# A simplified endogenous economic growth model with social capital: Evidence for Ecuador

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**Abstract:** The paper presents a simplified economic growth model with social capital, as an alternative for sustained long-term growth. The intuition behind the model suggests its application for developing economies that historically have focused their attention on the accumulation of physical capital and not on endogenous factors such as human capital and social capital. The model is considered as a Cobb-Douglas production function that includes three types of capital: physical, human and social. From the model, we obtain evidence from estimates for the Ecuadorian economy in the period 1980-2015, which underlie the main endogenous sources regarding physical capital. As a result, some policy implications are highlighted.

## 1. Introduction

The discussion on economic divergence between countries, generally from the same region, has aroused the interest of economics in analyzing and explaining the growth of both, developed and developing countries, and in this way, to be able to establish the preponderant factors of the existing socio-economic gap between them. As an alternative to the neoclassical theory led by Solow (1956) and Swan (1956), the "new theory" of growth, often called as an endogenous theory of economic growth, has emerged. This theory is relevant for developing countries because it addresses the growth from a 'within' perspective, that is through endogenous determinants. The theoretical basis of the models related to this theory (e.g. Romer, 1986; 1990; Lucas, 1988; Barro, 1990; Grossman & Helpman, 1991; Mankiw, Romer, & Weil, 1992) emphasizes on long- term growth defined within model and not by exogenous variables, as in Solow (1956). According to Argandoña, Gámez, & Mochón (1997), the origin of this new theory was motivated because of the dissatisfaction of the exogenous explanations of productivity growth in long term. This gave rise to models in which the determinants of the growth were endogenous, for example the externalities of capital through the processes of learning-by-doing or knowledge-spillovers, human capital, R&D, public expenditure and taxes, social capital, local development processes[1], etc.

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[1] According to Terluin (2003), in theories governing local environment models, factors in the local environment, such as workforce skills, organizational skills, knowledge and social and institutional structures, will affect income from the contributions of capital and labor.

According to Dornbusch & Fischer (1995), endogenous growth models try to determine the growth rate by itself; i.e., by keeping back benefits obtained from development in the same production function through externalities. Defenders of this theory base their ideas on the fact that the economic policy of governments and their economic behavior, in more general terms, must be able to influence the long-term growth rate and, therefore, look for theories that allow this to happen. In that sense, the idea of endogenization variables is crucial for the sustained growth of an economy that needs to depend on itself, as the case of developing countries. In this context, Romer (1986; 1990), Lucas (1988), Barro (1990) suggest the use of factors such as physical capital, human capital and State interventionism through public spending and taxes. On the other hand, recent literature (e.g. Dakhli & De Clercq, 2004; Gwartney, Holcombe, & Lawson, 2004; Dias & Tebaldi, 2012) has suggested the inclusion of 'social capital'[1] as a determinant of economic growth. This factor has not yet been fully extended and formalized in the literature of economic growth and, therefore, there is still no clear consensus in the predictors of this factor. The latter is mainly due to the fact that the individual returns of the social capital proxies are poor predictors of aggregate externalities (Durlauf & Fafchamps, 2005).

Regarding the importance of physical capital in the models of this new theory, it has been emphasized that it is a very strong predictor of economic growth and, with its accumulation, the basis of sustained future growth (e.g. Sequeira, 2011; 2012; Turner, Tamura, Mulholland, 2013; Li, Wang, Westlund, & Liu, 2015; Leimbach, Kriegler, Roming, & Schwanitz, 2017). According to Romer (1986), the increase in the capital stock of companies (through investment), besides increasing their own production, it also increases the companies that surround it, since the knowledge acquired by the organizations engaged in these investments can be used by others. In addition, Lucas (1988), in contrast to the neoclassical models of capital yields, argues that, despite the decreasing returns of the accumulation of physical capital, when human capital remains constant, returns on all capital reproducible (human plus physical) are constant[2]. In this perspective, the theory of endogenous economic growth has explored the possibility that combined accumulation of physical and human capital is enough to sustain growth in the long run. Both types of capital can be accumulated by investing in physical capital and by investing on education and training, respectively (Blanchard, 2006).

