

Around a zero inflation equilibrium, we have $MRS = MPL = \left(1 + \frac{1}{e}\right) \frac{W}{P}$.

Let's assume $F(L) = L^{1-\alpha} = \frac{L}{1-\alpha} MPL = L \frac{1+\frac{1}{e}}{1-\alpha} \frac{W}{P}$.

Similarly, $\frac{v(L)}{u'(C)} = \frac{L^{1+\phi}}{u'(C)} = \frac{L}{1+\phi} MRS = L \frac{\left(1+\frac{1}{e}\right)}{1+\phi} \frac{W}{P}$

Then $F(L) - \frac{WL}{P} = \frac{\frac{1}{e}+\alpha}{1-\alpha} \frac{WL}{P}$ and $\frac{WL}{P} - \frac{v(L)}{u'(C)} = \frac{\phi - \frac{1}{e}}{1+\phi} \frac{WL}{P}$

The first order log approximation of LHS and RHS become

$$lhs = \gamma \frac{(1-\beta\theta)(1+\phi)}{\phi - \frac{1}{e}} \sum_{k=0}^{+\infty} (\beta\theta)^k \left[w_t^* - \left(p_{t+k} + mrs_{t+k|t} \right) \right]$$
$$rhs = (1-\gamma) \frac{(1-\beta\theta)(1-\alpha)}{\frac{1}{e} + \alpha} \sum_{k=0}^{+\infty} (\beta\theta)^k \left[w_t^* - \left(p_{t+k} + mpl_{t+k|t} \right) \right]$$

$$mrs_{t+k|t} = mrs_{t+k} + \phi(l_{t+k|t} - l_{t+k}) = mrs_{t+k} + e\phi(w_t^* - w_{t+k}), \text{ so}$$

$$lhs = \gamma \frac{(1-\beta\theta)(1+\phi)}{\phi - \frac{1}{e}} \sum_{k=0}^{+\infty} (\beta\theta)^k \left[(1 - e\phi)(w_t^* - w_{t+k}) + (w_{t+k} - p_{t+k}) - mrs_{t+k} \right]$$

$$mpl_{t+k|t} = mrs_{t+k} - \alpha(l_{t+k|t} - l_{t+k}) = mpl_{t+k} - e\alpha(w_t^* - w_{t+k}), \text{ so}$$

$$rhs = (1-\gamma) \frac{(1-\beta\theta)(1-\alpha)}{\frac{1}{e} + \alpha} \sum_{k=0}^{+\infty} (\beta\theta)^k \left[(1 + e\alpha)(w_t^* - w_{t+k}) + (w_{t+k} - p_{t+k}) - mpl_{t+k} \right]$$

The aggregate wage satisfies $\frac{W}{P} = (1-\gamma)\frac{\eta}{\eta+1} MRS + \gamma \frac{\epsilon}{\epsilon-1} MPL$, so
$w_{t+k} - p_{t+k} = (1-\tilde{\gamma}) mrs_{t+k} + \tilde{\gamma} mpl_{t+k}$
with $\tilde{\gamma} = \frac{\gamma \frac{\epsilon}{\epsilon-1}}{(1-\gamma)\frac{\eta}{\eta+1} + \gamma \frac{\epsilon}{\epsilon-1}} = \frac{\gamma \frac{\epsilon}{\epsilon-1}}{\frac{e}{e+1}}$

$$lhs = \gamma \frac{(1-\beta\theta)(1+\phi)}{\phi - \frac{1}{e}} \sum_{k=0}^{+\infty} (\beta\theta)^k \begin{bmatrix} (1 - e\phi)(w_t^* - w_{t+k}) \\ +\tilde{\gamma}(mpl_{t+k} - mrs_{t+k}) \end{bmatrix}$$

$$rhs = (1-\gamma) \frac{(1-\beta\theta)(1-\alpha)}{\frac{1}{e} + \alpha} \sum_{k=0}^{+\infty} (\beta\theta)^k \begin{bmatrix} (1 + e\alpha)(w_t^* - w_{t+k}) \\ +(1-\tilde{\gamma})(mrs_{t+k} - mpl_{t+k}) \end{bmatrix}$$

