Human Capital Externalities and Economic Development in India

Nom : DJISTERA
Prénoms : Andrianasy Angelo
Coordonnées :
Adresse : Numéro 9, Cité du CUR
Tahiti Kely
501 Tamatave
E-mail : angelo.djistera@yahoo.fr
Téléphone : 032 40 710 39
Institution d'appartenance : Université de Toamasina
Statut : Maître de conférences

Résumé

La littérature économique souligne que le capital humain joue un rôle important dans la croissance économique. Il accroît la productivité de la main-d'oeuvre, et il génère des externalités positives. Selon la théorie de la croissance endogène, ces dernières permettent de justifier l'intervention du gouvernement en faveur des investissements en capital humain. Cet article cherche à démontrer l'existence de ces externalités, en utilisant le cas de l'Inde. Nous élaborons un test empirique basé sur le modèle de Lucas (1988). Les résultats montrent que le paramètre représentant l'ampleur des externalités du capital humain est positif et statistiquement significatif.

Mots-clés : capital humain, croissance économique, externalités.

Abstract

Economic literature underlines that the human capital plays a crucial role in the economic growth. It increases the labour productivity, and also generates positive external effects. According to the endogenous growth theory, the latter permits to justify government's intervention to favour the investments in human capital. This paper tries to justify the existence of these externalities, using the case of India. We build an empirical test based on the model of Lucas (1988). The results show that the parameter representing the magnitude of human capital externalities is positive and statistically significant.

Keywords: economic growth, externalities, human capital.

1. Introduction

Human capital plays a crucial role in the society. The educational level of people affects output through technical change, but also through institutional development. For the new growth theories, there is a large consensus on the importance of human capital in the growth process: investments in human capital are necessary to use available technologies (Lucas, 1988) and to produce new technologies (Romer, 1990). For less developed countries (LDCs) human capital plays a critical role in the technological development as an absorption capacity for newly imported technologies. It also encourages the development of institutions that are crucial for long-term growth. More educated workforce is associated to high quality institutions. It allows more benign politics, less violence, and more political stability (Glaeser et al. 2004). Moreover, when an individual invests in human capital, he or she increases the return of the investments of other individuals.

The aim of the paper is to determine the presence of human capital externalities. Most of empirical analysis on these externalities considers the US economy. However, LDCs constitute interesting framework. In order to identify these external effects on the production, we focus on the case of India. Since there is a predominance of industries with an important stream of new technologies (computers and pharmaceuticals) in this country, human capital plays particularly an important role in the development.

Researchers estimate Mincerian wages equation, augmented with an average human capital term in order to capture the productivity externalities generated by schooling (Cirrone and Peri, 2003; Moretti, 2004). In this paper, we propose an alternative approach to identify the strength of human capital externalities, based on the growth theory of Lucas (1988).

The paper is organized in the following way. The second section explains the methodology adopted to identify the strength of Indian human capital externalities. The third section is devoted to constructing and analyzing the data used in the estimation. Then fourth section presents the main results of empirical study. And the last and then final section is the conclusion of the study.

2. Methodology

In this study, human capital externalities are measured as the indirect effect of the average education on the level of production. In the Lucas's model, introducing the term

h_a^{γ} in the production function allows human capital to have positive external effects on production. And the production grows with physical capital (*K*), human capital (*h*) and labour force (*L*). Thus, the production function can be expressed by,

$$Y_t = A(h_{at})F(L_t, h_t, K_t) = h_{at}{}^{\gamma} F(L_t, h_t, K_t) \quad (1)$$

where γ is the strength of the average human capital externalities at the country level.

We propose a simple theoretical framework to analyze the role of human capital on economic growth, as in Monteils (2002). In order to estimate the significance of human capital externalities, we introduce the term h_a^{γ} in the production function proposed in this study.

In our Lucas-type model, we assume that the one-sector aggregate production is given by,

$$Y_t = K_t^{\beta}(h_t L_t)^{1-\beta} h_a^{\gamma} \quad , \quad 0 < \beta < 1 \quad (2)$$

where β represents the elasticity of production with respect to physical capital, which is equal to the physical capital share of income.

This way to model the growth effects of human capital makes it possible to introduce the direct and indirect impact of human capital. We assume that the average level of human capital is equalled to the human capital of the representative agent ($h_a = h$). Dividing equation (2) by population and taking logarithms, we can obtain the expression of the per capita growth rate,

$$\ln y_t - \ln y_{t-1} = \beta(\ln k_t - \ln k_{t-1}) + (1 - \beta + \gamma)(\ln h_t - \ln h_{t-1}) \quad (3)$$

where $(1 - \beta + \gamma)$ is the elasticity of production with respect to human capital.

This last equation allows determining the parameter characterizing the magnitude of the human capital externalities.

3. Data

Per capita output is approximated by the ratio of gross domestic product (GDP) at 2000 prices by population. We use data of GDP and population published by International Monetary Funds (IMF) (*Institute of Financial Statistics* (IFS)). The stocks of human capital and physical capital series are calculated using perpetual inventory method.

