EDUCATION AND ITALIAN REGIONAL DEVELOPMENT

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Abstract

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, while tertiary education seems to have a negative impact on regional growth. Our main results are robust to the inclusion of additional variables in the regression analysis and the use of an IV estimator. Overall, this study suggests that Italian growth benefited from the elimination of illiteracy in the South, mainly in the '60s. It also suggests a possible relationship between the level of development of an economy and returns to different levels of education, with Italian regions still far from being able to capture the positive returns from higher levels of education.

1. Introduction

Differences in human capital endowments and their rates of investment have long been recognised as an important element in explaining observed GDP gaps, with theoretical models often emphasising the presence of externalities to education. In particular, a number of growth models imply that public returns to education exceed private returns, often assuming that high average levels of human capital throughout the economy increase the productivity of any given worker[1]. But a higher level of education could be associated with many productivity improving factors not captured by private returns[2]. In contrast, traditional screening models of education generate the exact opposite result, stressing the possibility of negative externalities. These models are usually associated with higher levels of education. In this case, education only confers credentials used in the labour market to select able workers. But we may think of other mechanisms implying the possibility of negative externalities[3], affecting lower levels of education as well as high[4].

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 to education. Conversely, macro studies consider the data of direct interest, namely the returns at the level of the economy[5]. However, differently from the microeconometric evidence on return to education, empirical macro studies show puzzling results as often find that education is not strongly associated with per capita income growth.

It has been claimed that the main problem causing the observed lack of empirical support is that most growth regressions, while using large international datasets, incorrectly impose a single coefficient and thus equal returns on schooling among different countries. This

problem is likely to arise when the quality of education is influenced by differences in educational institutions. In this case, one explanation of the observed low returns to education found in large international data sets is that national statistics may not be comparable[6]. Moreover, it may well be that the quantity of education affects its quality: returns to education may be higher in more educated areas as usually predicted by growth models[7]. In both cases standard regressions would produce distorted estimates on education due to the presence of parameter heterogeneity and measurement error problems.

A second problem that may arise when we estimate returns to schooling is that in some cases acquisition of educational skills is not obviously linked with productivity. As noted by Shultz (1962), education may represent not only an investment for individuals but can also be considered as a consumption good and, thus, be privately valued for its own sake. But another interesting example is found in Pritchett (1996), who quotes as in 1988 fifty percent of university students in Saudi Arabia were studying Humanities, Religion and Theology. While this kind of degree probably represents a good credential in the Saudi Arabian job market, still does not represent an obvious acquisition of growth enhancing skills. A related problem has been emphasised by Griliches (1997). He observes that in many countries, and especially developing countries, the public sector represents the employer of most of the skilled labour force. This fact may create three sources of distortions when we estimate returns to schooling. Firstly, the output of the Public Sector is certainly badly measured in National Accounts and, possibly, underestimated. Secondly, the literature on developing countries shows many examples where the growth of the Public Sector with the corresponding absorption[8] of skilled labour force has not been governed by efficiency criteria. Finally, the Public Sector is not

obviously an innovative sector while, as predicted by many theoretical growth models, especially shumpeterian models, educational capital is growth enhancing only when allocated in innovative activities[9].

In this paper we investigate if, dealing with the problems described above, a standard macro analysis of returns to education would produce significant results. To control for the first problem, we focus on a more homogeneous data set rather than the whole international sample and ask if there has been any role for human capital in the Italian regional economic development. We claim that Italian data are most suitable for a macro study of returns to education: differently from most regional data sets, 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[10] - and, since the 60s, has experienced vast increases in the average duration of education at all three levels. Secondly, the Italian regions have common institutions so that, in large part, the data represent a controlled experiment in ceteris paribus variation of labour force educational endowments in a developed economy. Further, there is a large literature showing a clear duality in the Italian economy between the developed North-Centre and the less developed South, suggesting the presence of two convergence clubs. These two clubs are also characterised by the presence of homogeneous educational institutions in both areas, together with substantial differences in human capital endowments. In fact, with respect to the less developed South, the richer North-Centre is characterised by larger stocks of human capital. Therefore, this is an ideal sample to test the relationship between quantity and returns to education: allowing for parameter heterogeneity in the two clubs, we analyse if returns to education have been different in these two areas of the country

considered separately. Conversely, given the quality and the level of disaggregation of data, the problem of the link between acquisition of educational skills and productivity is certainly more difficult to deal with. Nevertheless, following Griliches, we control in our empirical analysis for the presence of a relatively large Public Sector and check if this may possibly affect our estimates on return to schooling.

