EDUCATION POLICIES AND LABOUR MARKETS: THE EFFECT ON REGIONAL GROWTH IN MEXICO

Paper for the 40th European Regional Science Association Congress, August 2000

Eduardo Rodriguez-Oreggia

The London School of Economics, Department of Geography S504, Houghton St., London WC2A 2AE, UK. Phone +44(0)207-9556158. Email: e.oreggia@lse.ac.uk

Human capital has been studied as one of the main factors affecting growth. The simple measure of human capital fails to attempt the level at which education policies should be focused. This paper tries to complement education and labour markets in such a way that in analysing effects on regional growth it will be possible to determine the differentiated regional direction of education policy, complemented with evidence for returns for skills. The evidence shows that in the Mexican case, the focus should be mainly on basic education and upgrade towards high education, findings supported also by the returns to education.

Introduction

Since the beginning of the 1990s there have been a stream of empirical studies trying to establish the statistical relation between human capital and economic growth determined in the works of Lucas (1988, 1993) and Romer (1990) based on the Nelson and Phelps (1966) idea that a larger human capital stock facilitates adoption of new products or ideas discovered in another places. According to this logic, a lagged country or region fostering its human capital would tend to grow faster, catching up from technological leaders.

Implications for policy planning are different if human capital is measured as stock or as a flow. The difference between them is important for two reasons (Psacharopoulos and Arrigada, 1986). First, the lag in time between investment in education, measured as enrolment rate, and additions to the stock of human capital is longer than other production factor. Second, some investment in education may never turn into additions to the stock of human capital because of losses in the process. Then, enrolment ratios could give an inadequate representation when used to assess relative priorities for educational investment.

Macroeconomic studies of growth, nevertheless, do not give signs for the address of education policies. The proxies for human capital only point towards more education, but fail in assessing the levels of education possessed by the workforce impacting growth. On the other hand, microeconomic evidence on returns to education, the support for educational policies focus, does not provide a complete representation of the education impact on economic growth given the externalities effects not reflected in the prevailing wage differential (Levin and Raut, 1997).

The purpose of this paper is to go further than previous research and include in a growth model more elements of the labour market in order to complement the traditional measures of human capital. In doing so, it would be possible to shed more light in the focus for education policies, as some occupational levels, reflecting the requirements for education, have more impact on growth. This evidence could be compared and completed with the micro evidence of returns to education.

The structure of the paper is as follows: next section present a review of the work in macroeconomic analysis of human capital and growth. The third section present some characteristics of the Mexican labour market, while the fourth section deals with the model and data. The results are in the fifth section, and finally some conclusion are drawn.

Theoretical background

In the analysis of the relation between growth and human capital the empirical evidence is far from being conclusive, and to some extent this does not support the idea of more education for more growth. Moreover, the simple measure of human capital does not give any insight about which education level has more contribution to economic growth. Two measures of human capital, as stock or as enrolment rates, prevail in the econometric evidence. When human capital is measured as enrolment rate it is possible to find sometimes a relation between this measure and economic growth. The opposite occurs when human capital is measured as stock, then findings are not conclusive.

One of the main and first attempts to build a human capital index based on educational attainment is Psacharopoulos and Arriagada (1986). They calculated the average numbers of years of schooling of the labour force for a set of countries. However, one problem with their measure is that they do not really know the number of years of those with an incomplete stage of schooling and additionally they use different definitions of workforce for different countries.

Barro (1991) measures the impact of school enrolment on growth for a set of countries. His proxies for human capital are school enrolments. These measures suffer the problem that they could be proxing for the flows of investment in human capital rather than for the initial stock, in addition the real number of students attending school could be less that the number enrolled, especially in developing countries or regions.

Barro (1991) also uses the proxy for the adult literacy rate obtaining a significant but negative coefficient. The literacy rate results attractive in that it relates to the human capital stock rather than to the flow of investment. However, considering this variable

as human capital proxy introduces to the model the assumption that any education acquired further than the most elementary level does not contributes significantly to productivity. Other measures have been done (Barro and Lee, 1993; Nehru et al., 1995), but they still suffer problems with the inaccuracy in the underlying data leading to overestimation or underestimation of the levels of education.

