Abstract

Given recent emphasis on externality to education, macroeconomic studies have a role to play in the analysis of return to schooling. In this paper we study the connection between growth and human capital in a convergence regression for the panel of Italian regions. We include measures of average, primary, secondary and tertiary education. We find that increased education seems to contribute to growth only in the South. Decomposing total schooling into its three constituent parts, we find that only primary education in the South seems to be important. The results thus suggest that the Italian growth benefited from the elimination of illiteracy in the South, mainly in the 1960s, but not from the substantial increases in education at the other levels.

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Education and Italian Regional Development

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1. Introduction

In this paper we investigate in Italian regional data the connection between economic growth and aggregate levels of education. The policy issue we have in mind is quite simple. Does a society become more productive, in the narrow economic sense (GDP/head, say), if the workforce is more educated? If the answer to this question is yes, then it is conceivable that it would be efficient, again in the narrow economic sense, to increase by public policy the amount of education received, depending, of course, on the costs of the increased provision. If reached, this conclusion would require presumably the existance of wide-spread externalities to education, for otherwise private agents would hardly acquire too little of this form of human capital in an already heavily subsidised market (in developed countries at least).

There is (or was) a strand of conservative[1] thought that doubts the efficacy of increased general education beyond a certain minimal level. Consider Hayek in *The Constitution of Liberty*, Chapter 24:

> There is not much reason to believe that, if at any one time the best knowledge which some possess were made available to all, the result would be a much better society. Knowledge and ignorance are very relative concepts, and there is little evidence that the difference in knowledge which at any one time exists between the more and the less educated of a society can have such a decisive influence on its character.

Hayek does not deny however that general education up to some level can be beneficial. Of von Humboldt's work on the Prussian system of state education, he writes "It can scarcely be denied that the general level of education which Prussia thus obtained was one of the chief causes of her rapid economic rise and later that of all of Germany". Taken together, the two quotes suggest very rapid decreasing social returns to education - in fact, this is more or less the conclusion of the present study. One can multiply examples. The Mills, *père et fils*, doubted a strong connection between wealth and formal schooling. James Mill refused to send his own children to school "lest the habit of work should be broken and a taste for idleness acquired". Rather differently and more

[1] We use conservative in the modern, denotative sense: most of the authors cited below would have described themselves, in their time, as liberals or radicals.

benignly, J. S. Mill thought the enoblement of the mind induced by education would not necessarily lead to riches:

> Every real improvement in the character of the English, whether it consist in giving them higher aspirations, or only a juster estimate of the value of their objects of desire, must necessarily moderate the ardour of their devotion to the pursuit of wealth.

Mill did believe, however, that a good elementary education would help the acquisition of skills[2]. The view of Arnold of Rugby was closer in spirit to James Mill:

> I would far rather send a boy to Van Dieman's land where he must work for his bread than send him to Oxford to live in luxury without any desire in his mind to avail himself of his advantages.[3]

Perhaps the last great educational sceptic was John Jewkes. In particular, his detailed study of the lives of inventors led him to believe that formal education tended to stifle creativity. The following quote refers to tertiary education:

> There is also the big and largely unplumbed question of the relation between education and inventive thinking. University education, even at its best, tends to bring about conformist thinking; for Universities cannot operate without standard tests and procedures. Might this have the effect of raising the average level of competance but only at the expense of frustrating the rarer spirits? It certainly seems true that if one takes the men who have broken through the existing barriers in the arts, in science and technology, a significant proportion of them would have been, or were, frustrated by the minimum degree of organization called for if we are to have a formal higher education at all.[4]

These sceptical views lost fashion towards the end of the 19th century and today all developed countries require children to stay in school until their late teens. Why this profound

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[2] See *Considerations on Representative Government, Collected Works*, XIX., ed. J.M. Robson, Toronto,

[3] Quoted by Jewkes, cited below. The Oxford effect could presumably be studied in micro data but we reserve this for further work.

[4] *Public and Private Enterprise*, Routledge, London, 1965, p. 49.

change in opinion and practice took place so universally is an historical question of considerable interest and warrants separate study. Hayek argues in the above reference that Prussia was both model and example. No doubt German economic growth was the subject of much contemporary study, just as, in our own day, scholars have swarmed over the currently successful economy – variously Japan, Sweden, Germany again - searching for the elusive secret.