We have census data on average years of schooling and primary, secondary and tertiary school attainments distinguished for gender and use information on enrolment rates to construct a yearly dataset. Thus, we follow the standard development literature that predict larger externalities for educated women than men and investigate if differences in male and female education have different impacts on the development of Italian regions. Finally, we ask if different levels of education produce different impacts on growth. In fact, due to their emphasis on the role of technology, most of the theoretical growth models expect that higher levels of educational attainments act more powerfully on growth than, say, primary school. This prediction contradicts microeconometric evidence, where returns to investments in primary education are usually estimated as the largest[11].

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: the illiterate proportion of the labour force and the proportions attaining primary school, secondary school and higher education as a maximum qualification[12]. Data are available for the census years: 1961, 1971, 1981, and 1991. We define the total stock of human capital of the labour force[13] as 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[14].

Table 1 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.

Table 1

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 60s and into the 70s, 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 everywhere[15]. This explains why differences in average schooling narrowed during the 60s and the 70s. 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. A similar overall pattern is observed for women with rather stronger convergence.

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 seemingly unrelated regression model, that is, a system of 19 regional equations with an unrestricted variance-covariance matrix, thus allowing for cross-sectional correlation of the disturbances since it is very likely that macroeconomic factors that affect regions affect all of them to varying degrees. In particular, by iterating a Feasible Generalised Least Squares procedure we obtain maximum likelihood estimates[16]. Note that this estimator is more efficient than standard estimator used in this literature when three conditions are satisfied. First of all, we need a panel in which the time length is greater than the number of individuals. Secondly, shocks must be correlated among regions. We use a regional sample with N=19 and T=32, thus these two conditions are certainly met by our dataset. Finally, errors must be non-autocorrelated and the Durbin's h test confirm that even the third condition is always met. We use annual data between 1963 and 1994. The system of equations is described by:

(1)
$$\Delta y_{it} = \boldsymbol{a} + \boldsymbol{b} y_{it-1} + \boldsymbol{g} h_{it-1} + \boldsymbol{l}_t + \boldsymbol{e}_{it}$$

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 $\boldsymbol{l}_t$ is an index of technology, assumed constant across the Italian regions. We assume that the $\boldsymbol{e}_{it}$ are correlated across i.

Equation 1 is transformed to:

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

where

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

where $\bar{y}_t$ and $\bar{h}_t$ are the Italian average per capita GDP in period t[17].

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[18].

4.   Results.

We set the scene by first estimating the standard convergence equation: see model (1) in Table 2.

Table 2

The estimate of **b** implies absolute convergence among the Italian regions of approximately 2% a year, consistent with the stylised facts[19] 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, as stated above, a standard result in the literature on Italian convergence is that decreasing dispersion in regional per capita GDP, while strong during the 60s, all but ceased after about 1975. 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 60s and early 70s, 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[20]. 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[21] and overstaffing may have created disguised unemployment[22] 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).

All of these considerations suggest introducing the relative size of the public sector as an explanator in the convergence regression[23]. 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[24]. In developing countries, evidence stresses the presence of intersectoral links between female education, health and fertility. These may have macro effects[25]. Data show that female education is correlated to a decrease in infant mortality and better health conditions, with one additional year of schooling for a mother resulting on average in a reduction of 9 per 1000 in infant mortality[26]. Empirical evidence usually refers to developing countries, but a negative relationship between education and fertility rates was clearly present in Italy after the second world war: the fertility rate,of 2.3 in 1960 decreased to 1.2 in 1995. Italy currently has one of the lowest fertility rates in the world. Further, empirical analysis of earnings differentials suggests that returns to education are higher for women[27].

Model 6 in Table 2 includes relative female human capital[28]. Other empirical growth studies find that education of women has a negative effect on growth[29]. The variable is

positively signed and significant, consistent with the findings suggested above.