Human capital

The annual time series of human capital are obtained using the method proposed by Nehru et al. (1995). Assuming that

individuals enter in the labour force at the minimal age and go out at the retirement age, the perpetual inventory method can be used to accumulate the total number of years of schooling *S* embodied in labour force:

$$S = \sum_{t=T-A_h+D_0}^{T-A_l+D_0} \left(\sum_{g} E_{g,\,t+g-1} \left(1 - r_g - d_g\right) P_{g,\,t+g-1} \right) \quad (4)$$

where $E_{g,t}$ is the enrolment at the level g at time t, A_h represents the maximal age of labour force (64 years), A_l is the minimal age of labour force (25 years), D_0 is age at which children enter school (6 years), r_g is the ratio of repeaters to enrolments in the grade g, d_g is the drop-out rate from grade g in year t and $P_{g,t}$ is the probability of the enrolee at grade g at time t to survive until the year T.

In order to calculate the average stock of education of labour force, the global stock of education is divided by the working age population P_w (used as proxy of the labour force),

$$s = \frac{S}{P_w} \quad (5)$$

The series of enrolment are supplied by UNESCO Institute for Statistics (UIS) and completed by Mitchell (1995) for data before the year 1988. Percentage of repeaters is also given by UIS. However, we neglect the drop-out and the survival rates because the data are not available. Population data are finally provided by United Nations (1997, 2005).

The results are in accordance with the literature. The table 1 shows that our proxy of Indian stock of human capital is similar to other studies. Thus, the methodology used in this study gives us a consistent and reasonable estimation of the level of human capital.

Table 1: Comparison of human capital stock indicators

	Average schooling years of working age population		
	Barro and Lee (2001)*	Soto and Cohen (2001)*	Calculated years
1970	1.90	1.52	1.83
1980	2.72	2.11	2.38
1990	3.68	2.97	3.21
2000	4.77	3.45	4.10

Note: * Population 25 and over

However, as in the case of all indicators that are based on education or schooling, the measure of human capital does not take into account some components of human capital stocks, such as the training on the job and at home which is important but difficult to quantify.

Physical capital

The series of physical capital stock are provided by Nehru and Dhareshwar (1993). Recent data are estimated using the perpetual inventory method. The assumed rate of depreciation δ of physical capital is 4%.

$$K_t = FBCF_t + (1-\delta)K_{t-1} \quad (6)$$

where GFCF is the gross fixed capital formation and K is the stock of physical capital.

To calculate the stock of physical capital, one needs long-term series data on GFCF and that of the initial physical capital stocks itself. The long-term data on GFCF are published by IMF (IFS). Of course the initial stock of physical capital (associated to 1980) was obtained from Nehru and Dhareshwar's database.

Physical capital per capita is approximated by the ratio of physical capital at the 2000 price to population.

4. Results and discussion

We analyse the Stationarity of the sets of data before estimating human capital externalities. We use Augmented Dickey-Fuller (1979), Phillips-Perron (1988) and Kwiatkowski, Phillips, Schmidt and Shin (1992) in order to test the existence of unit roots. The results are presented in Table 2. The conclusion is that the three variables considered in the regression are stationary in levels.

Table 2: Tests of stationary (ADF, PP and KPSS)

	ADF	**PP**	**KPSS**
	t-Stat	*Adjusted t*-Stat	*LM*-Stat
Output growth	-4.74***	-4.61***	0.33***
Human capital growth	-5.87***	-14.61***	0.45*
Physical capital growth	-4.05***	-3.91***	0.32***

Notes: ADF = Adjusted Dickey-Fuller test; PP = Philips-Perron test and KPSS = Kwiatkowski, Phillips, Schmidt and Shin test. The statistical tests are marked with an * when the test significance is 90%, ** when the test significance is 95% and *** when the test significance is 99%.

Estimation of human capital externalities in Lucas's based model

Table 3 contains the results of estimation of the growth function for India, defined by equation (2). We present estimated coefficients by ordinary least squares (OLS)

and the t-statistics for the significance of each one, reported in parentheses.

Table 3: Estimation results for the growth equation

Explained variable, per capita growth rate (1971-2004)

	Estimated coefficients
Human capital growth rate	0.978 (4.733)***
Physical capital growth rate	0.252 (2.404)**
R-squared	0.087
Durbin-Watson Stat	1.853
Observations	34

Notes: t-Stat in brackets. *, **, *** denote statistical significance at 10%, 5% and 1% respectively.

Before analyzing the estimated value for each variable, we note that the R-squared is modest (0.087), and the limited time period (34 years) implies the need for caution in interpreting results.

The coefficient on physical capital β is 0.252. The value of the parameter γ is deduced from the estimated coefficient presented in the Table 3. The estimated magnitude of the human capital externalities is 0.230 for India. So, there is a positive externality of human capital accumulation in India. In this case the estimated parameters reveal the existence of increase return to scale for the accumulated inputs, as in Lucas's model ($0.978 + 0.252 = 1.230 > 1$).

Note that the external effects of human capital constitute relevant features in characterizing Indian development. This economy *involves* an important number of scientists and engineers, even if a majority of the population has only achieved a low level of education. According to Barro and Lee's database, there is only 4.8% of population (aged 25 and over) in 2000.