Mankiw et al. (1992) argue that the explicit inclusion of human capital in a neoclassical model may explain some of the phenomena, such as long-lasting differences in growth rates, which were considered to require endogenous growth models. For Romer (1986), the first endogenous source of growth can be understood as the positive externalities linked to the investment of physical capital and the accumulation of knowledge. Lucas (1988) focuses on the analysis of human capital as a preponderant factor behind the growth of countries through the approach of externalities from the accumulation of human capital, which, as mentioned above, reinforce the productivity of physical capital and make the economy grow steadily. To do this, it proposes two forms of capital accumulation: 1) through the learning by doing processes; and, 2) as the product of the formal education of the labor force. By their characteristics, these two forms of human

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[1] Social capital refers all the rules and relationships that facilitate collective action; that is, the interaction between individuals and different types of institutions (Coleman, 1988; Portes, 1998). In this regard, the World Bank suggests as a concept that, "social capital refers to the institutions, relationships and norms that make up the quality and quantity of social interactions in a society. (...)".

[2] The model assumes that human capital depreciates at the same rate as physical capital (Mankiw et al., 1992).

*Business and Economic Horizons*

capital accumulation will inevitably take time. According to Dornbusch & Fischer (1995), education is the slowest but possibly the most powerful growth factor. Extensive literature (e.g. Fleisher, Li, & Zhao, 2010; Tsai, Hung, & Harriott, 2010; Zhang & Zhuang, 2011) has made use of proxies related to education form estimating a nation's economic growth and human capital on economic growth.

On the other hand, in the framework of endogenous economic growth, studies such as Dinda (2008), Roseta-Palma, Ferreira-Lopes, & Sequeira (2010), Sequeira & Ferreira-Lopes (2011), have proposed models than include the effect of social capital forms on economic growth. They have generally identified many plausible externalities connected to social capital in factors such as natural, human and physical capital. Following Woolcock (1998), social capital is defined as those rules and relationships that facilitate collective action. In the "new economic sociology", this concept arises to complement the accumulation of physical and human capital within a framework in which the economic system is solved from inside. According to Hall, Sobel, & Crowley (2010), the accumulation of physical and human capital lead to product growth only in cases of good institutions (social capital).

Investment in social capital creation is a powerful and useful component for growth (theoretically); however, the poor prediction referred by Durlauf & Fafchamps (2005) would have an explanation in its highly problematic identification, since it is hidden in classical sociological concerns as that: a) the nature and linkage of social relations vary within and between different institutional sectors; b) the tasks performed by these relations necessarily change as the economic exchange becomes more sophisticated; and c) that both "too little" and "too much" social capital at any institutional level can impede economic performance (Woolcock, 1998).

Amin (1998) emphasizes the processes of institutionalization as a way for stabilizing the economy which lacks equilibrium and is imperfect as well as irrational. Similarly, Vázquez (2007) argues that the development of an economy is influenced by the type of institutions that exist within it. It is due to actors or economic agents making their investment and location decisions in an organizational and institutional environment. Evidence for social capital proxies has highlighted the role of institutions (e.g., Rodrik, Subramanian, & Trebbi, 2004; Glaeser, La Porta, Lopez-de-Silanes, & Shleifer, 2004; Gwartney et al., 2004; Dias & Tebaldi, 2012); economic liberties, through the variable democracy (e.g., Barro[1], 1996; Doucouliagos & Ulubaşoğlu, 2008); and confidence (e.g., Knack & Keefer, 1997; Whiteley, 2000) in the development of the economy. Casey & Christ (2005) and Sequeira & Rodrigues (2009), using composite indexes of social capital have reached different conclusions regarding the literature mentioned above. Although it is true that social capital proxies are not good predictors of economic performance (despite their statistical significance), Casey & Christ's study has shown that, in the presence of controls such as physical and human capital, social capital does not have statistical significance and, therefore, does not explain economic performance. Similarly, the study by Sequeira & Rodrigues (2009) shows that the social infrastructure index has no significance after the inclusion of some human capital variables, related mainly to health.

Vazquez (2007) considers that the new theory has a more complex vision of the capital accumulation process, and the territorial economic development policies are those which allow civil society to play a leading role in the definition and execution of the future of the economy.