5.   The analysis of Convergence Clubs

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. For example, Krueger & Lindahl (2001) 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 in different countries. Kyriacou (1991) explains the anomalous evidence on human capital and growth by arguing that human capital is more effective when its average (educational) level is higher. These hypotheses can be tested by considering the North-Centre and the South separately, the latter having a lower average level of human capital with respect to the former over the sample period[30].

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 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.

Table 3

Models 1 to 3 in Table 3 differ from models 4 to 6 in Table 2 only in that the South and the North-Centre are allowed to converge to their own levels. With the exception of model 1 where we observe a negative sign, human capital is somewhat strengthened in these

experiments. In models 4 to 6 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 negative (and significant in model 4) in the North-Centre while positive and 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 '60s.

In Table 4 (models 1 and 2), 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.

Table 4

Despite the weight of microeconometric evidence that returns to primary education are usually estimated as higher than other levels, a number of growth models suggest that higher levels of educational attainment should act more powerfully on growth than primary levels[31]. Moreover, the analysis of he effects of the different levels of education may represent an indirect test of the hypothesis of the Nelson and Phelps (1966) approach. 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, implicitly suggest that higher levels of education should be more relevant for growth than lower levels. In model 1 we see that both primary and secondary education have a positive and significant coefficient, while if the public sector is introduced (model 2) only secondary

schooling is good for growth. Tertiary education has a negative effect.

In Table 4 (model 3 and 4), we allow the parameters to differ between the North-Centre and the South. In other words, we develop a specification that allows for some limited heterogeneity in slope coefficients. Note that, when we control for the public sector (model 4), educational levels are positively significant at the 95% level only once, for primary education in the South. 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 be emphasised that these are long-run effects and thus include in principle the effects of more educated parents on the earnings of children. Thus, these findings seem to confirm standard results on the effects of education on earnings in the microeconometric literature which, however, have hitherto been difficult to confirm in macroeconomic data.

There is little evidence in these data that increases in other levels of 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 in possession of a university degree rose from 2.1% to 7.5%, while the proportion with a secondary school certificate rose from 5.0% to 25.6%. The secondary education coefficient is positive and significant in model 3 but when we introduce the public sector in model 4 we fail to notice a robust positive effect of this level of education on productivity. Further, female education is never significant and, again, estimated coefficients on tertiary education are negative. Failing to find an important positive effect of higher education on productivity is not new in this literature as similar results have

been found with alternative international data sets[32].

There are a number of possible explanations for this negative sign. Firstly, it is possible that, unlike lower levels of education, higher education performs mainly a signalling function in the job market. That is, it seems likely that, if the signalling model has anything to it at all, it should apply to higher education[33]. An alternative hypothesis is that university education, rather than encouraging productive activities, simply stimulates rent-seeking activities, which inhibit growth[34]. It is well documented that the Italian labour market is characterised by a bureaucratic bias among the highly educated. Sestito (1991) finds a bias towards bureaucratic skills, mainly in the southern area of the country. Therefore, one explanation of the paradoxical result is that, as previously said, university educated workers have a greater tendency to be employed in the Public Sector itself characterised by a) non-innovative and non growth-enhancing activities and/or b) rent-seeking activities and/or c) activities whose contribution in terms of GDP is underestimated in national account statistics. However, this hypothesis is not confirmed by our data since we control for the Public Sector, and we do not observe any significant change in the tertiary education coefficient.

However, these results suggest another possible interpretation. Note that, compared to other OECD nations, Italy has one of the lowest percentages of skilled labour force[35] and one of the lowest percentages of university students with a scientific-technical background[36]. In the theoretical literature on growth, catching up models imply that technological progress is the result of both the adoption of existing technologies from abroad (for backward countries) and also of pure innovation (for leader countries). Imitation and innovation may require different types of skills. In particular, innovation activities are certainly influenced by higher levels of

education while imitation may be performed by labour forces with lower levels of education. As stressed by Vandenbussche, Aghion & Meghir (2003), this implies that the growth enhancing impact of a highly educated labour force may increase with the proximity to the (technological) frontier, since only countries at the frontier are likely to innovate rather than to simply imitate. Using a panel of 19 countries they find evidence in favour of this hypothesis, showing that a highly educated labour force had a stronger growth enhancing effect in economies closer to the technological frontier. Moreover, for backward countries, they find that higher education may have a negative impact on growth. It has been estimated that Italy is one of the countries more distant from the frontier[37]. Thus, overall, our findings on the absence of positive returns to tertiary education seem to suggest that growth rates in Italy have been mainly determined by low tech activities (imitation rather than innovation) where its small proportion of highly skilled labour force did not play a significant role.

