

ABSTRACT

The purpose of this paper is to explore some issues and implications regarding the design of economic policies which derive from incorporating related to a society's process of knowledge accumulation associated with an analysis of the relationship between economic growth and the level and composition of investment in knowledge.

The paper develops a model which serves as an analytical frame to study the relationship between economic growth and knowledge and to examine the mechanisms through which policies may alter the process of knowledge accumulation.

It is concluded that the impact of the policies oriented to promote investment in human capital and technological research and development activities depends crucially on the characteristics of the knowledge generated. The policies to support education and technological research should: promote the development of the capacity to absorb new knowledge; maintain an equilibrium between specialization and flexibility; and, explicitly incorporate aspects related to quality of education in the design of economic development policies.

SINTESIS

El propósito de este trabajo es explorar algunas de las interrogantes e implicaciones sobre el diseño de las políticas económicas que se derivan de la incorporación de variables vinculadas con el proceso de acumulación de conocimiento de una sociedad asociada al examen de la relación entre crecimiento económico y el nivel y composición de la inversión en conocimiento.

En el trabajo se desarrolla un modelo que sirve de marco de análisis para estudiar la relación entre crecimiento económico y conocimiento y para examinar los mecanismos a través de los cuales las políticas pueden alterar el proceso de acumulación de conocimiento.

Se concluye que el impacto de las políticas orientadas a promover la inversión en capital humano y las actividades de investigación y desarrollo tecnológico, depende crucialmente de las características del conocimiento generado. Las políticas de apoyo a la educación e investigación tecnológica deberían promover el desarrollo de la capacidad para absorber conocimiento nuevo; mantener un equilibrio entre especialización y flexibilidad; e, incorporar explícitamente los aspectos vinculados con la calidad de educación en el diseño de las políticas de desarrollo económico.

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COMPETITIVENESS, OPENNESS AND ECONOMIC GROWTH*

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1. INTRODUCTION

The orientation of economic policy in Latin America, over the last fifteen years, has been strongly influenced by the disequilibria accumulated in the seventies and the external financing crisis which developed at the beginning of the eighties.

Stabilization and structural adjustment programs, implemented during this period, were aimed primarily at restoring basic macroeconomic equilibria with a view to recreate the conditions needed to allow stable and sustained growth and poverty reduction. The "menu" of policies, applied in almost all structural adjustment programs implemented in the region, included, with varying degrees in depth, two basic components. The first component was aimed at restoring macroeconomic equilibria by reducing fiscal deficits and real devaluations. The second component in adjustment programs was directed at promoting efficiency through liberalization policies of domestic and external markets, reducing distortions, and restructuring the State apparatus. However, the debate regarding the specific content of a long-term development strategy was systematically postponed in the countries of the region and was reflected in the absence of long run policies which would go beyond the narrow and short term framework, characteristic of the stabilization programs.

This situation, however, has begun to show a reversal recently due to the consensus attained regarding the minimum conditions needed to ensure stable and sustained growth --macroeconomic stability, integration to international markets and expansion of the role of markets in resource allocation-- and additionally by the generalized perception that these minimum conditions are insufficient and should be complemented by specific policies which promote economic growth. In particular, there exists consensus that the absence of a deliberate and consistent long-term policy of productive development, in practically all countries in the region, is an important constraint on the possibilities of the region's future economic growth.

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Evidence accumulated from historical experiences of economic growth shows that a key component of economic development is associated with the accumulation of knowledge. A review of the experiences of economic growth indicates that there exists a close association between a country's economic growth and the evolution of different factors associated with its level of technological development. On the other hand, the new literature on economic growth developed as from the second half of the eighties, suggests that the accumulation of knowledge which results from investment in human capital and technological innovation, has permanent effects on the level and trajectory of the total product of a society. An additional implication of this literature is that the existence of positive externalities associated with the production of knowledge, determines that, in general, the production of knowledge will be suboptimal without a policy that promotes technological innovation and human capital accumulation.

The purpose of this paper is to analyze policy implications arising from incorporating variables related to the process of knowledge accumulation in a society. The central motivation of this paper hinges on an analysis of the relationship between economic growth and the level and composition of investment in knowledge. The general conclusion of this paper is that the impact of policies oriented to promote investment in human capital and technological research and development activities, depends crucially on the characteristics of the knowledge generated. In particular, it is argued here that the policies which support education and technological research should: i) promote the development of the capacity to absorb new knowledge, ii) maintain an equilibrium between specialization and flexibility, and iii) explicitly incorporate aspects related to quality of education in the design of policies aimed at promoting economic growth. An additional implication to the model developed in this paper is, that under some conditions, there exists a "threshold" level of internal technological development such that would allow policies aimed at promoting technological innovation processes to have effects. The next section addresses the analytical framework which serves as a foundation to the relationship between economic growth and knowledge. The third section focuses on the implications of the model regarding the orientation of economic development policies. Finally, the fourth section sums up the main conclusions.

2. ANALYTICAL FRAMEWORK

Evidence accumulated over the last decades regarding economic development suggests that knowledge accumulation is a central element to economic growth processes. A review of successful experiences in economic growth indicates that economic policies which encourage technological innovation and stimulate investment in human capital have positive effects of a permanent nature on the trajectory of a society's product.

In this section we will develop two alternative models for the production of knowledge, so as to illustrate the relationship between domestic production of knowledge, technical progress in the rest of the world and economic growth.

2.1. The Basic Model

The notion that the production of knowledge, associated with technological innovation processes and investment in human capital, is a key element in economic growth, may be formalized through a total production function which explicitly incorporates knowledge as an additional productive factor. The relationship between total production and knowledge is stated in the following equation:

$$y = F [(1 - a_K) K, (1 - a_L) L, C] \quad (1)$$

where K , L and C stand for capital stock, labor force and available stock of total knowledge, respectively. Parameters a_K and a_L , in turn, represent the proportions of total capital stock (a_K) and labor force (a_L), allotted to domestic production of knowledge.

Based on (1), the product growth rate can be represented by the following expression:

$$\hat{Y} = \alpha_K \hat{K} + \alpha_L \hat{L} + \alpha_C \hat{C} \quad (2)$$

where α_K , α_L and α_C represent the elasticities product/capital, product/labor and product/knowledge, respectively.