In the standard market-clearing model, increases in the level of compulsory education are unambiguously wealth-reducing. If individuals allocate time to education to maximise the present value of income, then requiring them to accumulate human capital beyond their desires would lead to lower wealth, just as would requiring firms to increase physical capital above profit-maximising levels: in the case of physical capital, GDP would rise but consumption would fall[5] ; in the case of human capital, consumption would fall but GDP might rise or fall[6].

Traditional screening models hypothesise that education does not directly add to productivity: rather it confers credentials used in the labour market to select able workers. In this case, private returns to schooling can be high at the same time as social returns are nugatory. Some authors have argued that higher education tends to create rent-seekers who do not add to the genuine output of the economy.[7] More prosaically, recent work suggests that conventional schooling has, or may have, harmful side effects by creating peer groups with rival values to those of parents and adults generally. Thus Hargreaves (1994):

> If one wanted to create a separate teenage culture, if one wanted to make adolescents feel cut-off from adult responsibilities, the best way would be to do as we now do: segregate them for most of their lives outside the family with those who happen to have been born in the same year.

[5] Essentially because of diminishing returns to capital. In a small open economy, the extra capital is imported, leading to a fall in the foreign asset component of national wealth, not offset by the increase to the present value of income.

[6] For a one-year increase in compulsory education beyond the level freely chosen, GDP would rise in steady state if one year as a proportion of the average working life exceeds the real interest rate. These two quantities are of the same order of magnitude so it could go either way.

[7] For an example of the snake and mongoose relationship between lawyers and modern economists, see Lodde (1995) who finds the number of engineers and growth positively connected, but lawyers and growth negatively connected (among the Italian regions). See also Wolff and Gittleman (1993) and Pugno (1998).

The psychiatrist Michael Rutter[8] has argued similarly that it is seperation from the influence of adults that has led to observed increases in adolescent psychological problems[9]. Interestingly, there is good evidence that similar effects are at work among very young children. Feinstein *et al.* (1998) show that children emerge from nurseries with weaker language skills than children cared for by their mothers or informally by other adults.

What can be put on the other side of the balance? Intervention in the market for schooling can be most easily justified if there are important externalities and a number of recent growth models have nominated ways in which these can occur. For example, Lucas (1988) assumes that high average levels of human capital throughout the economy increase the productivity of any given worker. One could think of this as a positive peer-group effect. But there are a number of other possible mechanisms. A higher level of education could be associated with a reduction in crime, increased social cohesion, more informed political decisions, inter-generational benefits (assuming parents' education is transmitted to their children) and technological and organisational improvements not captured by private returns.

Note that individual-based micro analyses will be useless as a guide to public policy when there are important externalities because such analyses will measure only private returns. Macro studies, on the other hand, consider the data of direct interest, namely the returns at the level of the economy. In fact, the existing empirical literature on macro growth and human capital shows substantial differences to the microeconometric evidence on returns to education. While Mincerian regressions[10] indicate the existence of positive private returns on educational attainments in both developed and developing countries, often of the order of 10% for each extra year, cross-country studies of aggregate returns to education (typically using the standard growth-regression approach) usually find that education is not strongly associated with per capita income growth. Indeed, sometimes the relationship is negative. Psacharopoulos (1985), using data from forty-four developing and developed countries, compares private and social rates of return for different levels of education and finds that: (a) returns to primary education (whether social or private) are highest

[8] See Rutter and Smith (1995)

[9] "…These changes, combined with the lengthening of youth and the postponment of economic independence, may tend to insulate young people from the influence of adults, in particular their parents, and increase the influence of the peer group. It may therefore be that it is an isolated youth culture leads to the increase in psychosocial disorders."

[10] See Mincer (1974).

among all educational levels; (b) private returns are in excess of social returns, especially at university level; (c) returns to education in developing countries are higher than the corresponding returns in more advanced countries[11]. One possible non-economic reason for the disparity in measured returns lies in the non-experimental nature of the Mincerian regression. If individuals evaluate further education by comparing their own private (but otherwise unobserved) return with a market discount rate, then the parameter on "stay-on" will be an estimate of the average of supra-marginal returns in the population. A policy which increases observed human capital by increasing compulsory schooling, however, adds in precisely those with sub-marginal private returns, so that the return to this could be much lower.