Not only the human capital variables have suffer of problems, but also further research has shown that measures for human capital enter insignificantly in regressions for economic growth (Levine and Renelt, 1992; Benhabib and Spiegel, 1994; Pritchett, 1996). Explanations for this problem range from that human capital is a factor affecting the long run or the non-linear effects on growth (Levin and Raut, 1997), the lack of independent variation in the variable to explain cross-country differences in growth (Levine and Renelt, 1992), to the existence of a perverse institutional environment in which acquired skills are allocated to socially wasteful although privately remunerative activities, hampering growth as the most talented people stays away from productive activities (Pritchett, 1996).

All this measures of human capital and their impact on growth are not able to elucidate the address of education policies through the impact on growth of the different levels of education. The traditional support for education policies focus are the returns to education rates. These rates measure the premium in earnings for an additional year of education experienced by the worker. Nevertheless, this measure suffer also from problems and does not portray the complete impact of education on growth. First, the wage differential may not reflect the externality effect that worker may provide to the firms and then to growth. Second, investment in education might reduce fertility and improve life expectancy, then affects growth indirectly. Third education could be used for screening when hiring, in such a way that relative earnings may not reflect the correct productivity differential due to more education (Levine and Ruat, 1997). And fourth, it does not capture other factors affecting earning such as unionism, discrimination, market segregation, etc.

This paper goes further in the search of evidence for education policy. We will try to establish a relationship between growth and the occupational attainments of the workforce in order to separate the effects on growth of different levels of education.

This come from the fact that every occupational level is related to a determined requirement of education. Therefore, in determining the impact on growth of every occupational attainment, it will be possible to have an approach to which level of education foster in education policies, at the same time that avoid overstatements on the variable for simple human capital in the regression.

The Mexican Case

At the Mexican regional level is possible to find two studies relating growth with relevant variables, including human capital. Garza Campos (1994) shows that if South states had the same levels of schooling than North states, living standards would tend to equalise among them, given that the lack of machines, buildings and in general productive infrastructure in the South, would make more profitable private investments in those regions. His evidence suggests that this is not happening because of unfavourable differences in human capital in the South.

Tijerina (1995) tried to analyse the effect of public investment on regional growth in Mexico. He also control for human capital measured as the enrolment rate in high school. He could not find evidence of the impact of public investment on regional growth. He neither found evidence of the impact of human capital on growth.

However, none of these macro studies [points towards the focus on education policies. At the microeconomic level studies, it is possible to find calculation for the returns to education in Mexico, although at national level, it could shed some light in our efforts to focus on educational policies. Garro et al. (1997) calculated the additional earnings for an additional year of education. The advantage of their calculation is that they correct the rates from the individual effect, eliminating a common problem in other works. Their findings suggest that basic education is more profitable for the society, the followed by training programmes, and then by higher education levels. Their findings are presented in Table 1.

Table 1

Earning premium for an additional year of education, by gender. Mexico, 1993. Percentages

Education	Men	Women
No education	17.8	25.4
Incomplete primary	12.5	17.8
Complete primary	9.5	13.7
Secondary	7.6	11.0
Subprofessional careers	5.6	8.0
Vocational	5.3	7.6
Medium professional careers	4.0	5.7
Professional	3.5	5.0

Source: Garro, Gomez and Melendez (1997)

As has been mentioned, there is no evidence linking macro evidence for education with micro evidence for the same issue. Next step is to present the model in which we are relying for the analysis.

The model and data

To measure the impact of human capital on growth, I am taking a model by Delsen and Schonewille (1999), based at the same time in Cörvers (1996). Cörvers starts from a Cobb-Douglas function:

$$Y_i = AK_i^a L_i^{*b}$$

Where Y is production in an individual firm, being result of the efficiency parameter A, and the production factors K, physical capital, and L* efficiency units of labour, consisting of the number of workers in a firm or the number of hours worked, and the initial levels of education.

Rearranging the equation to measure the impact of human capita on productivity, he proposes:

$$\frac{Y}{L} = A\left(\frac{K}{L}\right)^{a} L^{a+b-1}(1-L_2-L_3)^{b(1-q2-q3)} L_2^{bq2} L_3^{bq3}$$

Where $L_s^{\theta s}$ is the number of employees with education levels, s=1,2, and 3 respectively.

Therefore, productivity levels depend on the relative shares of the three educational levels in the labour force of the industry. This equation points up two effects: to the extent of a positive marginal product, more labour produces more output, or the worker effect; and that a more efficient use of input and methods could happen through better skilled labour, or the allocation effect.