Equation (2) states that the product growth rate depends basically on the trajectory of capital stock, labor force and available stock of knowledge. The evolution of the stock of knowledge, in turn, depends on the resources used in its production and, additionally, on the characteristics specific to the learning and diffusion processes.

Traditionally, in studying the relationship between growth and productivity, the role of formal education as well as the research and development efforts made by firms have been emphasized as key components in the process of accumulating knowledge. However, some skills are independent from the resources directly used in producing knowledge, and they are acquired through a process of learning and imitation, which internalizes information provided by the markets and the experience accumulated in the productive process. In this sense, the evolution of the available stock of knowledge reflects not only the deliberate effort to create new knowledge, but also the capacity to absorb previously developed knowledge through imitation and learning that arises within the productive process itself. In particular, the main

source of knowledge accumulation, at the first stages of a process of economic development, has been, in the case of many countries, the outcome of a deliberate process of imitating and using previously existing techniques.

The evolution of a society's stock of knowledge reflects, then, the interaction between two types of factors. In the first place, it reflects the trajectory of the stock of knowledge originated domestically which, in turn, depends on the resources assigned to its production, and on the stock of knowledge originated externally, which depends, in turn, on the evolution of knowledge in the rest of the world and on the capacity of an economy to absorb and adapt technological innovations developed previously in other countries.

Formally, then, the accumulation rate of knowledge could be represented by the following equation:

$$\hat{C} = \theta \hat{E} + (1-\theta)\beta w \quad (3)$$

where E represents the stock of knowledge of domestic origin and w the growth rate of the stock of knowledge in the rest of the world. Parameter β represents the capacity to absorb knowledge generated in the rest of the world and θ the relative importance of knowledge of domestic origin in the stock of total knowledge.

The production of domestic knowledge depends primarily on both the amount of capital and labor used to produce it as well as the stock of total knowledge which reflects the level of technological development and the average human capital available domestically. On the other hand, the capacity to absorb technological innovations developed in the rest of the world depends on a number of factors related to an economy's degree of integration to international markets, the scope of domestic distortions and the level of domestic technological development.

The characteristics of the domestic production function of knowledge and the determinants of the capacity to absorb knowledge developed in other countries are summed up in equations (4) and (5):

$$\dot{E} = E(a_K K, a_L L, C) \quad (4)$$

$$\beta = \beta(A, E/C) \quad (5)$$

Equation (4) indicates that the production of domestic knowledge depends on the amount of capital and labor assigned to the production of knowledge and the total stock of knowledge available at the domestic level.

Equation (5), in turn, shows that the capacity to absorb and adapt knowledge developed in the rest of the world depends on the economy's degree of openness and integration to international markets (A) and on domestic technological development itself relative to external development (E/C).

Assuming in addition that the production function of knowledge displays constant returns to scale, the growth rate of the total stock of knowledge can be represented by the following expression:

$$\hat{C} = \theta E (a_K K/E, a_L L/E, C/E + (1 - \theta) \beta (A, E/C)w \quad (6)$$

Equation (6) states that the growth rate of the total stock of knowledge depends positively on the proportion of resources needed to produce it (a_K, a_L), on the degree of integration to international markets (A), on the relative endowments of factors (K/E, L/E), and on the rate of technical progress in the rest of the world (w).

In turn, the growth rate of the capital stock --if we assume that investment represents a constant proportion of the product-- can be expressed by the following relationship:

$$\hat{K} = \sigma(Y/K) \quad (7)$$

The expression for the growth rate of the total stock of knowledge suggests several interesting implications regarding the relationship between knowledge and economic growth and in relation to the nature of economic growth processes. In the first place, it implies that one-time increases in the percentage of resources allotted to finance domestic technological innovation, have permanent effects on the trajectory of the total stock of knowledge and, through it, on the product growth rate. In the second place, the equation for the growth rate of the stock of knowledge, indicates that there does not exist a single equilibrium that is independent from the initial conditions. The characteristics of the equilibrium to be attained depend crucially on the relative factor endowments and, in general, on the set of past decisions adopted by economic agents. The existence of multiple equilibria suggests that the growth rate may be suboptimal and that an intervention by the authority, focused on the production of knowledge, may have a positive impact on economic growth. Finally, the model developed in this section suggests that the capacity to incorporate knowledge to the productive process depends on the trade policies adopted and on the characteristics of the knowledge generated domestically. The accelerated rate of the technological innovation process and the globalization of markets requires developing countries to encourage the generation of increasingly malleable knowledge.

Replacing (6) and (7) in (2) the product growth rate may be represented through equation (8):

$$\hat{Y} = \alpha_K \sigma (Y/K) + \alpha_L \hat{L} + \alpha_C [\theta E (a_K K/E, a_L L/E, C/E) + (1 - \theta) \beta (C/A, A) w] \quad (8)$$

The expression summarized in (8) shows that the product growth rate depends positively on: i) investment rate (σ), ii) proportions of capital and labor assigned to the production of knowledge (a_K, a_L), iv) accumulation rate of the endowment of knowledge in the world (w), and v) capacity to absorb innovations generated in the rest of the world (β).

With a view to illustrate some implications of the model developed above, figures (1) and (2) describe the process of determining the accumulation rate of knowledge and the growth rate of the capital stock, assuming that the labor force remains constant and that the production of knowledge depends exclusively on K and C.

In the upper part, curve EE describes combinations of \hat{E} and C/E suggested by equation (4), assuming that the proportion of the capital stock assigned to the production of knowledge (a_K) and the relative endowment of capital to domestic knowledge (K/E) are constant. The curve SS, in turn, describes the relationship between the growth rate of the stock of knowledge of external origin and (C/E) implied in equation (5). The negative slope of this curve in figure 1 illustrates the increase in the capacity to absorb innovations generated in the rest of the world, as the stock of knowledge generated domestically increases in relation to the total stock of knowledge. In the lower part, curve EE describes the relationship between \hat{E} and (K/C), keeping (C/E) and the proportion of resources allotted to the production of knowledge constant. An increase in (K/C), keeping (C/E) constant, implies an increase in (K/E) and, therefore, equation (4) reflects an increase in the growth rate of the stock of knowledge produced domestically. Curve KK, in turn, represents the combinations of (K/C) and \hat{K} implicit in equation 7, assuming that there are decreasing marginal returns to capital. The position of curve K depends, in turn, on the savings rate.