Italian data are most suitable for a macro study of the return to education: the Italian regions are quite diverse in their endowments of human capital - among the European countries, Italy has the highest dispersion of regional education attainment[12] - and, since the 1960s, has experienced vast increases in the average duration of education at all three levels. Moreover the Italian regions have common institutions[13] so that, in large part, the data represent a controlled experiment in *ceteris paribus* variation of labour force educational endowments in a developed economy[14].

2. Description of the Data

We begin with a brief description of the main regional differences in human capital endowments. We use data from the Italian census to construct four different indicators of the educational attainment of the regional labour force[15]: the illiterate proportion of the labour force and the proportions attaining primary school, secondary school and higher education as a maximum

[11] See also Pritchett (1996) and Krueger and Lindhal (2000).

[12] See Lodde (1999). The sample includes Germany, France, UK, Belgium and Italy, 1981-1991.

[13] Not to say capital mobility.

[14] One explanation of the observed low returns to education found in large international data sets is that national statistics may not be comparable. See Temple (1999), Krueger and Lindhal (2000).

[15] The exact definition is not labour force but active population.

qualification[16]. Data are available for the census years: 1961, 1971, 1981, and 1991. We define the total stock of human capital of the labour force[17] as:

$$\text{Total Stock of Human Capital} = \Sigma_j \, YR_j * HK_j$$

where j is the schooling level, YR_j is the number of years of schooling represented by level j, and HK_j is the fraction of the labour force for which the jth level of education represents the highest level attained. Within the Italian system, primary school lasts eight years[18], the secondary level is usually attained after five years, and university courses take four to six years. The total stock is thus the average years of schooling of the labour force. For descriptive purposes, we consider the usual partition of the Italian peninsula into three geographical areas, the North, the Centre and the less-developed South[19].

Table 1a gives average educational attainment by area. In 1961 the North had an average of 6.3 years of education versus 5.2 years in the South; by 1991 the two regions had increased to 9.8 and 9.4 years respectively, with the Centre now having the highest average educational attainment with approximately 10 years. Thus the South was still behind, but proportionately much less. The North and the Centre have always had quite similar average years of schooling. University attainment has been fairly similar across all three regions. Perhaps surprisingly, between 1971 and 1991 the South had a greater stock of *laureati* (people with post-secondary school education) than the North. The Centre, which contains Rome, the seat of government, has always had the greatest proportion of highly educated labour force. During the 1960s and into the 1970s, a very high proportion of the Southern labour force had no formal education. For example, 20% of the Calabrian labour force had no schooling in 1961 as against 0.2% in Trentino Alto Adige. However, this gap narrowed quickly. By 1981 the proportion of illiterate labour force was almost zero

[16] Note that, we focus explicitly on the stocks of human capital available in the *workforce*, rather than the stocks of educated people in the whole *population*.

[17] Characteristics of the dataset are described in Appendix I.

[18] Compulsory schooling has been recently reformed.

[19] The classification given by ISTAT, the National Institute of Statistics, is: **North** - Piemonte, Valle d'Aosta, Lombardia, Trentino Alto Adige, Veneto, Friuli Venezia Giulia, Liguria, Emilia Romagna; **Centre** - Toscana, Umbria, Marche, Lazio; **South** - Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, Sardegna.

everywhere[20]. This explains why differences in average schooling narrowed during the 1960s and the 1970s. The gap still present between the South and the North and Centre is caused primarily by the smaller fraction of the Southern labour force with secondary school attainment. Only 25.6% of this workforce completed secondary school, against 29.2% in the North and 30.8% of the centre. Thus a greater proportion of Southern workers stop school at the primary level. Table 1b shows a similar overall pattern for women with rather stronger convergence. By 1991, Southern women had approximately the same average years of schooling as women in the North and, from 1961 to 1991, reversed a 5% disadvantage in years of schooling compared to Southern men to a 6% advantage.

In summary we see large increases in schooling everywhere but some persistent differences. In particular, Southern males still lag behind. We analyse below if these differences and their patterns over time can help to explain the observed regional pattern of growth.