Setting $lhs = rhs$ implies

$$\begin{aligned} &(\gamma(1+\phi) + (1-\gamma)(1-\alpha)) w_t^* \\ &= (1-\beta\theta) \sum_{k=0}^{+\infty} (\beta\theta)^k \begin{bmatrix} (\gamma(1+\phi) + (1-\gamma)(1-\alpha)) w_{t+k} \\ + \left(\frac{\gamma(1+\phi)}{e\phi-1}\tilde{\gamma} + \frac{(1-\gamma)(1-\alpha)}{1+\alpha e}(1-\tilde{\gamma}) \right)(mpl_{t+k} - mrs_{t+k}) \end{bmatrix} \end{aligned}$$

This can be written recursively as

$$(w_t^* - w_t) = (1-\beta\theta) \frac{\frac{\gamma(1+\phi)}{e\phi-1}\tilde{\gamma} + \frac{(1-\gamma)(1-\alpha)}{1+\alpha e}(1-\tilde{\gamma})}{\gamma(1+\phi) + (1-\gamma)(1-\alpha)} (mrs_t - mpl_t) + \beta\theta \left(w_{t+1}^* - w_t \right)$$

As a result, I get a Phillips curve

$$\pi_t = \frac{(1-\beta\theta)(1-\theta)}{\theta} \lambda (mrs_t - mpl_t) + \beta\pi_{t+1}$$

with a slope coefficient

$$\lambda = \frac{\frac{\gamma(1+\phi)}{\phi-1/e}\tilde{\gamma} + \frac{(1-\gamma)(1-\alpha)}{\alpha+1/e}(1-\tilde{\gamma})}{\gamma(1+\phi) + (1-\gamma)(1-\alpha)} \left(\frac{-1}{e} \right)$$

$$\lambda = \frac{\frac{\gamma^2(1+\phi)(1+1/e)}{\phi-1/e}\frac{\epsilon}{\epsilon-1} + \frac{(1-\gamma)^2(1-\alpha)(1+1/e)}{\alpha+1/e}\frac{\eta}{\eta+1}}{\gamma(1+\phi) + (1-\gamma)(1-\alpha)} \left(\frac{-1}{e} \right)$$

Appendix B

Appendix of Chapter 3

Proofs

Theorem 7. *(1) Under linear pricing, L, C and K are lower than under perfect competition, due to the markup*

(2) Under featherbedding, C and K are lower than under perfect competition. L is ambiguous

(3) C and K are higher under monopoly than under featherbedding. L is ambiguous

Proof : (1) write (K, L, C) as a function of the markup μ

$$\begin{aligned} MPL(K,L) - \mu MRS(C,L) = 0 \\ MPK(K,L) - (\rho + \delta) = 0 \\ F(K,L) - \delta K - C = 0 \end{aligned}$$

Differentiating this system with a Jacobian,

$$\begin{pmatrix} \frac{KF_{KL}}{F_L} & \frac{LF_{LL}}{F_L} - \frac{Lv''(L)}{v'(L)} & \frac{u''(C)}{u'(C)}C \\ KF_{KK} & LF_{KL} & 0 \\ KF_K - K\delta & LF_L & -C \end{pmatrix} \begin{pmatrix} \frac{\partial \ln K}{\partial \ln \mu} \\ \frac{\partial \ln L}{\partial \ln \mu} \\ \frac{\partial \ln C}{\partial \ln \mu} \end{pmatrix} = \begin{matrix} 1 \\ 0 \\ 0 \end{matrix}$$

Since MPL and MPK are homogenous of degree 0 in (K, L), it can be shown that

$$\frac{\partial \ln K}{\partial \ln \mu} = \frac{\partial \ln L}{\partial \ln \mu} = \frac{\partial \ln C}{\partial \ln \mu} = \frac{-1}{\sigma + \phi}$$

with σ and ϕ the (possibly local) elasticities of the utility of consumption and disutility of work.

(2) write (K, L, C) as a function of the markup μ

$$\begin{aligned} MPL(K,L) - MRS(C,L) = 0 \\ F(K,L) - \mu LMPL(K,L) - (\rho+\delta)K = 0 \\ F(K,L) - \delta K - C = 0 \end{aligned}$$