Figure (1) illustrates both the long term effect of the increase in the proportion of the capital stock assigned to producing knowledge domestically on the trajectory of the capital stock and the stock of domestically and externally produced knowledge. The impact effect of the increase in a_K , will be reflected on an increase in the growth rate of the stock of domestic knowledge, which is illustrated in figure (1) by the movement from a to point b. At point b, $\hat{E} > BW$ and therefore (C/E) will be decreasing. In the lower part, point b implies that $\hat{E} > K$ and therefore (K/E) is decreasing. The reduction of (C/E) brings about, in turn, in figure (1), in the lower part, a downward displacement of curve EE to the right. In turn, the reduction in (K/E) implicit in the reduction of the ratio of capital to knowledge,

brings about, in turn, in the upper part of figure (1), a downward movement of curve EE. The new equilibrium is attained at c, with an increase in the growth rates of the capital stock and total endowment of knowledge. The increase in the proportion of resources allotted to the production of knowledge brings about, in turn, a reduction in (K/C) and an increase in the relative participation of domestic knowledge in the total stock of knowledge.

FIGURE 1

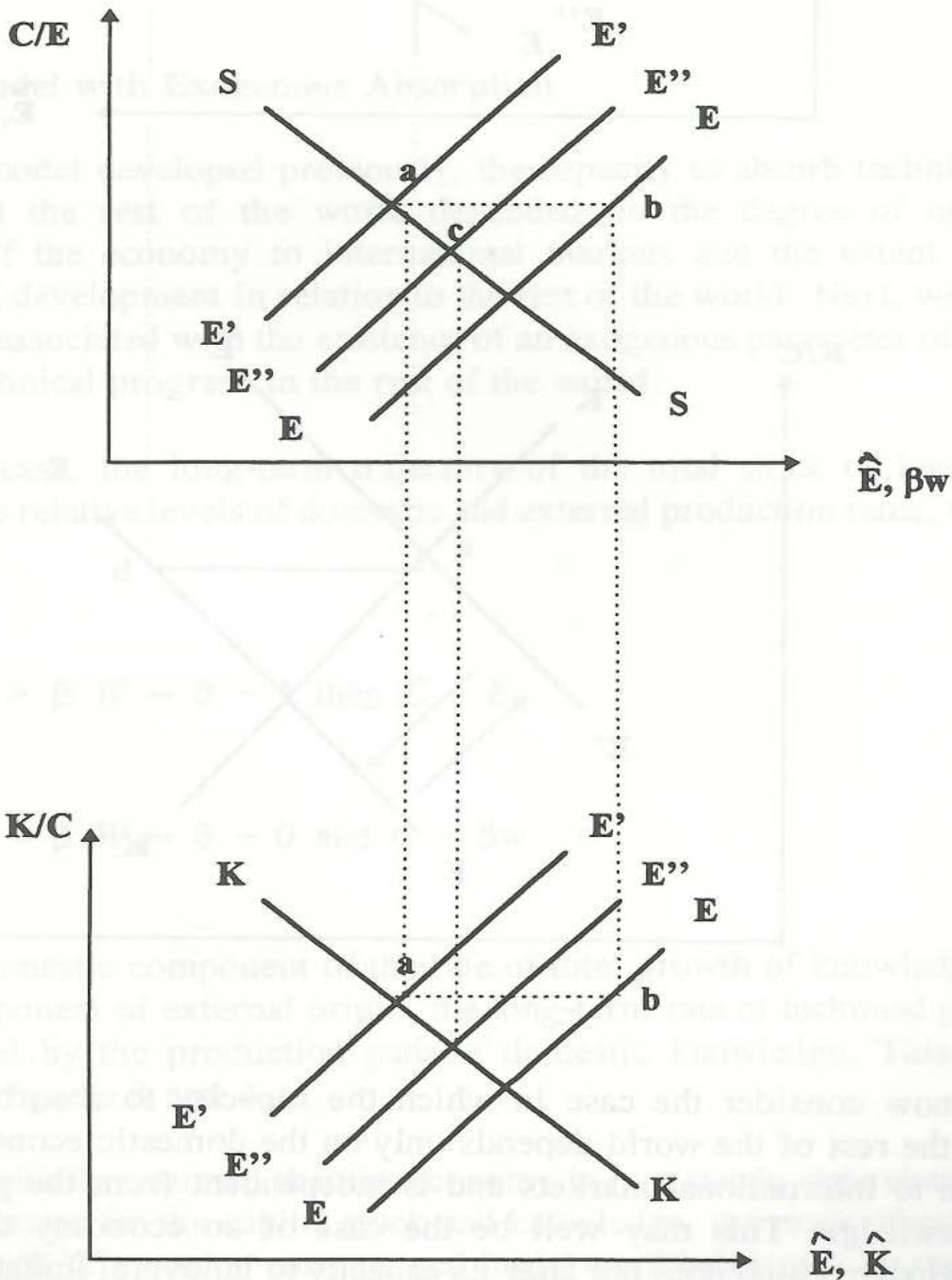
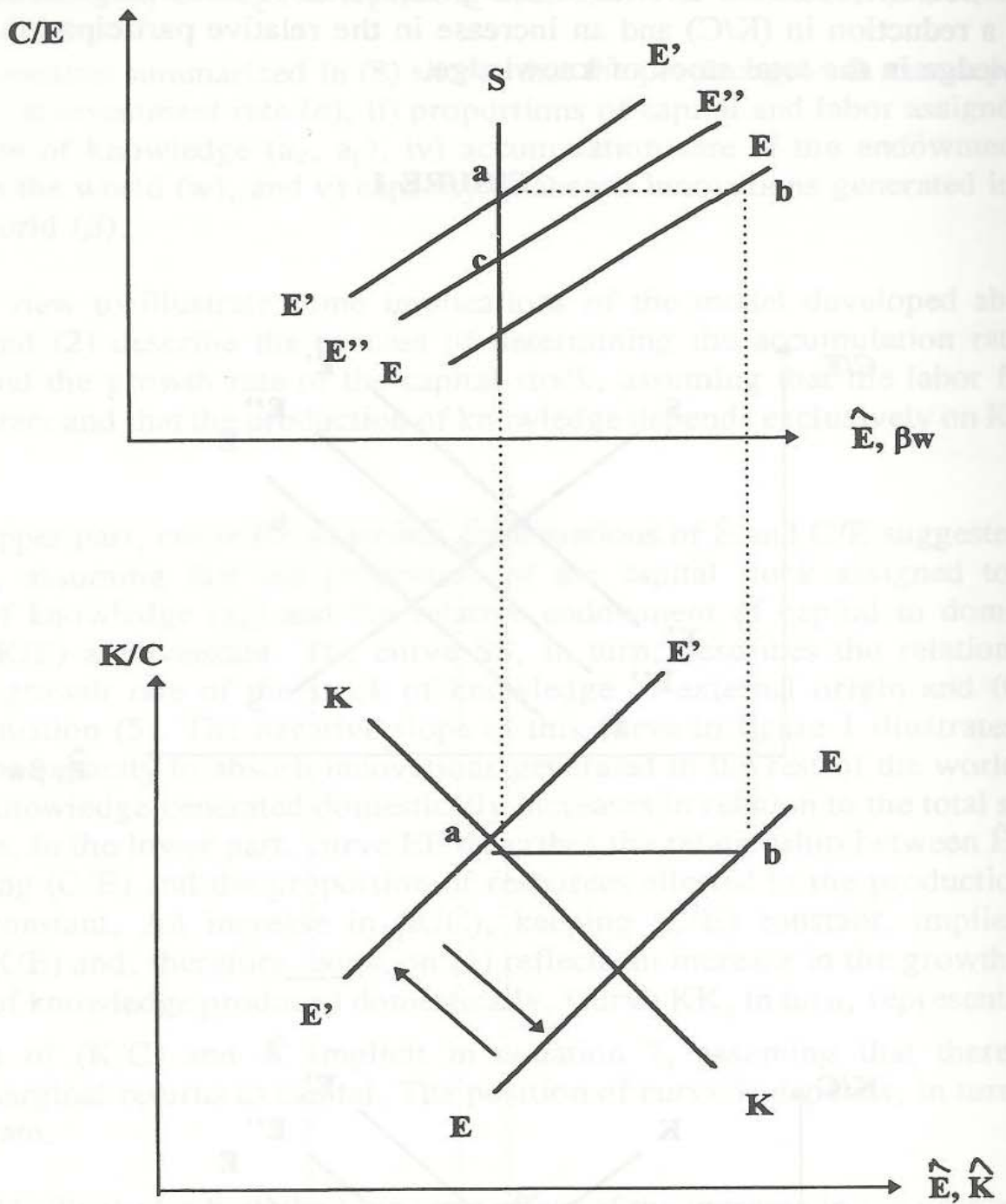