3. Regressions

We study the role of human capital by introducing lagged stocks into a standard beta-convergence growth regression: the role of the human capital endowment of an economy is then explicitly introduced into the catch-up process. We estimate a system of 19 regional equations with an unrestricted variance-covariance matrix, thus allowing for cross-sectional correlation of the disturbances (Maximum Likelihood)[21]. We use annual data between 1963 and 1994. The system of equations is described by:

$$\Delta y_{it} = a + by_{it-1} + gh_{it-1} + l_t + e_{it} \qquad (1)$$

where y_{it} is the logarithm of per capita GDP in period t for region i, h_{it} is the of stock of human capital (or a vector of stocks) measured as regional average years of education, and l_t is an index of technology, assumed constant across the Italian regions.

[20] Although the South still shows the highest proportion of labour force with no schooling, 1.1% in 1991.

[21] This is obtained by iterating a Feasible Generalised Least Squares procedure. ML enjoys no advantage over FGLS procedure in its asymptotic properties; however, it may be preferable in small samples. The estimation procedure is fully described in Di Liberto and Symons (1999).

Equation 1 is transformed to:

$$\Delta y_{it}^{*} = b y_{it-1}^{*} + g h_{i,t-1}^{*} + e_{i,t}^{*} \qquad (2)$$

where

$$y_{it}^{*} = y_{it} - \bar{y}_t \qquad h_{it}^{*} = h_{it} - \bar{h}_t \qquad (3)$$

where $\bar{y}_t$ and $\bar{h}_t$ are the Italian average per capita GDP in period t[22].

The variable *h* will represent our four different school attainment indices: primary, secondary and tertiary education plus the total stock. All these indicators are estimates of the average years of schooling in the given category[23].

4. Results

We set the scene by first estimating the standard convergence equation: see model (1) in Table 2. The estimate of b implies absolute convergence among the Italian regions of approximately 2% a year, consistent with the stylised facts[24] of regional convergence. However, evidence of absolute beta-convergence may hide both the presence of a non-homogeneous process of convergence within the period covered by our sample or the existence of convergence clubs. In fact, a standard result in the literature on Italian convergence is that decreasing dispersion in regional per capita GDP, while strong during the 1960s, all but ceased after about 1975[25]. Explanations abound. There was a decrease in migration from the South to the North; there were efforts directed towards achieving a uniform wage between the northern and the possibly less productive southern labour force[26]; there was a change in policies directed to foster the development of more backward

[22] We excluded one region from the sample, the Valle d'Aosta, in the estimation to avoid the multicollinearity arising from the use of data in differences from the mean.

[23] See the Appendices for more details.

[24] See Barro and Sala-i-Martin (1995).

[25] See Mauro and Podrecca (1994).

[26] This policy started officially in 1969.

regions. In particular, the Italian Government sought to boost industrial investment (especially in heavy industries like chemicals and steel) in the South during the 1960s and part of the 1970s[27]. After that period, there was a shift in policy from investment to income-maintenance in the form of direct transfers and an expansion of the public sector, also associated with an acceleration in the process of administrative decentralisation. These issues are not the point of our study and, as a provisional measure, we simply allow the b parameter to change after 1975: see model 2. It will be seen that the convergence parameter falls from 3.3% per annum before 1975 to 0.7% after that date. Thus, while beta-convergence was strong in the 1960s and early 1970s, it is currently weak and only on the border of significance. In models 3 and 4 we include the aggregate human capital term: the parameter is small and insignificant in both models. Thus, in these experiments, allowing for different rates of convergence across time does not rescue human capital.

As noted above, one possible explanation of the observed shift in the convergence process after 1975 is a change in the nature of public intervention, from provision of physical capital to increases in local public administration. It has been argued that decentralisation gave rise to a new class of local bureaucrats with increasing control of local economies[28]. Mass recruitment of civil servants may have caused a distortion in the allocation of the labour force. For example, skilled workers may have found it more convenient to dedicate their efforts to rent-seeking rather than entrepreneurial activities.

Rent-seeking aside, it is possible that the expansion of public administration in Italy has been distortionary. Recruitment of civil servants was one policy adopted to reduce the very high unemployment levels in the southern area of the country. This is a familiar problem in developing countries[29] and overstaffing may have created "disguised unemployment"[30] in Italy. A related problem is that the true output of the public sector is in any case almost certainly badly measured, as noted by Griliches (1997).

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[27] See Graziani (1978).

[28] On this point see also Boltho, Carlin and Scaramozzino (1997).

[29] Pritchett (1996) cites as an example the guarantee by the Egyptian government of a job to all educated people. The continual expansion of its Public Sector caused heavily overmanned bureaucracies and state enterprises. See also Griliches and Regev (1995) for evidence on the Israeli case and Funkhouser (1998) for Costa Rica.