A similar differentiation brings

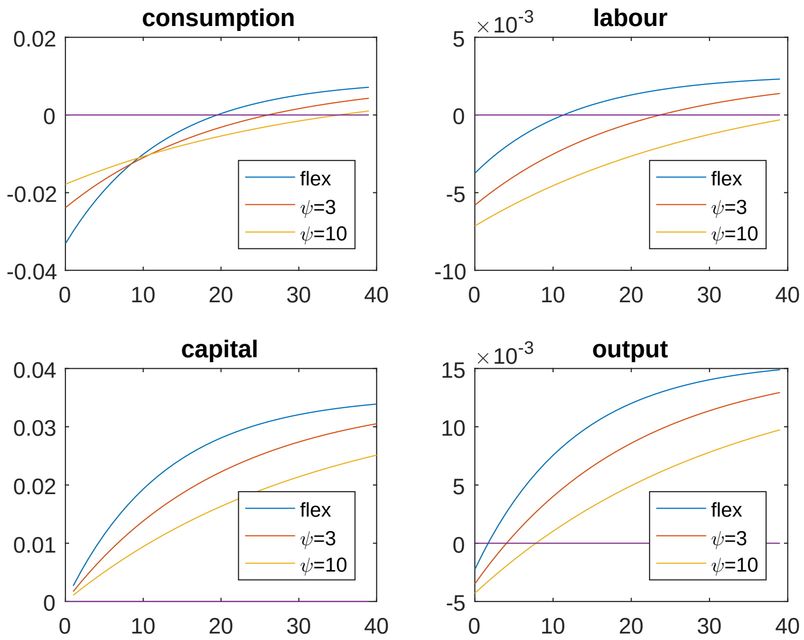
$$\begin{pmatrix} \frac{KF_{KL}}{F_L} & \frac{LF_{LL}}{F_L} - \frac{Lv''(L)}{v'(L)} & \frac{u''(C)}{u'(C)}C \\ (\mu-1) - \mu\frac{KF_{KL}}{F_L} & (1-\mu) - \mu\frac{LF_{LL}}{F_L} & 0 \\ KF_K - K\delta & LF_L & -C \end{pmatrix} \begin{pmatrix} \frac{\partial \ln K}{\partial \ln \mu} \\ \frac{\partial \ln L}{\partial \ln \mu} \\ \frac{\partial \ln C}{\partial \ln \mu} \end{pmatrix} = \begin{matrix} 0 \\ \mu \\ 0 \end{matrix}$$

Using the (possibly local) elasticities of the production and utility function, this gives

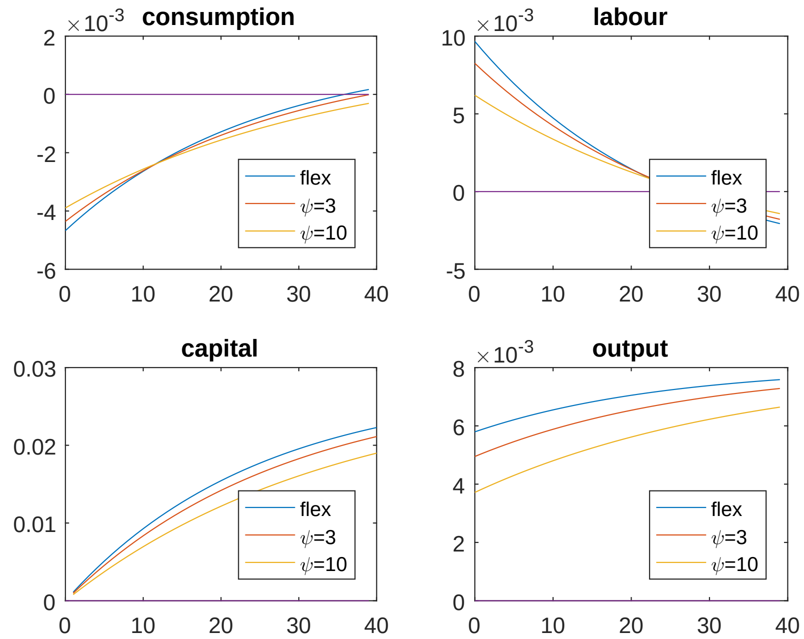
$$\begin{aligned} \frac{\partial \ln K}{\partial \ln \mu} &= \left(\frac{\alpha + \phi + \sigma\frac{LF_L}{C}}{\alpha - \frac{(\mu-1)}{\mu}}\right)\frac{-1}{\phi+\sigma} < \frac{-1}{\phi+\sigma} \\ \frac{\partial \ln C}{\partial \ln \mu} &= \frac{\left[\alpha + \phi\frac{(KF_K - K\delta)}{C}\right]}{\alpha - \frac{(\mu-1)}{\mu}}\frac{-1}{\phi+\sigma} < \frac{-1}{\phi+\sigma} \\ \frac{\partial \ln L}{\partial \ln \mu} &= \left(\frac{\alpha - \sigma\frac{(\mu-1)\delta(1-\alpha)+\rho\alpha}{\mu\delta(1-\alpha)+\rho}}{\alpha - \frac{(\mu-1)}{\mu}}\right)\frac{-1}{\phi+\sigma} \gtrless 0 \end{aligned}$$