FIGURE 2



Let us now consider the case in which the capacity to absorb innovations generated in the rest of the world depends only on the domestic economy's degree of integration to international markets and is independent from the production of domestic knowledge. This may well be the case of an economy that produces specific knowledge which does not alter its capacity to innovate, imitate and absorb new technology. This situation is illustrated in figure (2). The growth rate of the stock of domestically produced knowledge is independent from domestic production

of knowledge and, consequently, curve SS is represented by a vertical curve. In figure (2), the percentage increase of resources allotted to the production of domestic knowledge is reflected initially on the movement from a to b. In the long term, however, the growth rate of the total stock of knowledge and the growth rate of the capital stock remain constant. The increase in resources assigned to domestic production of knowledge brings about a reduction in the ratio of capital to domestic knowledge (K/E), which explains the second displacement of curve EE and the new equilibrium at c, with an increase in the participation of domestically produced knowledge in the total stock of knowledge. In the upper part of the figure the new long-term equilibrium is characterized by the preservation of the growth rates of factors and a decrease in (C/E). The reduction in (C/E) accounts for the second displacement of curve EE, in the lower part of the figure.

2.2. The Model with Exogenous Absorption

In the model developed previously, the capacity to absorb technical progress developed in the rest of the world depended on the degree of openness and integration of the economy to international markets and the extent of domestic technological development in relation to the rest of the world. Next, we analyze the implications associated with the existence of an exogenous parameter of the capacity to absorb technical progress in the rest of the world.

In this case, the long-term trajectory of the total stock of knowledge will depend on the relative levels of domestic and external production rates, respectively. Specifically:

(i) If $\hat{E} > \beta W \rightarrow \theta \rightarrow 1$ then $\hat{C} \rightarrow \hat{E}$

(ii) If $\hat{E} < \beta W \rightarrow \theta \rightarrow 0$ and $\hat{C} \rightarrow \beta w$

If the domestic component of the rate of total growth of knowledge is greater than the component of external origin, the long-term rate of technical progress will be determined by the production path of domestic knowledge. This situation is illustrated in figures 3 and 4.

If it is initially assumed that the economy is in a steady state characterized by equal growth rates for the capital stock and knowledge, the stock of capital relative to knowledge (K/C) remains constant and initial equilibrium will be represented by point a.