[30] In which workers work normal hours but their capacities are not fully utilised: see Blaug, Layard and Woodhall (1969).

All of these considerations suggest introducing the relative size of the public sector as an explanator in the convergence regression[31]. This is done in Table 2, model 5. The size of the public sector is negatively signed and strongly significant. More importantly for our purposes, the human capital term becomes now more significant.

Finally we consider the level of education of the female labour force. Male and female education are often distinguished in both theoretical and empirical work. In Becker's (1976) framework, educated women have smaller families but devote more maternal time to each child. Experience in developing countries shows that female education is linked to a decrease in infant mortality and better health conditions. These may have macro effects. Moreover, empirical analysis of earnings differentials suggests that returns to education are higher for women[32]. Model 6 in Table 2 includes relative female human capital[33]. The variable is positively signed and significant, consistent with the two findings suggested above.

The shift in the beta parameter after 1975 is almost certainly due to the failure of the South to continue its former rapid growth. An attractive alternative to an *ad hoc* parameter-shift is to allow the North-Centre and South to converge separately. Other considerations suggest a separate analysis of these two non-homogenous areas. Krueger and Lindahl (2000) argue that a positive and significant coefficient on the level of human capital may result from incorrectly imposing a single coefficient and thus equal returns on schooling among different countries. Kiriacou (1991) explains the anomalous evidence on human capital and growth by arguing that human capital is more effective the higher is its average level[34]. These hypotheses can be tested by considering separately the North-Centre and the South, the latter having a lower average level of human capital with respect to the former over the sample period[35].

In Table 3 variables are expressed as deviations from the two regional averages (North-Centre, South). In preliminary experiments we found that the beta-shift variable was always

[31] The variable is defined as the ratio between the number of workers employed in the Public Sector over total employment.

[32] See Psacharopoulos (1985) and Krueger and Lindhal (2000).

[33] The difference between female and male average years of schooling.

[34] Azariadis and Drazen (1990) develop a model in which the presence of threshold externalities to education implies that investments in human capital have significant effects on growth only when certain threshold levels of human capital are passed.

insignificant and trivial in magnitude. Thus allowing the two areas to converge to different levels removes the need for a shift in the convergence parameter. Models 1 and 2 in Table 3 differ from models 5 and 6 in Table 2 only in that the South and the North-Centre are allowed to converge to their own levels. Human capital is somewhat strenghtened in these experiments. In models 3 and 4 in Table 3 we allow the parameters on the forcing variables to differ between the South and the North-Centre. One can see that the convergence parameters are of a similar order of magnitude in the two regions. Most striking however is that human capital is insignificant in the North-Centre while strongly significant in the South. Similar results hold for relative female human capital. In general, the implication appears to be that increased education in the South, but only in the South, has a positive effect on growth. As we have seen, increased education in the South took place from very low levels, particularly in the 1960s.

In Table 4, model 1 we decompose the total stock of human capital into components corresponding to the average years of schooling in primary, secondary and tertiary education attained by the Italian regional labour force[36]. A number of growth models suggest that higher levels of educational attainments should act more powerfully on growth than primary levels[37] (despite the weight of microeconometric evidence that returns primary education are usually estimated as higher than other levels[38]). We see that secondary education is good for growth but that tertiary education has a marginal negative effect. In model 2 we allow the parameters to differ between the North-Centre and the South. Observe that these components are positively significant at the 95% level only once: for primary education in the South, with a long-run GDP/capita return of nearly 100% for each extra year of primary education. Of course, all Italian children now attend school to age 14 and close to 95% of the workforce have completed primary school in the South. Between 1961 and 1991, the proportion of the workforce in the South with no schooling fell from almost 15% to 1%. Our point estimates thus indicate very high returns to this increase in basic education. It should

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[35] Thus the two areas can converge to different equilibria. The SURE estimation procedure does allow the shocks to be correlated among the two different clubs.

[36] For more details see Appendix I.

[37] In particular, models where human capital has a fundamental but indirect role in the growth and catch-up process of an economy, by increasing the capacity to adopt and implement innovations or new technologies. In these models the better educated are more involved in innovative activities. See Nelson and Phelps (1966), Romer (1990) and Benhabib and Spiegel (1994) among others.