(3) Comparing the cases (1) and (2) above, one simply needs to look at

$$\begin{aligned} \frac{\partial \ln K}{\partial \ln \mu}|_{(2)} &< \frac{\partial \ln K}{\partial \ln \mu}|_{(1)} \\ \frac{\partial \ln C}{\partial \ln \mu}|_{(2)} &< \frac{\partial \ln C}{\partial \ln \mu}|_{(1)} \\ \frac{\partial \ln L}{\partial \ln \mu}|_{(2)} &\gtrless \frac{\partial \ln L}{\partial \ln \mu}|_{(1)} \end{aligned}$$

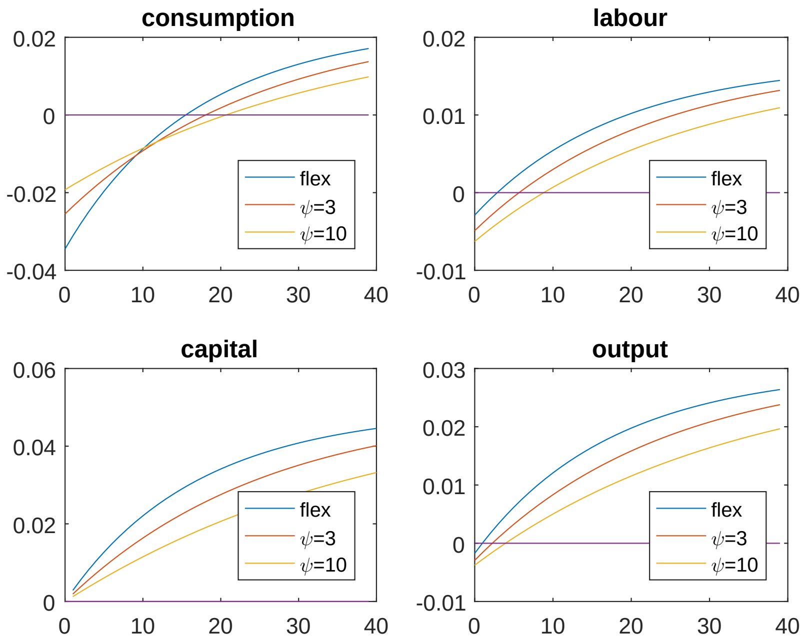


(a) $\sigma = 0.2$

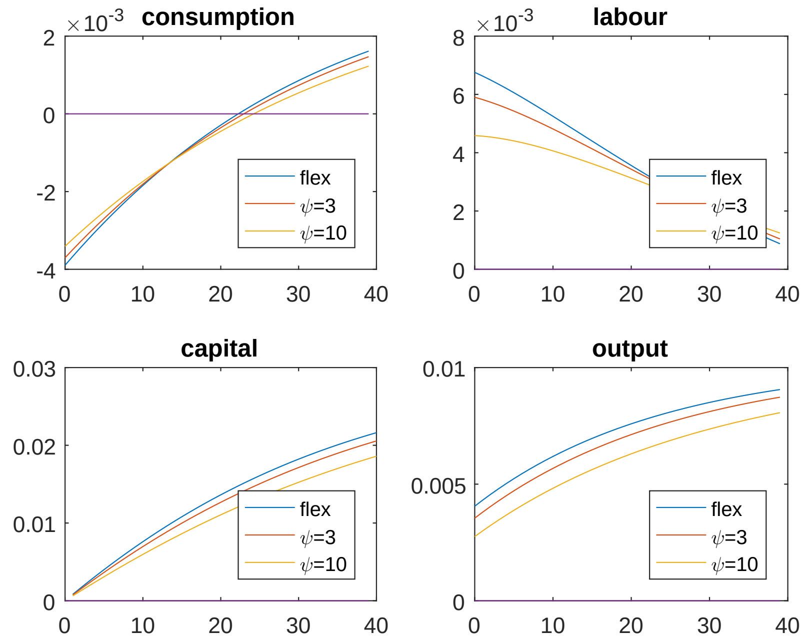


(b) $\sigma = 4$

Figure B.1: IRF to a fall in MPL markup, $\sigma = 0.2$ and $\sigma = 4$



(a) $\sigma = 0.2$



(b) $\sigma = 4$

Figure B.2: IRF to a fall in both markups, $\sigma = 0.2$ and $\sigma = 4$

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