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[1] Barro argues the existence of a nonlinear relationship between economic growth and democracy.

Under these considerations, the purpose of this paper is to design a simplified model that strictly considers the main sources and mechanisms of endogenous economic growth, sustainable in the long term. The article is organized in four sections that include: the description of the endogenous growth model (in the second section); then, the analysis of the proxies of physical, human and social capital for the application of the model in the Ecuadorian economy and the results of the estimations; and finally, a brief discussion and conclusions of the research is presented.

## 2. Methodology

The endogenous model of economic growth is an extension of the neoclassical model of Solow (1956) and Swan (1956), also, an extension of the Barro model (1990) of public expenditure and taxes[1]. For this purpose, as the basis, it is considered the national income identity where GDP, $Y_t$, is formed of: private consumption ($C_t$), which represent the purchases made by households for themselves; investment ($I_t$), which are the physical capital purchases made by companies to be able to operate in the market; the public expenditure ($G_t$) that are the outflows of money by the government for public investment; and finally, net exports ($NX_t$), which is the rest of the production marketed by the country's external sector (exports and imports). This is:

$$Y_t = C_t + I_t + G_t + NX_t \tag{1}$$

As indicated (1), the term on the left, $Y_t$, is the supply of the economy; and, the terms on the right refer to aggregate demand.

**First assumption:** to have the desired long-term effects in the model, it must have a balanced trade equal to zero, which reduces the effects of the external sector on economic growth, so that it is possible to focus the analysis on endogenized factors such as physical, human and social capital. Thus, the national income identity eliminates net exports that represent a variable whose profits are not directly retained in the same economy through externalities. In addition, it is assumed that each country in the world produces the same homogeneous commodities.

**Second assumption:** according to Barro (1990), the government can influence the economy. The model incorporates the government participation through the contribution of public capital, destined to incur expenses ($G_t$) in the level of qualifications ($H_t$) of human capital, which is another determinant factor of production from the point endogenous view[2]. Romer (1986; 1990) and Lucas (1988) emphasize this factor by considering it as the main determinant for the economy to grow steadily (in the long run). This assumption aims at analyzing the scope of investment - public - in "H" to contribute to economic growth (e.g., Pierre-Richard, 2011). Therefore, the identity remains as:

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[1] The methodological detail of the Solow-Swan model and the Barro model is detailed in Sala-i-Martín (2000).
[2] The level of qualifications of human capital includes all those aspects that allow to strengthen the workforce: education, health, work environment, technological infrastructure, etc.

$$Y_t = C_t + I_t + G_t \tag{2}$$

This identity implies that product is distributed to consumers, investors and the government. In that sense, the endogenous production function considers three fundamental factors such as: labor $(L_t)$, physical capital $(K_t)$ and, skill level $(H_t)$; so that:

$$Y_t = F(K_t, H_t, L_t) \tag{3}$$

Considering that the objective of this research is to analyze the impact of $K_t$ and $H_t$, we subtract (2), in both terms, *private consumption and taxes*, so we have:

$$Y_t - C_t - T_t = S_t^d = I_t + G_t - T_t \tag{4}$$

Where $S_t^d$, is the private savings available, which in turn equals:

$$S_t^d = Y_t - C_t - T_t \tag{5}$$

A person consumes a part of his income, $c$ (marginal propensity to consume) and the difference is destined for saving, $s$ (marginal propensity to save). Therefore, consumption is $C_t = cY_t$; which is equal to $C_t = (1 - s)Y_t$. In addition, the collection of taxes varies with income; that is: $T_t = \tau Y_t$. Thus, private saving $(S_t^d)$ is as follows:

$$S_t^d = Y_t - (1 - s)Y_t - \tau Y_t = (s - \tau)Y_t \tag{6}$$

On the other hand, *private consumption* would be given by:

$$C_t = [(1 - s) - \tau]Y_t = [1 - (s + \tau)]Y_t \tag{7}$$

That is, a person consumes a part of his income and rest is destined for saving, Then, for this consumption, consumers must pay taxes $(T_t)$ in certain goods and services, which represents the government's financing to make the respective public expenditure $(G_t)$. This remains as (7); i.e.:

$$C_t = (1 - s)\, Y_t - \tau Y_t = [1 - (s + \tau)]Y_t \tag{7}$$

In (4) it was obtained that $S_t^d = I_t + G_t - T_t$. Dumping $I_t$, we have:

$$I_t = S_t^d + (T_t - G_t) \tag{8}$$

Being $(T_t - G_t)$ the public saving or State budget.