[38] See Pritchett (1996) and Krueger and Lindhal (2000).

be emphasised that these are long-run effects and thus include in principle the effects of more educated parents on the earnings of children. There is little evidence in these data that increases in secondary and tertiary education in the South have had any effect on GDP/capita. These increases have been substantial: between 1961 and 1991: the proportion of the workforce with a degree rose from 2.1% to 7.5%, while the proportion with a secondary school certificate rose from 5.0% to 25.6%.

The parameters on secondary education in model 2 both have positive point-estimates. However secondary and tertiary education are positively correlated so these estimates are largely artefacts of the negative parameter estimates on tertiary education. In fact, the likelihood-ratio test for the exclusion of *all* education parameters in the North-Centre gives $c^2_{(3)} = 4.17$, insignificant at the 20% level[39], so the data are quite consistent with small values for all education parameters in the North-Centre. Similarly the likelihood-ratio test for the exclusion of *all* education variables except for primary in the South is insignificant at the 20% level.

Failing to find an important positive effect of higher education on productivity is not new in this literature: this has been found with other international datasets[40]. There are a number of possible explanation for the negative sign. First, while the experience of university may be beneficial to some individuals in many respects, it need not, for the variety of reasons discussed in the introduction, increase the productivity of the economy. It seems likely as well that, if the screening model has anything to it at all, it should apply to higher education where children arrive with most of the numeracy and literacy needed as workers.

On balance, how strong is the evidence that the returns to non-primary education are small? In Table 3, model 4 we find a 95% confidence interval of (-.07, .10) for the long-run return of human capital in the North-Centre. Thus, though small at the middle, the long-run return is quite reasonable towards the top of the confidence interval. It is fair to say that these results are suggestive rather than conclusive. They suggest that the principal gains from education, in terms of growth at least, flow from the elimination of illiteracy. This is a common result in the development literature: we have demonstrated that similar results hold for the regions of a developed country.

[39] The corresponding statistic for the South is 11.93, a P-level of about .007%.

[40] Wolff and Gittelman (1993) find ambigous evidence on the role of university education as a source of growth.

5. Summary

We have attempted to estimate the social returns to schooling by including measures of average primary, secondary and tertiary education in a convergence regression for the panel of Italian regions. It is well known that convergence in the South slowed after about 1975. We deal with this problem by two different methods: first by allowing the convergence rate to slow after 1975; second by allowing the South to converge to its own, potentially different level. We find marginally significant returns to total education by both methods. When we allow the parameters to differ between regions, however, we find that increased education seems to contribute to growth only in the South. Decomposing total schooling into its three constituent parts, we find that only primary education in the South seems to be important. The results thus suggest that the Italian growth benefited from the elimination of illiteracy in the South, mainly in the 1960s, but not from the substantial increases in education at the other levels.

Table 1a: Percentage of the total labour force with different educational attainments

Total Stock of Human Capital

	north	*centre*	*south**
61	6.2	6.0	5.2
71	7.0	7.1	6.4
81	8.3	8.5	8.0
91	9.8	10.0	9.4

Higher Education (degree)

	north	*centre*	*south*
61	2.2%	2.8%	2.1%
71	3.2%	4.3%	3.5%
81	4.8%	6.3%	5.6%
91	7.3%	8.9%	7.5%

Primary School

	north	*centre*	*south*
61	90.3%	86.2%	78.3%
71	86.4%	83.2%	79.4%
81	76.8%	73.1%	74.8%
91	63.4%	60.1%	65.8%

Secondary School

	north	*centre*	*south*
61	6.3%	6.5%	5.0%
71	9.9%	11.0%	9.5%
81	18.2%	20.2%	17.4%
91	29.2%	30.8%	25.6%

No school

	north	*centre*	*south*
61	1.2%	4.4%	14.7%
71	0.5%	1.5%	7.6%
81	0.2%	0.4%	2.2%
91	0.2%	0.2%	1.1%

Notes

i) According to the ISTAT (1961) classification

ii) Total stock of human capital is the average years of education in the

iii) The percentages in the table represent the percentage of labour force with the corresponding maximum

Table 1b: Percentage of the female labour force with different educational attainments

Total Stock of Human Capital

	north	*centre*	*south*
61	6.3	6.2	5.0
71	7.1	7.4	6.5
81	8.5	8.8	8.5
91	10.0	10.2	9.9