FIGURE 3

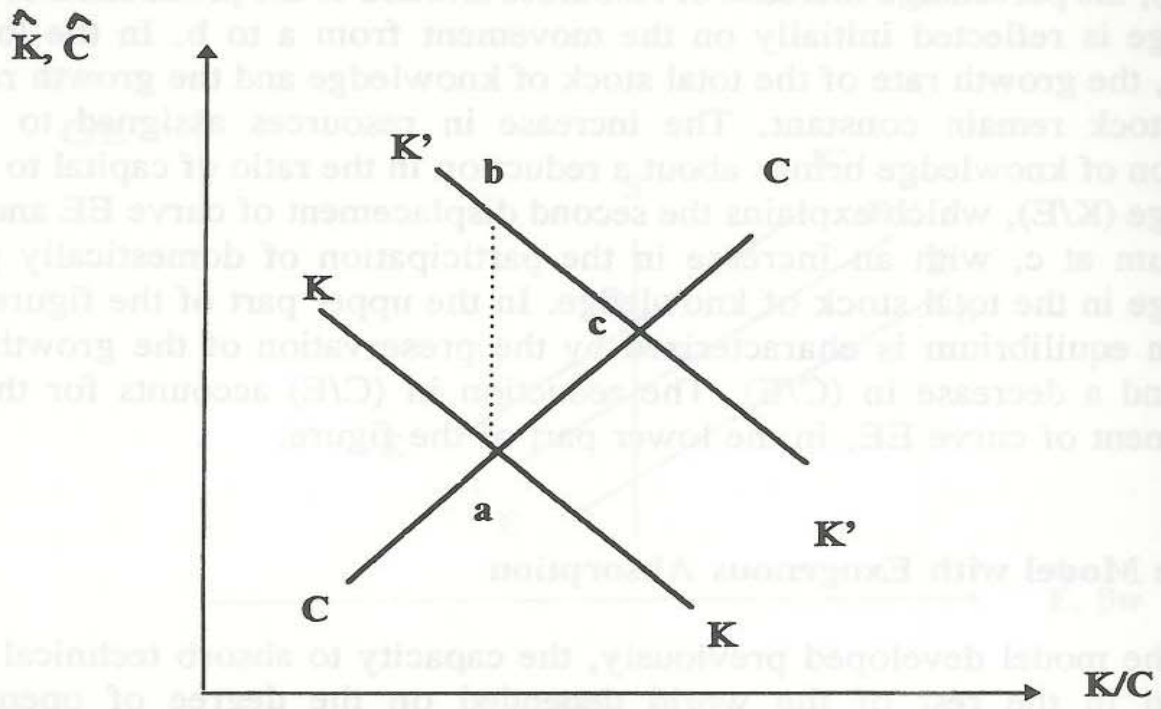
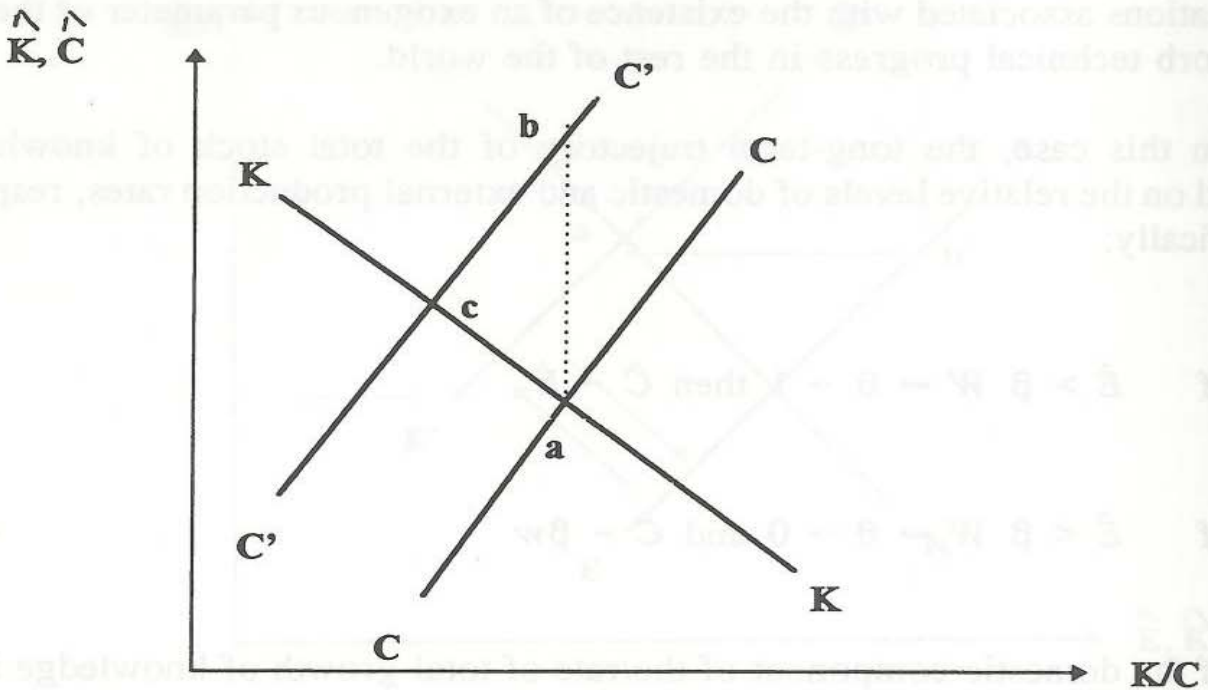


FIGURE 4



If, based on the initial situation, the savings rate increases, curve KK will move upwards. The impact effect of the increase in the savings rate will be reflected by an increase in the growth rate of the capital stock illustrated in figure 3 by the movement from a to b . In the long term, the economy finally converges to a point such as c with a total growth rate higher than the initial one. Figure 4 illustrates, in turn, the long-term impact effect associated with an increase in the proportion of capital stock assigned to the production of knowledge. Curve CC moves to the left and the economy shifts from a to c with a growth rate in productive factors and product higher than the initial one.