**Third assumption:** balanced government budget. The assumption implies that the amount of money collected by the State is equal to its level of public investment (in human capital); that is: $T_t = G_t$.

**Fourth assumption:** from the above assumption a transcendental fact emerges. It responds to the optimal size of the government. Despite State could dedicate investment to productive facts in economic terms, the effect of taxes can be distorting for investment, which devotes its efforts to the accumulation of physical capital.

Now the inversion is: $I_t = S_t^d$; therefore, substituting (6) into (8) we have:

$$I_t = (s - \tau)Y_t = sY_t - \tau Y_t \tag{9}$$

This implies that investment $(I_t)$ made by the companies is equivalent to the savings realized from a part of the income $(sY_t)$, less taxes paid to the State from another portion of the income $(\tau Y_t)$, as a contribution to public spending $(G_t)$. The investment made by the companies is allocated to the physical capital $K_t$; however, the cost of depreciation of all physical capital $D_t = \delta k_t$ must also be considered. Thus:

$$I_t = K_t + \delta k_t \tag{10}$$

Public spending $(G_t = \tau Y_t)$ carried out through a balanced State budget, for investment in the level of qualifications of human capital $(H_t)$, plus its depreciation $(D_t = \delta H_t)$, is:

$$G_t = H_t + \delta H_t \tag{11}$$

Where "$\delta$" represents the depreciation ratio of either, physical capital units or human capital units. Transforming the production function shown in (3) in per capita terms must:

$$y \equiv Y_t/L_t \ = \ F(K_t, H_t, \ L_t)/L_t \ = \ F(k, h, 1) \ \equiv \ f(k, h, 1) \qquad (12)$$

Expressing (12) in a Cobb-Douglas production function, we obtain that:

$$y = k^a h^\lambda \qquad (13)$$

As indicated, Lucas (1988)[1] assumes that, despite of the decreasing returns of the accumulation of physical capital, when human capital remains constant, the yields of all the reproducible capital (human plus physical) are constant[2]. That is, physical capital can be considered as an endogenous factor of production, especially if the State can encourage savings and investment in the private sector to support the creation of new capital.

Evidence supports the idea that investment in human capital, education and training tends to increase the rate of growth, at least during a transitional period. For this reason, the decisions of the governments are fundamental on how to use the limited resources that they have at their disposal for investment in this type of capital. Even if they had sufficient financial resources, it would take years to form the group of teachers needed to disseminate education and training (Dornbusch & Fischer, 1995). For Larroulet & Mochón (1995), knowledge is a semi-public good, and therefore requires government policies that contribute to the optimum research and development efforts in society. Growth will inevitably take time, since the accumulation of factors of production is very slow.

**Fifth assumption:** technological progress is endogenized in the long term as a function of the accumulation of human capital[3]. In contrast to the standard neoclassical models, and as observed in (11) and (12), the model does not include preliminarily the technological progress factor ($A_t$), because it is principally, an exogenous variable and thus, it increases even though if no member of the economy dedicates efforts or resources to make this happen and it is incorporated into human capital. In addition, it is a "non-rival" good, which implies that it is within the reach of any economy without the need to have to prevent one of them from consuming it by the use of another. In the long term, the accumulation of human capital through public investment (11) can generate processes of technological progress that improve productivity levels according to the needs of the productive sector.

**Sixth assumption:** inclusion of the social capital factor as a solution to economic imbalances. In line with the endogenous theory of economic growth (e.g., Dakhli & De Clercq, 2004; Gwartney et al., 2004; Dias & Tebaldi, 2012), it has been thought desirable to incorporate the social capital factor (13) - whose externalities affect economic

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[1] Lucas (1988) focuses on human capital analysis as a preponderant factor behind the growth of countries. It considers two factors of production, human and physical capital. It posits the existence of externalities from the accumulation of human capital, which reinforce the productivity of physical capital and make the economy grow steadily.