6.   Robustness: instrumental variables and additional controls

Another plausible explanation for our negative sign on higher education is that it could be a spurious result. Human capital models assume that the decision to invest in higher education is affected by the rate of return, the cost of this investment and by family background factors. In general, the opportunity cost of education may act countercyclically[38]. Our data on higher education for example show that, in some cases, northern regions invest less in higher education than southern regions. All this seems to suggest another solution for explaining our results: endogeneity. Regions are not performing badly because of their (high) stock of highly educated workers. The reverse could be true: people invest more in education

when job opportunities are low. However, endogeneity problems may affect our estimates through other mechanisms. A well known problem in this literature is that countries growing richer may decide to expand their education system[39]. In this case all our human capital variables may be endogenous. Further, for the same reason our public sector indicator may be endogenous as well. In these cases, even if the use of the initial stocks instead of enrolment rates should help to mitigate this problem, there will be a reverse causality problem in our estimated coefficients.

Tables 5 and 6 replicate the analysis seen in Tables 3 and 4 using a 2SLS estimator. Given the panel nature of our data set, we use lagged values of endogenous variables as instruments, together with lagged values of other right hand side variables. A test for the endogeneity of regressors is included among diagnostic checks together with a test for overidentifying restrictions.

Tables 5 and 6

Specification tests do not always support the endogeneity of regressors hypothesis. In particular, in Table 5 model 1, the stock of human capital indicator is instrumented using lagged values of it and of the public sector variable[40]. While the Basmann test of overidentifying restrictions accepts the null that the excluded instruments are valid instruments, the Durbin-Wu-Hausman test of endogeneity does comfortably accept the null that OLS would yield consistent estimates. We reach the same conclusion in model 2 where we assume the endogeneity of the public sector proxy[41]. Further, very similar results have been obtained by replicating the analysis separately for the two club's samples (models 3 and 4) [42]. To sum up, the use of an IV estimator did change the results previously found in Table 3. Not

surprisingly, almost all our coefficients lose significance[43]. However, specification tests do not seem to confirm that our public sector proxy and our measure of the total stock of human capital are truly endogenous variables.

Conversely, when we replicate Table 4 regressions assuming the endogeneity of our tertiary education variable (see Table 6)[44], in model 1 the p-value of our endogeneity test indicates that instrumental variables techniques are required. Still, this result is not confirmed by the clubs analysis (model 3). Further, the results obtained in Table 6 are very similar to that obtained in Table 4. As in Table 4, the higher education coefficient remains negative in all models but it is not significant in models 3 and 4. Moreover, the hypothesis of a negative effect of the public sector on growth is somewhat weakened by this new evidence, while the coefficient on primary education in the South is always positive and significant.

Further, we control if our results are robust to the inclusion of additional explanatory variables. Note that, a typical problem of the empirical growth literature is model indeterminacy, as there is no consensus on which growth determinants ought to be included in a growth model[45]. Secondly, the choice of regressors is not neutral since, as noted by Krueger & Lindhal (2001), the absence of a positive and significant relationship between growth and human capital in many studies may be due to the model specification and the use of a parsimonious specification, as we have adopted so far, may be preferable[46]. An obvious and popular choice to avoid problems of model indeterminacy is to replicate the structural equation of the neoclassical growth model[47] including our variable of interest, and results are robust to the inclusion of these additional indicators[48].

In sum, both IV estimates and the use of additional controls do not contradict our

previous results. In particular, specification tests do not seem to confirm that all regressors are truly endogenous variables and, what is more, while some results are somewhat weakened by the IV evidence, estimates always confirm our main result of a positive effect of lower levels of schooling in the more disadvantaged areas of the country.