Delsen and Chonewille (1999) modify this model in order to introduce external effect as in Lucas (1988). They propose the model:

$$\frac{Y}{L} = A\left(\frac{K}{L}\right)^{a} L^{a+b-1}(1-L_2-L_3)^{b(1-q2-q3)} L_2^{bq2} L_3^{bq3} H(\bullet)$$

Where H(·) can be specified in many ways and educational levels also assume many structures. They specify H(·) as learning by doing, using production of industry i in period t-1, and adding a variable X denoting average experience of the employees of a particular industry in order to avoid overestimating the relative significance of other human capital components.

Departing from this model and modifying the analysis to examine the aggregate situation, I will reinterpret human capital as two components, the specific and the general. Then, as specific skills I will take the $L_s^{\theta s}$, which measured as the occupational levels in work can be interpreted also as learning by doing if we follow the logic that past production (variable proposed by Lucas as proxy) determine the levels of occupation required for production. Then, according to these levels of occupation attainment in the job, people with determined skills interact with each other and may come up with new ideas more easily.

The variable H(·) will be reinterpreted as the general level of skills (or knowledge) and will comprise the evolution of general education on time. This variable will help to determine the impact of general human capital on productivity proposed by many studies, and will be denoted as H_t.

As has been noted before, the simple measure of human capital only remarks the need for more education, failing in addressing the focus for differentiated educational levels. In this context, this new reinterpretation of the model will allow to link labour markets with education policies, and at the same time to avoid overstatements of general measures of human capital.

I am also modifying the model in a way that includes the effect of public investment, which can be also considered as an external effect on productivity and because on developing countries public investment has been one of the main motors of growth. I the works of Aschauer (1989) and Munnell (1990) is found a positive relation between public investment and economic growth in per capita GDP. As this investment is directed to increase the productive process of the economic activity (this will impact the distribution of occupations in the economy as well as send signs for the acquisition of human capital), it is also directed to increase the human capital component of population (or what is called social capital). Therefore, the inclusion of this variable will avoid overstatements or understatements of the occupational levels of the workforce.

Then, the final model is as follow:

$$\frac{Y_{it}}{L_{it}} = A\left(\frac{K_{it}}{L_{it}}\right)^{a} L_{i1}^{b1} L_{i2}^{b2} L_{i3}^{b3} H_{ti}^{d2} \left(\frac{G_{it}}{L_{it}}\right)^{g}$$

Where i denotes the region. In a logarithmic form:

$$In\frac{Y_{it}}{L_{it}} = InA + aIn\left(\frac{K_{it}}{L_{it}}\right) + b_1 L_{i1} + b_2 L_{i2} + b_3 L_{i3} + d_2 H_{ti} + gIn\left(\frac{G_{it}}{L_{it}}\right)$$

Then, the left side of the equation is per capita GDP per region. Data was taken for the Mexican states from the GDP per state published by INEGI since 1970. Data for population is collected from the Population General Censuses also by INEGI, many years. K is capital, measured in this empirical application as total bank deposits per states taken from Nafin (1986) and from the statistical Annexes to the Presidential Address to the Nation many years.

L_{si}, where s=1,2 and 3 are the occupational levels of employed workers. Level 1 corresponds to the employees in lower occupational attainments (manual workers), this category will be omitted from the regression in order to avoid perfect collinearity, then will be the base for the next two categories. Level 2 correspond to medium skilled occupations. And level 3 correspond to highly skilled occupations (professionals). Data was taken from the Population General Census by INEGI, different years.

Ht is years of schooling for population aged 15 and more. Data was collected from the Secretary of Labour (2000). Gi is federal public expenditure by state, with data gathered from Statistical Annexes to the Presidential address to the Nation for different years.

In order to elucidate about different effects of variables according to the position of regions in the income distribution, I estimate a quantile regression model. Quantile regression models are based on the work of Koenker and Basset (1978). These models have been extensively used in labour economics to study wage inequalities (Garcia et al, 1999). We use this method to analyse changes in regional income at different points of the income distribution. Let (Y_{ij}, X_{ij}) be a sample of data, where Y is per capita GDP and X a set of main explanatory variables for a given period. The relation between these two variables may be formulated as:

$$Y_{ij} = b_i X_{ij} + m_{0i} \qquad (3)$$

Then the quantile regression can be expressed as:

$$Quant_q(Y_{ij} / X_{ij}) = b_{i0} X_q \qquad (4)$$

Where the *Quant* denotes the conditional quantile (q) of Y_{ij} and the regressor vector X_{ij} assuming that $Quant_q(U_{oi} / X_{ij}) = 0$. The estimation results $\hat{Quant}(Y_{ij} / X_{ij}) = \hat{b}_q X$ indicate how inequality will vary as q increases in the distribution. Therefore, the quantile coefficients inform about the marginal change in the ith conditional quantile due to a marginal change in the jth element of *X*.