FIGURE 5

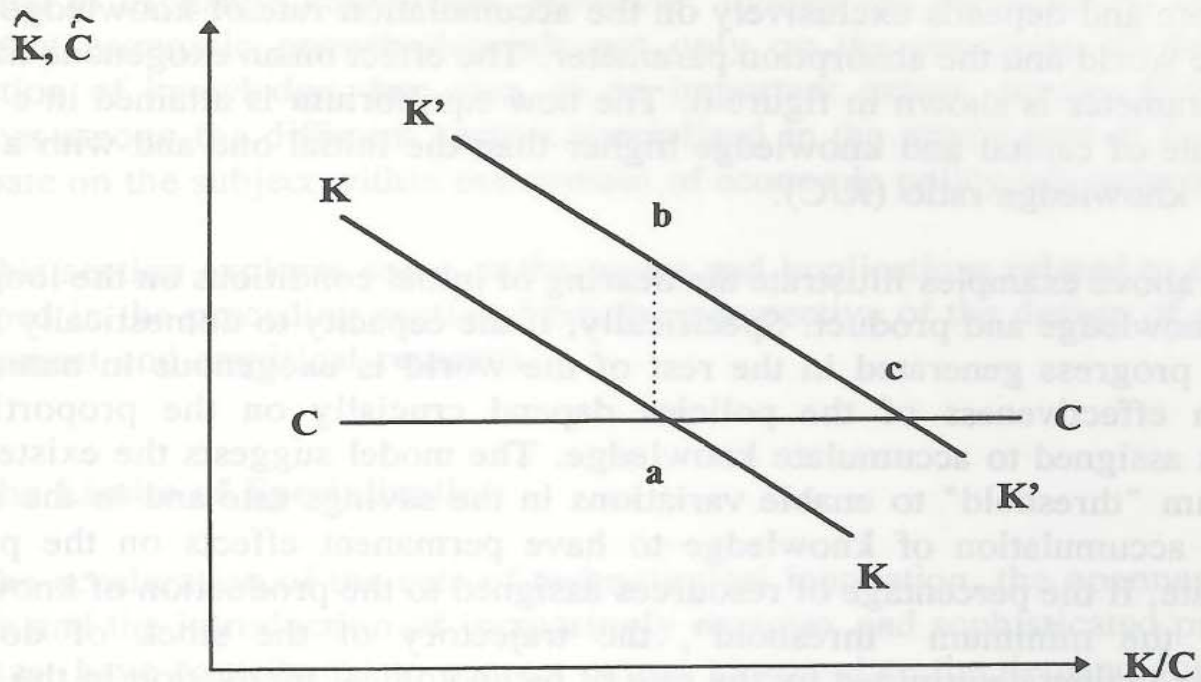
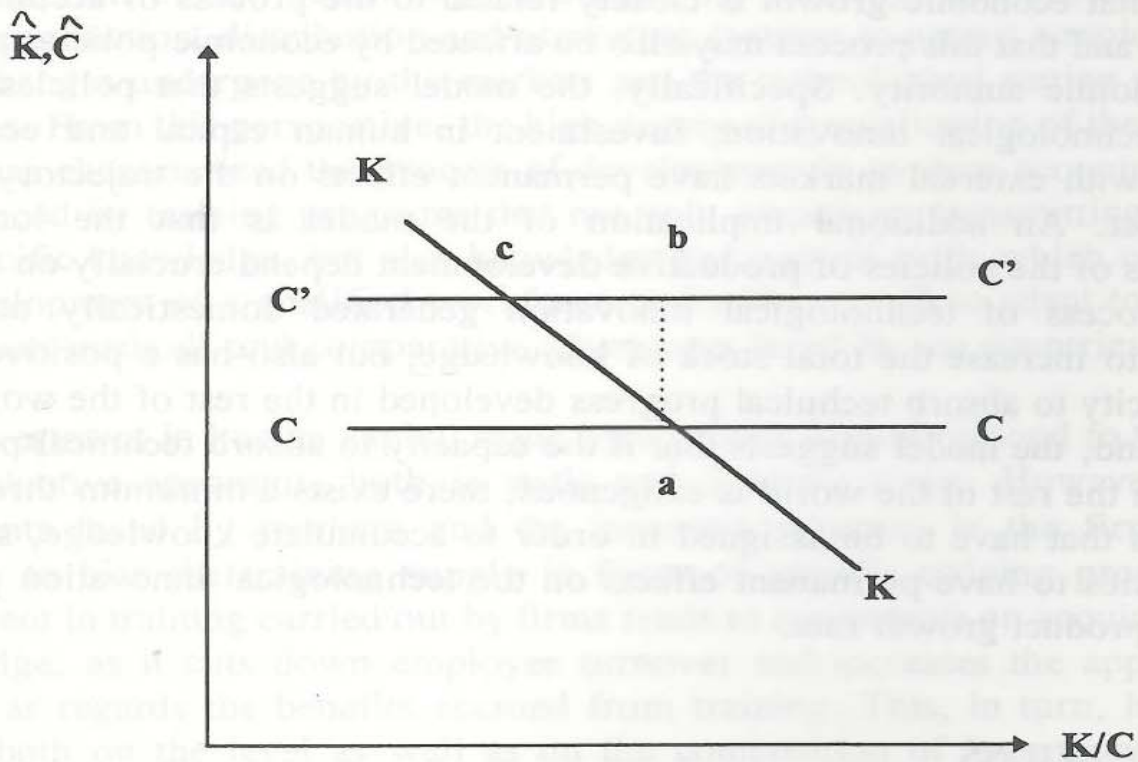


FIGURE 6



Let us now consider the case in which the growth rate of the stock of knowledge of external origin is higher than the growth rate of the domestic production of knowledge. This situation is illustrated in figures 5 and 6. Figure 5 illustrates the effect of a change in the savings rate. In this case, the economy shifts from a to c and the accumulation rates of knowledge and capital remain constant

in the long term. The accumulation rate of knowledge is independent from the savings rate and depends exclusively on the accumulation rate of knowledge in the rest of the world and the absorption parameter. The effect on an exogenous increase in this parameter is shown in figure 6. The new equilibrium is attained in c with a growth rate of capital and knowledge higher than the initial one and with a lower capital to knowledge ratio (K/C).

The above examples illustrate the bearing of initial conditions on the long-term path of knowledge and product. Specifically, if the capacity to domestically absorb technical progress generated in the rest of the world is exogenous in nature, the long-term effectiveness of the policies depend crucially on the proportion of resources assigned to accumulate knowledge. The model suggests the existence of a minimum "threshold" to enable variations in the savings rate and in the rate of domestic accumulation of knowledge to have permanent effects on the product growth rate. If the percentage of resources assigned to the production of knowledge is below the minimum "threshold", the trajectory of the stock of domestic knowledge is then determined by the rate of technological innovation in the rest of the world.

Briefly stated, the central message of the model developed in the foregoing section, is that economic growth is closely related to the process of accumulating knowledge, and that this process may also be affected by economic policies adopted by the economic authority. Specifically, the model suggests that policies which stimulate technological innovation, investment in human capital and economic integration with external markets have permanent effects on the trajectory of the total product. An additional implication of the model is that the long-term effectiveness of the policies of productive development depend crucially on the fact that the process of technological innovation generated domestically not only contributes to increase the total stock of knowledge, but also has a positive effect on the capacity to absorb technical progress developed in the rest of the world. On the other hand, the model suggests that if the capacity to absorb technical progress generated in the rest of the world is exogenous, there exists a minimum "threshold" of resources that have to be assigned in order to accumulate knowledge, so as to enable policies to have permanent effects on the technological innovation process and on the product growth rate.