[2] The model assumes that human capital depreciates at the same rate as physical capital (Mankiw *et al.*, 1992).

[3] The reason why we do not include technological changes (progress) within the model is because it is assumed to be an endogenous variable in the long term.

development - and, through this, the effect of institutionality, as a variable of stability of the economy.

The institutional theme is an element of convergence between the new theory of growth and the theory of economic development. In that sense, recognizing the importance of the institutional framework in growth implies accepting the importance of government intervention by ensuring compliance with agreements, contracts, property rights and regulation of market functioning when there are obvious market failures. Consider that endogenous growth models recognize that there are defects in coordination between private actors and that this hinders the achievement of a social optimum. The purpose of this assumption is to establish the necessary conditions to improve the coordination of the actors involved in the economy and to allow their sustained economic growth.

Accordingly, expressed in a production function of Cobb-Douglas, the model of endogenous economic growth, after incorporation of social capital in (13) is given by:

$$y = k^a h^\lambda \chi^{\eta = f(h)} \qquad (14)$$

Where $\chi$ represents the social capital or institutionality of the economy and $\eta$, the importance of the externality. As can be seen, the coefficient of social capital is a function of (among other factors) the accumulation of human capital that is supported by the government in this model. In conclusion, long-term economic growth is a function of physical capital, human capital and social capital (institutionality).

## 3. Empirical application of the model

This section analyzes the data used for the empirical application of the simplified model of endogenous economic growth with social capital. For this purpose, it has been considered to provide empirical evidence for Ecuador through different estimates that capture the effect of time on each of the proxies' variables of physical, human and social capital that have been used. It should be noted that due to available information (scarce in human capital), the analysis of the data, as well as the estimates, made date from the period 1980-2015. Information has been compiled from the World Bank (2017) [gross national income (GNI), gross fixed capital formation (GFCF), students enrolled in secondary education[1] and population] and from the Center of Systemic Peace (2017) [index of institutionalized democracy[2]].

### 3.1. Data analysis

Figures 1 and 2 show the direct relationship of the physical and human capital accumulation with the Ecuadorian income, according to what the economic literature suggests. The elasticities of each of these factors appear to be very similar, probably with

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[1] Evidence such as that of Chatterji (1998) and Zhang & Zhuang (2011) suggests that tertiary education plays a more important role than primary and secondary education in economic growth; however, for the case of Ecuador, time series for this variable (or similar) is scarce.

[2] The first index goes from 0 to 10, where 10 indicates a high institutionalized democracy in the country.

superiority in the case of the human capital proxy and suggest a positive and more than a moderate correlation.

FIGURE 1.  RELATIONSHIP BETWEEN LOGARITHM OF GNI PER CAPITA
AND LOGARITHM OF GFCF PER CAPITA, 1980-2015
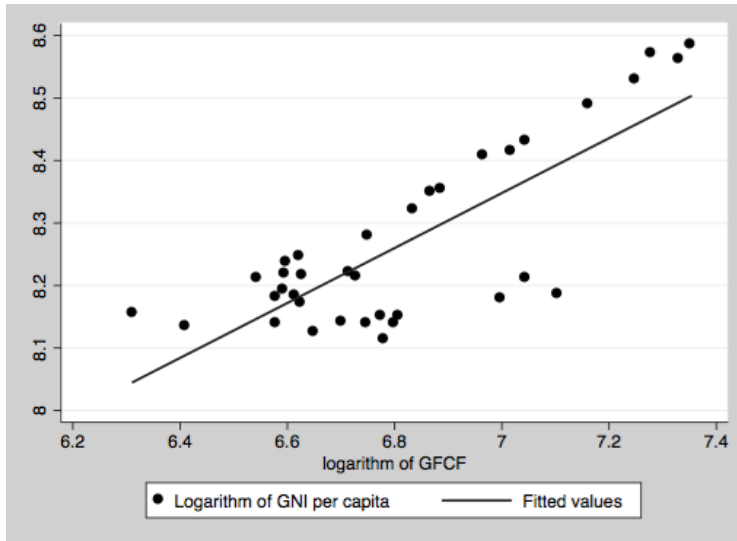