This study provides empirical evidence consistent with Lucas's model: the more important are the externalities of human capital the higher is the level of per capita output.

The presence of human capital externalities has an important policy implication. India's experience contributes here a lot to the justification of the government intervention in favour of economic development. Klien (2002) pointed out that the subsidies in human capital are, on a large scale, based on the existence of an important gap between private and social benefits of human capital. Individuals under-invest in human capital if the private benefits from human capital are

much lower than social benefits. However, as Carneiro and Heckman (2003) highlighted, policy must consider the multiplicity of institutions that influence the investment in human capital and the dynamic nature of the human capital accumulation process. In addition to schools, families and firms also produce human capital. Thus, as opposed to the traditional approach to human capital policy that focuses on schools (subsidy), this approach implies the importance of other measures. The relaxation of household's borrowing constraint can for example favour human capital development because the family's financial resources influence investment in human capital (Carneiro and Heckman, 2002)

It should be underlined that the models of growth based on the Lucas's framework can be limited in order to explain self-sustained economic growth in the long run. The latter requires as well that the growth rate of human capital stock is constant.

5. Conclusion

This paper provides empirical evidence on the presence of human capital externalities in production. The existence of externalities implies an important policy implication (Klien, 2002). However human capital policies must be treated with caution because, as noted by Zhang (1996), government subsidies to private education stimulate growth, but the direct provision of education by the public sector may reduce growth. Hence, the positive externalities generated by higher education levels must be sufficiently high for government intervention to be welfare improving. In the case of India, public subsidies on education are justified because they permit poor family to finance education. The mix optimal between education policies and the anti-poverty policy constitutes particularly a key question to promote growth in the long-term.

To conclude, immigration must be considered seriously in the case of India. Human capital policies must take into account the brain drain (or gain) process. Policy makers should in the first place favour the return immigration of human resources in research and technology. The

latter can also constitute an important source of positive externalities through the increase of the average level of human capital in the country, due to the entry of high-skilled workers.

References

Barro, R.J., Lee, J-W., 2001. "International Data on Educational Attainment: Updates and Implications", *Oxford Economic Papers*, 53(3).

Carneiro, P., Heckman, J., 2002. "Human Capital Policy", *NBER Working Paper*, No. 9495.

Carneiro, P., Heckman, J., 2003. "The Evidence on Credit Constraints in Post-Secondary Schooling", *NBER Working Paper*, No. 9055.

Dickey, D. A., Fuller, W.A., 1979. "Distribution of the Estimators for Autoregressive Time Series with Unit Root", *Journal of American Statistical Association*, 74, p. 427-431.

Glaeser, E.L., La Porta, R., López-de-Silanes, F., Schleifer, A., 2004. "Do Institutions Cause Growth?", *NBER Working Paper*, No. 10568.

Klien, S., 2002. "Human Capital Externalities in India", *London School of Economics and Political Science mimeo*.

Kwiatkowski, D., Phillips, P.C.B., Schmidt, P., Shin, Y., 1992. "Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root. How Sure Are We that Economic Times Series Have a Unit Root?", *Journal of Econometrics*, 54, p. 159-178.

Lucas, R.E., 1988. "On the Mechanics of Economic Development", *Journal of Monetary Economics*, 22(1), p. 3-42.

Mitchell, B.R., 1995. *International Historical Statistics: Africa, Asia & Oceania 1750 - 1980*, Second Revisited version, Stockton.

Monteils, M., 2002. "Education and Economic Growth: Endogenous Growth Theory Test. The French Case", *Historical Social Research*, 27, p. 93-107.

Nehru, V., Dhareshwar, A. 1993. "A New Database on Physical Capital Stock: Sources, Methodology and Results", *Revista de Analisisis Economico*, 8(1).

Nehru, V., Swanson, E., Dubey, A., 1995. "A New Database on Human Capital stock in Developing and Industrial Countries: Sources, Methodology, and Results", *Journal of Developing Economics*, 46, p. 379-401.

Phillips, P.C.B., Perron? P., 1988. "Testing for Unit Root in Times Series Regression", *Biometrika*, 75, p. 335-346.

Romer, P.M., 1990. Endogenous Technological Change. Journal of Political Economy 98, 71-102.

Soto, M., Cohen, D., 2001. Growth and Human Capital: Good Data, Good Results. *CEPR Discussion Paper*, no. 3005.

UNESCO Institute for Statistics. 2007. UNESCO Database. Available at: *http://www.uis.unesco.org.*

United Nations. 1997. *Demographic Yearbook*, Historical Supplement, New York. Available at: http://unstats.un.org/unsd/demographic/products/dyb/DYBHist/HistTab01.pdf.

United Nations. 2005. *World Population Prospects: The 2004 Revision Population Database*, New York. Available at: *http://esa.un.org/unpp/index.asp?panel=2*.

Zhang, J., 1996. "Optimal Public Investments in Education and Endogenous Growth", *Scandinavian Journal of Economics*, 98, p. 387-404.