3. IMPLICATIONS

In general, the literature related to designing endogenous growth models suggests that the specific characteristics of the process of creating and diffusing knowledge determines that, in the absence of specific policies to promote technological research and innovation, production of knowledge will be suboptimal. On the other hand, the lack of organized markets specialized in diffusing knowledge is a source of under-utilization of the potentially available stock of knowledge and

leads to, in many cases, the implementation of policies aimed at "creating" markets organized to exchange knowledge. However, though the literature on the subject states that economic growth depends not only on the resources allotted to the production of knowledge, but also, to an important extent, on the allocation of resources among the different sectors specialized in the production of knowledge, the debate on the subject within the domain of economic policy has been neglected.

This section explores some of the issues and implications related to the model developed in the preceding section from the perspective of the design of economic development and empirical research.

3.1. The Limits of Specialization

The acceleration of the rate of technological innovation, the openness of new markets and the introduction of increasingly complex and sophisticated productive processes, have contributed to a great extent to stimulate the demand for training and account for the development of a highly specialized labor force within modern economies. On the other hand, increasingly globalized markets and shorter technological cycles, reinforce the competitive advantage based on innovation efforts and absorption of new technology and pose the challenge of developing flexible enough production, distribution and marketing systems to permit a rapid adaptation to the changes undergone by the markets and the technological setting surrounding the firms. From this perspective, the high degree of specialization of the workforce, which has characterized the process of development in modern economies, should be balanced by training programs that not only emphasize transmitting techniques and specific knowledge, but also knowledge and general skills which contribute to the development of a qualified workforce malleable enough to adapt to changes in production methods and comparative advantages faced by the countries.

Investment in human capital made by a society should respond to the needs of the productive apparatus, both in static and dynamic terms. However, liquidity constraints faced by workers and the incentive structure in the firms tend, in general, to bias the training supply in favor of specific training programs. The investment in training carried out by firms tends to concentrate on acquiring specific knowledge, as it cuts down employee turnover and increases the appropriability margin as regards the benefits accrued from training. This, in turn, has negative effects both on the level as well as on the composition of investment in human capital.

In the first place, by concentrating the supply of education in specific training programs brings about a reduction of the incentives which workers face to invest in human capital. The return on investment in human capital is determined primarily by the impact of education on the profile of real wages, which, in turn, depend on the conditions of supply and demand for a given type of specific skill. The

increasing integration of developing economies to international markets, combined with the intensification of the technological innovation processes, suggests that the uncertainty inherent to investment in specific human capital will tend to become higher over the next years and that, therefore, if there is no change in the supply structure in training, the investment in human capital will be lower than the amount of socially optimum investment.

On the other hand, investment in specific training tends to reduce the capacity of workers to adapt to changes and, therefore, it can represent an important limitation for developing countries as regards the possibility of absorbing innovations generated in those countries which lead the process of technological development. An additional cost brought about by excessive specialization is related to increasing expenditures to coordinate activities within firms. The greater the degree of specialization and heterogeneity of workers inside a firm, the lower the degree of effective communication that can be established among them and, therefore, the greater the costs to coordinate increasingly specialized and interdependent activities.

The design of a policy of productive development within Latin American economies should be based on generating conditions which encourage investment in human capital and knowledge in general and which, in addition, make it possible to balance the benefits that accrue from specialization with the costs it brings about in terms of greater coordination requirements and lower adaptive capacity to changes in the technological setting. On the supply side, this involves expanding the time span devoted to general education at schools and to emphasize the provision of knowledge that develops creativity, analytical capacity and ability to "learn how to learn". On the demand side, this involves concentrating the subsidy to training on the workers who, ultimately, receive the main benefits of general training. The usual practice of encouraging investment in human capital, by entitling firms to discount the amounts spent in training from taxes, allows firms to decide on the investment and content of the training program, which in most cases involves a level of investment that is suboptimal and biased to specific training.

3.2. The Debate on Quality Versus Coverage

It is often argued that expanding the coverage of the school system, at the level of both primary and secondary education, represents a central element to a policy of productive development that makes it possible to ensure compatibility between the objectives of efficiency and equity. The recommendations made to developing countries, by specialized agencies, and a review of evidence in relation to the allocation of public spending in education in these countries, confirms the importance attached to expanding the coverage of the school system in the design of economic development policies.

However, internal technical progress and the capacity to absorb technological innovations generated externally depend not only on the primary educational system's coverage, but also, and primarily, on the quality of education. From this perspective, the policies aimed at promoting technological innovation and creation of knowledge within a society, should balance the expansion of the educational system's coverage with specific policies encouraging investment in quality.

The argument that it is needed to concentrate resources in primary and secondary education and to prioritize expanding the coverage of the school system is based on evidence from different studies on returns to education, which consistently show that the social return to education tends to diminish as we move up in the educational pyramid. However, these results are based on comparing returns by type and level of education which do not control for differences in quality of education which, in general, implies that the traditional methods in estimating returns to education tend to overestimate the social outcome associated with expanding coverage at the primary level. This may bring about, as it is shown below, several problems from the perspective of an educational policy which aims at establishing compatibility between the objectives of efficiency and equity.

In the first place, the limited studies available suggest that the return to investment in quality of education is, in general, higher than or at least similar to the return associated with increases in years of schooling. This implies that, from an efficiency perspective, the conventional criterion prioritizing the expansion of the school system's coverage should be balanced by the creation of programs encouraging the improvement in the quality of education.