7.   Conclusion

The relationship between human capital and development has always been considered a close one. Theoretical studies on growth claim that the level of education of the labour force should be positively correlated with growth. Likewise, development economists share the idea that, among different possible policy interventions in LDC's, investments in education may represent a magic bullet against poverty[49]. Despite the importance placed by both theoretical growth literature and development strategists, empirical evidence on aggregate returns to schooling is weak since econometric studies that introduce international data sets usually find that human capital is insignificantly or even negatively correlated with the process of development.

This study investigates the regional Italian case introducing a new data set on human capital. We use a measure of the stock of regional human capital instead of its rate of accumulation as has been done so far and estimate a standard convergence equation using a new and, possibly, more efficient panel estimator. We have attempted to estimate the social returns to schooling by including measures of average primary, secondary and tertiary education. It is well known that convergence in the South slowed after about 1975. We deal with this problem using 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 with both methods. In our empirical analysis we also control for the presence of a relatively large Public Sector and results show that this affects our estimates on return to schooling. 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 primary education in the South seems to be important. The results thus suggest that Italian growth mainly benefited from the elimination of illiteracy in the South, during the '60s, but not from the substantial increases in education at the other levels. Our main results are robust to the inclusion of additional explanatory variables and to the use of an IV estimator.

To sum up, it is fair to say that our results are suggestive rather than conclusive. They suggest that the principal gains from education, in terms of growth at least, stem from the elimination of illiteracy. Moreover, they suggest there is a plausible link between stages of development and returns to different levels of education that would help to explain the negative sign for tertiary education stressed by our and other studies. That is, Italy was far from able to capture the positive returns from higher levels of education since growth rates in Italy have been mainly determined by low tech activities where a high skilled labour force did not play a significant role. However, this latter hypothesis certainly needs to be further investigated, possibly with more disaggregated data, and will be the subject of future research.

Aknowledgments

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[1] One could think of this as a positive peer-group effect. See Lucas (1988).

[2] For example, 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.

[3] Some authors have argued that higher education tends to create rent-seekers who do not add to the genuine output of the economy. See Wolff & Gittleman (1993).

[4] More prosaically, recent work suggests that conventional schooling may have harmful side effects by creating peer-groups with rival values to those of parents and adults generally. See Hargreaves (1994) and Rutter and Smith (1995). There is also evidence that similar effects are at work among very young children. See Feinstein, Roberston & Symon(1998).

[5] See Temple (1999a).

[6] As noted by Temple (1999b), even the presence of a small number of influential outliers may cause serious distortions in the empirical analysis. On this see also Pritchett (1996) and Krueger & Lindhal (2001).

[7] For example, in Azariadis & Drazen (1990) the presence of threshold externalities to education implies that investments in human capital have more significant effects on growth when certain threshold levels of human capital are passed.

[8] "I would like to suggest another possible answer to this puzzle "….much if not most of the growth in human capital was absorbed in the Public Sector of many of these economies." Griliches (1997).

[9] For an exhaustive survey of these models see Aghion and Howitt (1998).

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

[11] See Psacharopoulos (1994), Pritchett (1996) and Krueger & Lindhal(2001).

[12] All details on the data set (sources and the details about the interpolation procedure used to construct annual data) may be found in www.diliberto.it/WP.html.

[13] We focus explicitly on the stocks of human capital available in the workforce rather than the stocks of educated people in the whole population. Differently from most macro studies we have a preference for this specification since some schooling is acquired by persons who are not income earners and should not be included in the analysis of returns to schooling. This may be the case especially for women and for Italy where partecipation rates are very low compared to other OECD countries.

[14] 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.

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

[16] Maximum likelihood 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 & Symons (2003) but see also Greene (1993).

[17] We excluded one region from the sample, the Valle d'Aosta, from the analysis since it is a clear outlier. But results are robust to the inclusion of this region.

[18] See the Appendix for more details.

[19] See Barro & Sala-i-Martin (2004).

20 On this point see also Boltho, Carlin & Scaramozzino (1997).

21 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 resulted in heavily overmanned bureaucracies and

state enterprises. See also Griliches & Regev (1995) for evidence on the Israeli case and Funkhouser (1998) for Costa Rica.

22 In which workers work normal hours but their capacities are not fully utilised: see Blaug, Layard & Woodhall (1969).

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

[24] Women's education may affect the demand for children by altering preferences, but it also affects the supply of children by raising, for example, the age of marriage. Finally, education typically change the regulation of fertility by increasing knowledge about contraception. See Psacharopoulos (1985).