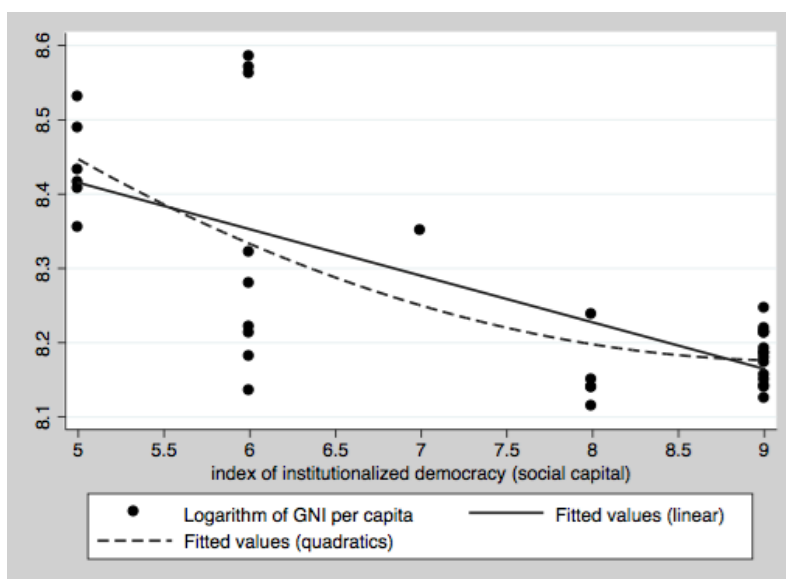Source:  Authors, with data from the World Bank (2017).

FIGURE 2.  RELATIONSHIP BETWEEN LOGARITHM OF GNI PER CAPITA AND
THE LOGARITHM OF "SECONDARY EDUCATION" 1980-2015
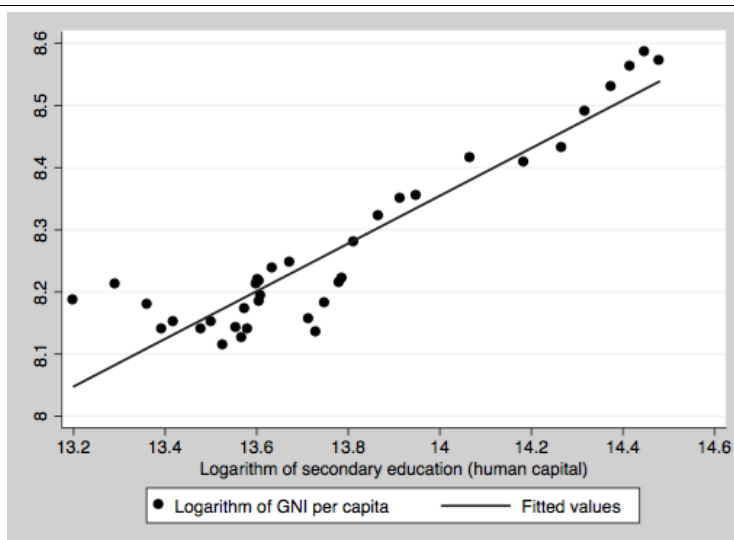


Source:  Authors, with data from the World Bank (2017).

In the case of Figure 3, a weak negative correlation between the institutionalized democracy index and the per capita gross national income of the Ecuadorian economy can be evidenced. According to Durlauf & Fafchamps (2005), this situation was to be expected because the individual return of the proxies used to measure the accumulation of social capital is poor predictor of aggregate externalities. On the other hand, it is worth recalling the evidence shown by Barro (1996) regarding the nonlinear relationship (inverted U-shape) between these two variables, in which, in the first instance, a democratic environment is positive for the development of private initiative, but beyond a certain point can result in redistributive pressures that compromise the political stability of the country.

FIGURE 3. RELATIONSHIP (LINEAR AND QUADRATIC) BETWEEN THE LOGARITHM
OF GNI PER CAPITA AND THE INSTITUTIONALIZED DEMOCRACY INDEX, 1980-2015



Source: Authors, with data from the Center of Systemic Peace (2017).