Second, if aspects related to expanding coverage at the base of the pyramid of the school system are emphasized, the educational policy can not only be inefficient from the standpoint of allocating public resources, but also inconsistent with the objectives of promoting equity and equal opportunities. In most developing countries, inequalities in income distribution do not depend exclusively on inequalities in opportunities to have access to primary and secondary education, but also, and to an important extent, on differences in the quality of education which different groups within a society may have access to. From an efficiency and equity perspective, public spending in primary and secondary education, should concentrate subsidies among the most needy sectors and encourage schools to invest in quality. Incentives on the supply side, involve, as a necessary condition, developing suitable mechanisms to measure and evaluate the final product turned out by the educational system. On the side of the demand, subsidies or education coupons given to low income families should be complemented with massive diffusion programs regarding the educational alternatives available in terms of the quality of the schools. In this sense, administering instruments to measure the quality of education provided at the different schools, allows achieving compatibility between subsidies on the supply side and those on the demand side.

Third, the inclusion of elements associated with the quality of education in designing educational policies may eventually generate a conflict between the objectives of efficiency and equity. Specifically, if the social return associated with investing in projects aimed at improving the quality of education is higher than the return to projects intended to expand the coverage of the school system, it would be preferable, from an efficiency perspective, to concentrate resources in order to strengthen the system and improve its quality, which could eventually have a regressive impact on income distribution. When implementing reforms to the educational system, the potential conflict between efficiency and equity should be made explicit, in order to ensure a transparent evaluation of costs and benefits related to the different programs which make up the educational policy, and facilitate the application of compensatory programs when needed.

Finally, the criterion of allocating subsidies to education, on the basis of returns which do not control for differences in quality of education, tend to overestimate the productivity gains associated with expanding coverage in urban areas with respect to urban ones. The differences in returns to education across different regions and, therefore, the traditional criteria in allocating public spending involve, in general, suboptimal levels of investment in education in rural areas and an excess of investment in urban ones. The optimal policy which permits establishing compatibility between objectives aiming at efficiency and equity, require focalizing public spending in education in areas and sectors featuring greater deficiencies in terms of quality of education. The policies based on the observed return to education tend, in general, to underscore inequalities and do not necessarily imply a greater efficiency in allocating resources in relation to better focalized policies.

To sum up, quality of education plays a fundamental role in human capital accumulation and its inclusion in designing a coherent economic development strategy makes it indispensable to ensure allocating public spending that is consistent with promoting growth and equity.

3.3. Empirical Research and Comparativeness between Countries

The new literature on endogenous economic growth suggests that there are several mechanisms whereby economic policies can affect the product growth rate. The validation of some of these hypotheses and the quantification of the impact of the policies on the long-term trajectory of the product have encouraged the development of an extensive and broad empirical literature.

The starting point for most of these studies is associated with the estimation of an equation of the form:

$$\hat{Y} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k$$

where the vector (X_1, \dots, X_k) summarizes the long-term determinants of the product growth rate. In these works the sign and statistical significance of the coefficients are used as a validation criteria for some of the hypotheses regarding the relationship between the policies and economic growth.

This procedure which is widely used in the literature implicitly assumes that there is a monotonic relationship between the vector of explanatory variables and the product growth rate. However, if the magnitude and even the sign of the relationship between the explanatory variables and the product growth rate, depend on the initial conditions, the estimated parameters will be biased and the criteria to validate the relevant hypotheses are not valid.

The model developed in this paper suggests the existence of non-monotonic relationships between economic growth and policy variables. The impact of the policies on the trajectory of the product may differ significantly across countries, both in terms of their magnitude as in the degree of their persistence in time. This means that the evaluation of the impact of the policies on economic growth has to be based on a detailed analysis of the initial conditions of each country and that the generalizations arising from cross-section studies ought to be taken with caution.

4. SUMMARY AND CONCLUSIONS

This paper represents a preliminary attempt to address some of the issues and implications which arise in defining a minimal frame of reference for the design of a coherent economic development policy within the context of an economy integrated to international markets. To do so, the second section puts forth a model which serves as an analytical framework to study the relationship between economic growth and knowledge, and additionally to examine the mechanisms through which economic policies can alter the process of knowledge accumulation. Next, the third section examined some of the issues and implications related to the model from the perspective of the design of economic development and empirical research. The main conclusions may be summarized as follows:

1. The composition of spending within the educational system should balance the existing comparative advantages with those that may be developed over time. Comparative advantages are essentially dynamic and can be altered by policies related with the allocation of resources in education and technological research.
2. The capacity to absorb technological innovations developed in the rest of the world and adapt it to changes in the technological setting, depend on the existence of a workforce that is malleable and flexible enough. From this perspective, the high

degree of specialization which has characterized the development of modern economies should be balanced by the development of general knowledge and skills.

3. The advantages accruing from the expansion of the educational system's coverage should be balanced by specific policies directed at promoting the improvement in quality of teaching and training programs.

4.- The relationship between economic policies, technological innovation and economic growth is not unique and depends crucially on the initial conditions associated with the degree of openness, the capacity to absorb technical progress generated in the rest of the world and the characteristics of knowledge generated domestically.

REFERENCES

- AZARIADIS, C. and A. DRAZEN (1990): "Threshold Externalities in Economic Development," *Quarterly Journal of Economics* Vol. 105, pp. 501-526.
- BARRO, ROBERT J. and XAVIER SALA-I-MARTIN (1994): "Quality Improvements in Models of Growth," NBER Working Paper 4610.
- GROSSMAN, G. and E. HELPMAN (1990): "Trade, Innovation, and Growth," *American Economic Review*, Vol. 80, 796-815.
- LUCAS, R. (1988): "On the Mechanics of Economic Development," *Journal of Monetary Economics*, Vol. 22, 3-22.
- MUJICA, P. and J. QUIROZ (1992): "Los determinantes del crecimiento económico y los problemas de equivalencia observacional", *Cuadernos de Economía*, (Chile), año 29, 307-328.
- ROMER, P. (1986): "Increasing Returns and Long Run Growth," *Journal of Political Economy*, Vol. 94, 1002-1037.
- (1989a): "Human Capital and Growth: Theory and Evidence," NBER Working Paper 3173.
- (1989b): "What Determines the Rate of Growth of Technological Change?," World Bank PPR Working Paper 279.
- SCHMITZ, J. (1989): "Imitation, Entrepreneurship, and Long Run Growth," *Journal of Political Economy*, Vol. 97, 721-740.
- STOCKEY, N. (1988): "Learning by Doing and the Introduction of New Goods," *Journal of Political Economy*, Vol. 96, 701-717.