[25] Note that in a neoclassical growth model a decrease in fertility rates affects the growth rate during the transition towards the steady state.

[26] See Psacharopoulos (1985). Recent evidence stresses the positive impact of female education on the control of the HIV epidemic. See World Bank (2001).

27 See Psacharopoulos (1985) and Krueger & Lindhal (2001).

28 The difference between female and male average years of schooling.

[29] See Barro & Sala-i-Martin (2004) and Barro (1997). However, note that in these studies a fertility rate variable has been included among regressors.

30 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.

31 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, and in shumpeterian models. See Nelson & Phelps (1966), Romer (1990) and Aghion & Howitt (1998).

32 For example, Wolff & Gittelman (1993) find ambiguous evidence on the role of university education as a source of growth. See also Vandenbussche, Aghion & Meghir (2003). An exception may be found in Ayiar & Feiyer (2002).

[33] As shown by Psacharopoulos (1985), private returns are in excess of social returns, especially at university level.

34 Murphy, Shleifer & Vishny (1991) describe a model in which rent seeking is highly remunerative, prompting talented people to leave productive activities. See also Wolff & Gittleman (1993).

[35] Despite recent improvements, tertiary completion in Italy is very low with only 23% of an age cohort completing a first university degree, while the OECD average is 32% (with Australia and Finland reaching 45%). See OECD (2004)

[36] See De la Fuente & Da Rocha (1996).

37 Proximity to the technological frontier is calculated as the ratio of a country's TFP level to that of the US. Among 19 countries, only Ireland has been estimated to be more distant from the frontier than Italy.

[38] For example, Sakellaris & Spilimbergo (1999) find that in the US, during recessions, when labour market opportunities are few, the university enrolment rate increases.

39 In this case we have a positive correlation between growth and education. On endogeneity in this context see Bils & Klenow (2000), Caselli, Esquivel & Lefort (1996), Krueger & Lindhal (2001) and Self & Grabowski (2004).

[40] We have also used lagged values of GDP as instruments, but the Basmann test of overidentifying restrictions has rejected the null of the presence of a valid set of instruments.

[41] In this case, the public sector indicator is instrumented with lagged values of it and of education. We thank a referee for this suggestion. We introduced two further lags of both variables. There are no significant changes when further lags are introduced among instruments.

[42] We obtain the same results assuming both variables are endogenous.

[43] As IV studies tend to have relatively imprecise estimates.

[44] Even if it is less likely that we observe for developed economies reverse causality problems for lower levels of education, we have also performed the same analysis for both secondary school and primary school indicators. In this case the endogeneity test does not reject the null.

[45] Durlauf, Johnson & Temple (2005) list 145 variables which have been found to be statistically significant in different studies.

[46] In particular, they strongly criticise the use of a physical capital indicator together with educational variables. Further, when rates of change of education are introduced in the regression analysis and

measurement error problems are present, they stress that parsimonious specifications have to be preferred as the conditioning on other variables may "soak away" any of the remaining explanatory power of education.

[47] This implies introducing in equation (1) two additional variables, respectively, the ratio of investment to GDP and $(n+d+g)$, where the latter is the sum of the population growth rate (n), the depreciation rate (d) and the technology growth rate (g). For more on this see Mankiw Romer & Weil (1992), Islam (1995) and Durlauf et al. (2005) among others.

[48] We did not include these results in the final version of the paper. All details are available in www.diliberto.it/WP.html.

49 Pritchett (1996).

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Table 1

Percentage of the total labour force with different educational attainments

Total stock of human capital

	north	centre	south*
61	6.1	6.0	5.1
71	6.8	6.9	6.2
81	8.1	8.3	7.8
91	9.5	9.7	9.1

Higher education (degree)				**Primary school**		
	north	centre	south		north	centre	south
61	2.2%	2.8%	2.1%	**61**	90.3%	86.2%	78.3%
71	3.2%	4.3%	3.5%	**71**	86.4%	83.2%	79.4%
81	4.8%	6.3%	5.6%	**81**	76.8%	73.1%	74.8%
91	7.3%	8.9%	7.5%	**91**	63.4%	60.1%	65.8%