Theoretically, what is happening for Ecuador during the study period is that, a very democratic environment generates a negative growth for the economy. The quadratic relation (this time, in the form of "U") does not seem to have transcendence. However, if a longer time series of each of these variables is used, a strong non-linear, inverted "U" - shaped relationship is possible. The figures of the correlation between the income of the economy and its possible endogenous sources of growth provide a first guideline that both physical capital and human and social capital could explain long-term endogenous economic growth for the case of the Ecuadorian economy.

### 3.2. Estimations results

For the estimates, the Gross National Income per capita (calculated with the population variable) was used as the dependent variable. The regressors were the gross fixed capital

formation per capita (proxy of physical capital), students enrolled in secondary education (human capital) and an index of institutionalized democracy (social capital). The results show the elasticity of physical and human capital, since the logarithms of both the dependent variable and the two endogenous sources of capital were used. In the case of social capital, the relationship would be log-lin. In addition, except for social capital, which is an index ranging from 0 to 10, stationarity treatments were performed through first differences. To analyze possible interactions, three variables were constructed through products between paired combinations of endogenous factors.

Table 1 presents the results of the main estimates for the proxy variable of the economy as a dependent variable and the proxies of the endogenous sources of capital as independent variables. The methodology used was based on estimates with robust Ordinary Least Squares (OLS).

## TABLE 1. ROBUST OLS ESTIMATES FOR THE LOGARITHM OF GROSS NATIONAL INCOME PER CAPITA[1]

| Variable | [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|---|
| L5.ypc | -0,2071* | -0,1911 | -0,1996 | -0,2175** | -0,2337** | -0,2191* | -0,2268* |
|  | (0,1183) | (0,1304) | (0,1219) | (0,1045) | (0,1035) | (0,1125) | (0,1106) |
| CFpc | 0,2610*** | 0,4440* | 0,2602*** | 0,1745*** | 0,2504*** | 0,1819** | 0,2598** |
|  | (0,0321) | (0,2148) | (0,0333) | (0,0474) | (0,0300) | (0,0798) | (0,0983) |
| L3.HC | 0,2101* | 0,2094* | 0,2072* | 0,2064** | 0,1930* | 0,2048** | 0,2095 |
|  | (0,1082) | (0,1092) | (0,1095) | (0,0909) | (0,0960) | (0,0992) | (0,1350) |
| SC | 0,0123** | 0,0376 | 0,0177 |  |  |  |  |
|  | (0,0052) | (0,0313) | (0,0173) |  |  |  |  |
| L1.SC | -0,0119** | -0,0370 | -0,0178 |  |  |  | -0,0024 |
|  | (0,0055) | (0,0312) | (0,0194) |  |  |  | (0,0046) |
| CFpc*SC |  | -0,1752 |  | 0,0794* |  | 0,0718 |  |
|  |  | (0,2031) |  | (0,0391) |  | (0,0784) |  |
| HC*SC |  |  | -0,0384 |  | 0,0739* | 0,0075 |  |
|  |  |  | (0,1164) |  | (0,0364) | (0,0720) |  |
| CFpc*HC |  |  |  |  |  |  | -0,0361 |
|  |  |  |  |  |  |  | (0,1082) |
| _cons | 0,0024 | 0,0007 | 0,0076 | 0,0059 | 0,0040 | 0,0057 | 0,0243 |
|  | (0,0200) | (0,0201) | (0,0275) | (0,0051) | (0,0053) | (0,0049) | (0,03081) |

Source: Authors, with data from the World Bank (2017) and the Center of Systemic Peace (2017).
Note: ***p<0,01; ** p<0,05; p<0,1. No mark on the coefficients implies that the variable is non-significant. () represents robust standard errors.
Notation: ypc= Gross National Income per capita (in logarithms); CFpc= Gross capital fixed formation (in logarithms); HC= human capital (students enrolled in secondary education, in logarithms); SC= social capital (index of institutionalized democracy); CFpc*SC represents the interaction of physic and social capital variables; HC*SC is the interaction of human and social capital variables; CFpc*SC, the interaction of physic and human capital variables; and, L term represents the number of lags used.