Results

Ordering database with the variable presented in last section as a panel data for periods from 1970 to 1996, we include a variable year in order to control for the gap between periods, also a dummy variable for oil producer states (Campeche and Tabasco) will help to control not only overstatements for the public expenditure coefficient given the allocation made during the oil boom, but also for variations in per capita GDP due to the same effect of oil boom in such variable. Results are presented in Table 5.

Table 2

Quantile regression. Mexican Regions 1970-96. Dependent variable: per capita GDP.

Variable	OLS	0.25	0.5	0.75
Constant	0.3937**	0.6356***	0.4999***	0.5973**
	(0.1929)	(0.1691)	(0.2027)	(0.2665)
Capital	0.1372***	0.1509***	0.1436***	0.0853
	(0.0362)	(0.0310)	(0.0372)	(0.0519)
Schooling	0.4219***	0.4338***	0.4129**	0.3049
	(0.1853)	(0.1594)	(0.1924)	(0.2963)
High skill occupations	-1.4716	-1.3409	0.1795	-2.8057
	(1.5198)	(1.3662)	(1.5726)	(2.3087)
Medium skill occupations	3.0224***	2.8285***	2.7089***	4.4655***
	(0.6459)	(0.5680)	(0.7128)	(0.8817)
Public investment	0.1236***	0.0866***	0.1127***	0.0853**
	(0.0276)	(0.0244)	(0.0295)	(0.0383)
Year	-0.07797	-0.1159***	-0.1325***	-0.0392
	(0.4686)	(0.0410)	(0.0514)	(0.0669)
Oil	0.2627***	0.02644	0.0071	0.6646***
	(0.944)	(0.0800)	(0.0961)	(0.1304)
Adjusted R^2	0.7747	0.6366	0.6014	0.5759

N=128, *** Significant at 1%, ** significant at 5%, *significant at 10%

Table 5 shows results of the model for the Mexican regions with panel data. The first column shows results for OLS regression, while the other columns show outcomes for the quantile regression

The variable capital is positive and significant for the general regression (OLS) and the low and medium income level states. The variable schooling has also a positive and significant effect on per capita GDP, meaning that the more general education is accomplished by the population, the more the increase in per capita GDP can be achieved, although for the higher income levels is not relevant. This is opposite to the idea that high income regions could be fuelled by higher impact of education. However, we have to note that for the higher quantile, the variable for oil producer states is only relevant for this level, then we cannot generalise that their exceptionally performance should obey to normal theory statements.

High skilled occupation has a mixed performance, changing sign from quantile to quantile, but remaining not significant in all of them. Medium skill occupations have a strong, positive and significant effect on per capita GDP in all the income level distribution. The variable for public investment has a positive and significant effect for all income levels, while oil dummy is not significant, although positive, except for the higher level, where has a significant impact.

As we have included variables for the occupational attainment of the labour market, we are relating these variables with those of education. The variable for those medium skilled activities (mainly dependants and clerks, etc) has a positive and significant impact on income in all levels of the distribution. Nevertheless, the highly skilled workforce has a "null" statistical impact on growth. This can be read as that medium skill occupations are more productive than low skill occupation (the base variable), while we have not evidence that higher skill occupation are performing better in productivity terms than those low skill occupations.

This could mean that even though that education in general has a positive impact on growth, the priority in the educational programmes should be directed towards primary

and secondary school, and even vocational, given that those levels are the required education for the medium skilled occupations.

This does not mean that programmes to improve high educational centres should be disregarded, but that the focus should be mainly in the former education. Nevertheless, it means that economic growth in the Mexican regions should be supported by a primary and secondary school system with wide covering and quality. Once this target has been achieved, public policy should focus on higher levels of education. These findings can be matched with research at the micro level done by Garro, Gomez and Melendez (1997). They found that the highest premium for investment in human capital is in the basic education, then in training, vocational, and university, in that order (back to Table 1). Then, they recommend making the basic education system the focal point of the public programmes.