Secondary school				**No school**		
	north	centre	south		north	centre	south
61	6.3%	6.5%	5.0%	**61**	1.2%	4.4%	14.7%
71	9.9%	11.0%	9.5%	**71**	0.5%	1.5%	7.6%
81	18.2%	20.2%	17.4%	**81**	0.2%	0.4%	2.2%
91	29.2%	30.8%	25.6%	**91**	0.2%	0.2%	1.1%

Notes:

i) According to the ISTAT (1961) classification of regions

ii) Totale stock of human capital is the average years of education in the labour force

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

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)
No. of observations	589	589	589	589	589	589
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; *1% significant, **5% significant, ***10% significant.
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.
vi) 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).
(2)
i) Variables are expressed as deviations from the Italian average.

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	Restricted estimates			Unrestricted estimates		
	1	**2**	**3**	**4**	**5**	**6**
				NORTH-CENTRE		
Beta-convergence: yit-1	-0.048*	-.046*	-.041*	-.056*	-.048*	-.045*
	(-8.84)	(-8.73)	(7.77)	(-9.09)	(-7.34)	(-6.35)
Total stock of human capital	-.0008	.003***	.003***	-0.003**	-.001	.0008
	(-.55)	(1.85)	(1.71)	(-2.13)	(-.80)	(.42)
Proportion of the public sector		-.012*	-.012*		-.006*	-.006*
		(-6.33)	(-6.32)		(-2.66)	(-2.69)
Relative total stock of female human capital			.005*			-.003
			(3.23)			(-.96)
				SOUTH		
Beta-convergence: yit-1				-.047*	-.039*	-.028*
				(-5.04)	(-4.14)	(-2.77)
Total stock of human capital				.027*	.022*	.015**
				(5.57)	(4.26)	(2.39)
Proportion of the public sector					-.024*	-.039*
					(-3.07)	(-4.08)
Relative total stock of female human capital						.007*
						(2.91)
No. of observations	589	589	589	589	589	589
Log of likelihood function	1705.4	1709.1	1710.5	1712.2	1715.4	1717.4
Average Durbin's h	.23	.22	.18	.28	.13	.11

Notes:

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) In models 1 to 3 parameters are restricted to be the same in the two areas.

Table 4
Different levels of schooling
Sample: 1963-94 (north-centre and south as convergence clubs)

Dependent variable: regional growth rates yit - yit-1	Restricted estimates		Unrestricted estimates	
	1	**2**	**3**	**4**
			NORTH-CENTRE	
Beta-convergence: yit-1	-.038*	-.034*	-.045*	-.036*
	(-6.93)	(-6.56)	(-5.95)	(-4.57)
Average years of tertiary studies	-.094*	-.097*	-.024	-.070**
	(-4.33)	(-4.42)	(-.77)	(-2.17)
Average years of secondary studies	.025*	.031*	.0002	.019***
	(3.18)	(3.90)	(.023)	(1.71)
Average years of primary studies	.002**	.0008	-.0004	-.0008
	(2.46)	(.79)	(-.322)	(-.59)
Proportion of the public sector		-.011*		-.006*
		(-5.29)		(-2.60)
Relative total stock of female human capital	.004**	.005*	-.004	-.001
	(2.52)	(3.08)	(-1.11)	(-.37)
			SOUTH	
Beta-convergence: yit-1			-.078*	-.045*
			(-6.12)	(-3.23)
Average years of tertiary studies			-.206*	-.104**
			(-4.42)	(-2.07)
Average years of secondary studies			.093*	.035
			(5.23)	(1.55)
Average years of primary studies			.054*	.046*
			(5.30)	(4.61)
Proportion of the public sector				-.041*
				(-3.56)
Relative total stock of female human capital			-.001	.004
			(-.64)	(1.53)
No. of observations	589	589	589	589
Log of likelihood function	1709.8	1713.8	1718.4	1723.7
Average Durbin's h	-.03	-.01	.08	-.001

Notes:
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) Average years means the average years of each level of schooling in the labour force.
v) In models 1 and 2 parameters are restricted to be the same in the two areas.