Higher Education (degree)

	north	*centre*	*south*
61	1.6%	2.5%	2.0%
71	3.0%	4.8%	4.3%
81	4.8%	7.0%	7.2%
91	8.5%	11.1%	10.6%

Primary school

	north	*centre*	*south*
61	89.1%	81.8%	67.9%
71	84.4%	78.0%	70.8%
81	73.2%	67.5%	65.6%
91	57.4%	53.2%	56.2%

Secondary School

	north	*centre*	*south*
61	8.3%	10.3%	9.1%
71	12.1%	15.5%	14.5%
81	21.8%	25.2%	24.5%
91	34.0%	35.5%	32.2%

No school

	north	*centre*	*south*
61	0.9%	5.4%	20.9%
71	0.4%	1.7%	10.4%
81	0.2%	0.4%	2.8%
91	0.1%	0.2%	1.0%

Notes

i) According to the ISTAT (1961) classification

ii) Total stock of human capital is the average years of education in the

iii) The percentages in the table represent the percentage of labour force with the corresponding maximum

Table 2: Human Capital in Convergence Regressions
Sample: 1963-1994 (Italy, 19 regions)

Dependent variable: regional growth rates
yit - yit-1

	1	2	3	4	5	6
Beta-Convergence: yit-1	-.019	-.007	-.021	-.007	-.007	-.001
	(-7.20)	(-2.00)	(-6.38)	(-1.79)	(-1.83)	(-.35)
Beta-Shift (before 1975)		-.026		-.026	-.025	-.029
		(-5.45)		(-5.45)	(-5.23)	(-6.17)
Total stock of human capital			.001	.0001	.002	.002
			(.87)	(.079)	(1.54)	(1.51)
Proportion of the Public Sector					-.007	-.007
					(-3.87)	(-3.88)
Relative total stock of female human capital						.005
						(3.49)
Log of Likelihood Function	1761.2	1767.1	1761.3	1767.1	1768.7	1770.6
Average Durbin's h	-.43	-.56	-.41	-.56	-.67	-.70

Notes:
(1)
i) t-stats in brackets
ii) yit is the logarithm of per capita GDP in region i in period t
iii) Beta-convergence is the beta parameter in equation 2.
iv) Proportion of the Public Sector means public sector employment as a proportion of the total employment.
v) relative stock of female human capital means the average years of education of females calculated as the difference from the corresponding male value
(2)
i) Variables are expressed as deviations from the Italian average
ii) Total stock of human capital means the average years of schooling in the labour force (eight years for primary schooling, five years for secondary and five years for tertiary

Table 3: North-Centre and South as Convergence Clubs

Sample: 1963-94 (North-Centre and South as Convergence Clubs)

Dependent variable: regional growth rates yit - yit-1	**Constrained* Estimates**		**Unrestricted Estimates**	
	1	**2**	**3**	**4**
Beta-Convergence: yit-1 (North-Centre)	-.046 (-8.73)	-.041 (7.77)	-.048 (-7.34)	-.045 (-6.35)
Total stock of human capital (North-Centre)	.003 (1.85)	.003 (1.71)	-.001 (-.80)	.0008 (.42)
Proportion of the Public Sector (North-Centre)	-.012 (-6.33)	-.012 (-6.32)	-.006 (-2.66)	-.006 (-2.69)
Relative total stock of female human capital (North-Centre)		.005 (3.23)		-.003 (-.96)
Beta-Convergence: yit-1 (South)			-.039 (-4.14)	-.028 (-2.77)
Total stock of human capital (South)			.022 (4.26)	.015 (2.39)
Proportion of the Public Sector (South)			-.024 (-3.07)	-.039 (-4.08)
Relative total stock of female human capital (South)				.007 (2.91)
Log of Likelihood Function	1709.1	1710.5	1715.4	1717.4
Average Durbin's h	.22	.18	.13	.11

Notes:

*In model 1 and 2 the parameters are restricted to be the same in the two areas

i) See notes section (1) Table 2

ii) Variables are expressed as deviations from the regional (North-Centre or South) average

iii) The beta-shift has never been introduced in the included results

iv) Total stock of human capital means the average years of schooling in the labour force (eight years for primary schooling, five years for secondary and five years for tertiary education)

Table 4: Different levels of schooling

Sample: 1963-94 (North-Centre and South as Convergence Clubs)