Explanations for the lack of significance of the high skill occupations can be manifold. The first should be referred to a possible effect of credentialism[1] (Fajerlind and Saha, 1983) taking place during 1970s and 1980s, while in the 1990s there is a skill-biased technological change (Llamas and Garro, 1998). This differential effect cannot be tested due to the lack of data for the last period. Also, the skill mismatch of different types of skills resulting from technical change could be an explanation. We can also take the possible explanation of Princhett (1996) referred to a slowdown in growth because of a vitiated institutional environment that reallocates skills to socially wasteful although privately remunerated activities.

Conclusions

This paper has investigated the relationship between education, skills in the labour market, and economic growth in the Mexican states. In spite of the inconclusive empirical literature, the Mexican case shows that the increasing education in the workforce is having a positive impact on growth, except on the higher income states that are dominated by oil producer states and there fore present an atypical behaviour.

[1] Credentialism means that the increase of the educational requirements will bring an increase in the demand for more skilled workers, but not necessarily implies a change in marginal relative productivity (Fajerlind and saha, 1983).

The evidence shows that medium skill occupation have more impact on growth than other occupation. Then, more efforts have to be focused on basic education (primary and secondary) and gradually turn the efforts to higher education. This macro evidence is contrasted with micro evidence in returns to education, suggesting the same pattern. Public expenditure has an important impact in explaining growth. This suggests the important role of public investment in equalising states' growth. However, this investment should be done not only according to amounts, but also in co-ordinated and planned programmes looking for an effective impact on productivity.

References

Aschauer, D. A. 1989. Is public expenditure productive*? Journal of Monetary Economics*, 23, 177-200.

Barro, R. and J. Lee. 1993. International comparisons of educational attainment. *Journal of Monetary Economics*, 32, 363-394.

Benhabib, J. and M. M. Spiegel. 1994. The role of human capital in economic development, evidence from aggregate cross-country data. *Journal of Monetary Economics*, 34, 143-173.

Cörvers, F. 1996. The impact of human capital on labour productivity in manufacturing sectors of the European Union. Paper of the Research Centre for Education and Labour Markets. Maastricht University.

Delsen, L. and M. Schonewille. 1999. Human capital and labour productivity: integration of institutions and endogenous growth. Paper to the EALE conference in Regensburg.

Garro, N., M. Gomez and J Melendez. 1997. Situación ocupacional y niveles de ingreso de los trabajadores en relación con su educación y capacitación. México: STPS.

Garza Campos, M. 1994. Resultado de la convergencia entre niveles de vida ehtre estados de Mexico, aplicacion de modelos de crecimeinto neoclasicos: la importancia del capital humano. Centro de Investigaciones Economicas, UANL. Monterrey: CIE.

Fajerlind, I. And L. Saha. 1983. Education and national development, a comparative perspective. New York: Pergamon Press.

Levine, A. and L. Raut. 1997. Complementarities between exports and human capital in economic growth: evidence from the semi-industrialized countries. Economic Development and Cultural Change, 46 (1), 155-171.

Levine R and D. Renelt. A sensitivy analysis of cross-country growth regressions. *American Economic Review*, 82, 942-963.

Llamas Huitrón, I. and N. Garro Bordonaro. 1998. *El mercado laboral mexicano 1991-1996: ¿cambio tecnológico o credencialismo?*. Paper to the V International Congress on Human Capital and Growth. Centro de Investigaciones Económicas, UANL. Mexico.

Munnell, A. 1990a. Why has productivity growth declined? Productivity and public investment. New England Economic Review, Federal Reserve Bank of Boston, January/February, 3-22.

Nehru, V., E. Swanson and A. Dubey, 1995. A new database on human capital stock in developing and industrial countries: sources, methodology, and results. *Journal of Development Economics*, 46, 379-401.

Nelson, R. and E. S. Phelps. 1966. Investment in humans, technological diffusion and economic growth. *American Economic Review*, LVI, 69-75.

Pritchett L. 1996. Where has all the education gone?. *Policy Research Working Paper 1581*. The World Bank.

Psacharopoulos G. and A. M. Arriagada. 1986. The educational composition of the labour force: an international comparison. *International Labour Review*, 125 (5), 561-574.