Table 5

North-centre and south as convergence clubs, 2SLS estimates

Sample: 1963-94 (north-centre and south as convergence clubs)

Dependent variable: regional growth rates yit - yit-1	Restricted estimates		Unrestricted estimates	
	1	**2**	**3**	**4**
			NORTH-CENTRE	
(1) Beta-convergence: yit-1	-.023*	-.023*	-.022**	-.022**
	(-2.80)	(-2.79)	(-2.36)	(2.35)
(2) Total stock of human capital	-.001	-.001	-.007**	-.007**
	(-.42)	(-.42)	(-2.12)	(-2.18)
(3) Proportion of the public sector	-.003	-.003	.003	.003
	(-.70)	(-.64)	(.76)	(.87)
(4) Relative total stock of female human capital	.0008	.0008	.0009	.0008
	(.42)	(.39)	(.17)	(.14)
			SOUTH	
(1) Beta-convergence: yit-1			-.036***	-.037***
			(-1.62)	(-1.67)
(2) Total stock of human capital			.011	.012
			(.90)	(.97)
(3) Proportion of the public sector			-.038***	-.036***
			(-1.86)	(-1.69)
(4) Relative total stock of female human capital			.0004	8.3e-06
			(.08)	(0.00)
			north-centre/south	
No. of observations	589	589	341/248	341/248
Instrumented	(2)	(3)	(2)	(3)
	Specification tests (p-value)			
Basmann test of overidentifying restrictions	1.62	2.86	3.71/.41	2.56/1.39
	(.65)	(.41)	(.29)/(.93)	(.46)/(.70)
Durbin-Wu-Hausmann test of endogeneity	1.77	0.53	.001/1.11	1.16/.10
	(.18)	(.47)	(.97)/(.29)	(.29)/(.74)

Notes:

i) See notes section (1) Table 2.

ii) In models 1 and 2 parameters are restricted to be the same in the two areas.

iii) In models 3 and 4 the regression analysis is performed separately in the North-Centre and South samples.

Table 6

Different levels of schooling, 2SLS Estimates

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

Dependent variable: regional growth rates yit - yit-1	Restricted estimates		Unrestricted estimates	
	1	**2**	**3**	**4**
			NORTH-CENTRE	
(1) Beta-convergence: yit-1	-.026*	-.026*	-.026*	-.026*
	(-3.63)	(-3.61)	(-2.88)	(-2.89)
(2) Average years of tertiary studies	-.102*	-.100*	-.059	-.058
	(-2.70)	(-2.66)	(-1.37)	(-1.34)
(3) Average years of secondary studies	.027***	.026***	.007	.006
	(1.93)	(1.87)	(.42)	(.37)
(4) Average years of primary studies	.003	.003	.001	.001
	(1.16)	(1.15)	(.57)	(.57)
(5) Proportion of the public sector	-.002	-.002	.001	.002
	(-.50)	(-.41)	(.37)	(.47)
(6) Relative total stock of female human capital	.001	.002	.003	.003
	(.89)	(.86)	(.65)	(.61)
			SOUTH	
(1) Beta-convergence: yit-1			-.058*	-.058*
			(-2.46)	(-2.44)
(2) Average years of tertiary studies			-118	-.114
			(-1.56)	(-1.50)
(3) Average years of secondary studies			.024	.023
			(.69)	(.68)
(4) Average years of primary studies			.038**	.037**
			(2.19)	(2.17)
(5) Proportion of the public sector			-.039***	-.037
			(-1.65)	(-1.47)
(6) Relative total stock of female human capital			.002	.002
			(.54)	(.47)
			north-centre/south	
No. of observations	589	589	341/248	341/248
Instrumented	(2)	(5)	(2)	(5)
Specification tests (p-value)				
Basmann test of overidentifying restrictions	2.36	2.02	.78/.10	1.99/1.66
	(.50)	(.56)	(.37)/(.75)	(.57)/(.64)
Durbin-Wu-Hausmann test of endogeneity	4.27	.669	.10/2.37	1.08/0.12
	(.04)	(.41)	(.75)/(.12)	(.30)/(.73)

Notes:

i) See notes section (1) Table 2.

ii) In models 1 and 2 parameters are restricted to be the same in the two areas.

iii) In models 3 and 4 the regression analysis is performed separately in the North-Centre and South samples.

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