Dependent variable: regional growth rates yit - yit-1	Constrained* Estimates	Unrestricted Estimates
	1	**2**
Beta-Convergence: yit-1 (North-Centre)	-.034 (-6.56)	-.036 (-4.57)
Average years of tertiary studies (North-Centre)	-.097 (-4.42)	-.070 (-2.17)
Average years of secondary studies (North-Centre)	.031 (3.90)	.019 (1.71)
Average years of primary studies (North-Centre)	.0008 (.79)	-.0008 (-.59)
Proportion of the Public Sector (North-Centre)	-.011 (-5.29)	-.006 (-2.60)
Relative total stock of female human capital (North-Centre)	.005 (3.08)	-.001 (-.37)
Beta-Convergence: yit-1 (South)		-.045 (-3.23)
Average years of tertiary studies (South)		-.104 (-2.07)
Average years of secondary studies (South)		.035 (1.55)
Average years of primary studies (South)		.046 (4.61)
Proportion of the Public Sector (South)		- (-
Relative total stock of female human capital (South)		.004 (1.53)
Log of Likelihood Function	1713.8	1723.7
Average Durbin's h	-.01	-.001

Notes:

*In model 1 and 2 the parameters are restricted to be the same in the two areas

i) See notes section (1). Table 2

ii) Variables are expressed as deviations from the regional (North-Centre or South) average

iii) The beta-shift has never been introduced in the included results

iv) Total stock of human capital means the average years of schooling in the labour force

v) Average years means the average years of each level of schooling in the labour force

Appendix

Interpolation of inter-censal observations.

We have data on the educational qualifications of the workforce (degree, secondary, primary, some primary, no school) for the census years, 1961, 1971, 1981, 1991. We have as well enrolments in school by type in each year. We assume certain of these enrolment rates are appropriate to interpolate the qualification proportion in a given category. Specifically, let p denote the numbers of workers with a given qualification and let c be the enrolment rate to be used for interpolation. Then we assume:

$$dp/dt = -r\,p + \alpha\,c$$

where r is the retirement rate (assumed constant) and α is an unknown constant. If $p = p/n$ where n is the labour force then

$$d\pi/dt = -(r + g)p + a\,k$$

where $k = c/n$ and g is the growth rate of n, assumed constant between the census years. The constant a can be obtained if the inter-censal average values of the variables in this equation are known. One then has:

$$dp/dt = (r + g)(\,P\,k/K - p\,) + kD/K$$

where P, K and D are the inter-censal averages of p, k, and dp/dt, respectively. Thus we estimate

$$Dp = (r + g)(\,P\,k/K - p\,) + cD/K,$$

taking $r = .02$, and g, P, K and D as observed[41]. For the interpolations we take c as one minus the secondary school enrolment rate for the proportion of workers with primary school qualifications, as the secondary school enrolment rate lagged three years for secondary qualifications, and as the secondary school enrolment rate lagged ten years for degree qualifications. No school and some school are linearly interpolated.

41 P is not observed but can be approximated by the average of the two closest census years.

Sources of Variables

Gross Domestic Product (1963-1994). Source: Prometeia

Population. Source: CRENOS

Population 15-19 years. Source: Dataset CRENOS

Women 15-19 years. Source: ISTAT, Popolazione residente per sesso, eta' e regione, Supplemento al Bollettino mensile di statistica anno 1978, n.11

Secondary school enrolment rates. Source: ISTAT, Annuario Statistico dell'Istruzione Italiana (1958-1994), Annuario Statistico dell'Istruzione Italiana 1959 (1946-58)

Labour force with tertiary school educational attainment (1961, 1971, 1981, 1991). Source: ISTAT, (XII-XV) Censimento della popolazione, fascicoli regionali, vol.II.

Labour force with secondary school educational attainment (1961, 1971, 1981, 1991). Source: ISTAT, Censimento della popolazione, fascicoli regionali, vol.II.

Labour force with primary school educational attainment (1961, 1971, 1981, 1991). Source: ISTAT, Censimento della popolazione, fascicoli regionali, vol.II.

Labour force that did not complete primary school (1961, 1971, 1981, 1991). Source: ISTAT, Censimento della popolazione, fascicoli regionali, vol.II.

Illiterate labour force (1961, 1971, 1981, 1991). Source: ISTAT, XII Censimento della popolazione, fascicoli regionali, vol.II.

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