[1] Estimates were made for per capita gross national income (in logarithms) with each of the endogenous sources of growth (separately), obtaining as results that: the variables of physical capital and social capital were significant for a α = 0.05 [for physical capital p <0.01]; meanwhile, for the human capital variable (students in secondary education), the coefficient was not significant, the latter variable responds better to a third lag, as shown in Table 1. There is also no evidence regarding the nonlinear relationship (quadratic) between the dependent variable and social capital.

To reach the results displayed in Table 1, estimates were made with lags of the variables; those lags that were the most significant for each of them were determined. By using an autoregressive process, it has been shown a negative effect of five lags of GNI on the economic performance of Ecuador. Then, the short-term importance (positive effect) of the accumulation of physical capital in the growth of the Ecuadorian economy is verified. This does not happen in the case of human capital, which, as Dornbusch & Fischer (1995) points out, is a slow growing factor, but very important for economic performance. Inevitably the educational process takes time to be determinant in economic growth; despite being a gradually accumulating factor, is likely to be the most powerful in developing economies.

In the case of the interest factor (social capital), highlights the statistical significance of a lag of the institutionalized democracy index, based on the relationship found in Figure 3; this is in [1]. However, with the inclusion of other controls, specifically interactions, this significance disappears. It should be noted that, for the Ecuadorian case and mainly during the period of study, the non-existence of a non-linear relationship and even less of an inverted "U" form, was demonstrated.

On one hand, results show that the effects of human capital are very similar to the effects of physical capital, with the difference of the temporality in the effect. The first one affects the economy in the medium term and the second one, in the short term. On the other hand, the type of democratic environment marks the pattern, also in the short term, of the economic performance of Ecuador. An interesting fact is that, omitting the variable of social capital as control in the estimates, and including it in the interactions with both physical capital [4] and human capital [5], these reach significance at a level of $\alpha = 0, 10$. This does not happen in any of the scenarios in which the interaction of physical capital and human capital is included. This leads us to think about the importance of the accumulation of social capital in the creation of incentives for the accumulation of physical and human capital, which, in turn, are the most powerful predictors of the behavior of the Ecuadorian economy.

## 4. Discussion and conclusions

The endogenous economic growth model presented here is a simplified extension of the neoclassical production function (Cobb-Douglas type), since it is part of the same initial methodology of the Solow (1956) and Swan (1956) models, and it extends towards a mathematical analogy of the Barro (1990) model that considers public spending and taxes. From the endogenous perspective, and considering the important role played by the social capital factor in the creation of incentives to generate economic growth, it is considered preponderant from the normative part that the State intervene in the economy as a corrector of the imbalances that are proper of economies; all through the promotion of local development, with policies that allow the endogenization of the effects of factors of production and that are not distorting the accumulation of both physical capital and human capital.

When speaking of local development, reference is made to factors such as the provision of technical and organizational labor skills and social and institutional structures that affect income from capital and labor inputs. Models of development or local environment are part of this group of models of endogenous growth and development (Terluin, 2003). In other words, local development models become a complementary response and alternative to regional or national development, due to new challenges that local

*Business and Economic Horizons*

administrations will face to respond to the needs and territorial problems that are continuous and constant (Calvo, 2009).

From the perspective of Vázquez (2007), the model that arises in the present investigation, not only should be considered as a model of endogenous economic growth, but also as one of endogenous development. Vázquez differentiates the growth models from the development ones in which the latter integrate the growth of production in the social and institutional organization of the territory, in which it adopts a territorial and non-functional vision of the processes of growth and structural change, in which understands that the mechanisms and forces of development act synergistically and condition the economic dynamics, fact that is considered in the simplified modeling of research, through social capital.

The State in the model plays the role of corrector of socioeconomic imbalances with policies of endogenous development, whose main function is to act as a catalyst for the mechanisms and forces of development, that act on the accumulation of physical capital and human capital, to through local initiatives[1]. The synergistic effect between social capital (driven by the State) and physical and human capital takes great importance in the analysis of the model. As it was argued in the model's approach, for growth to be sustained over the long term, direct intervention by the government in the accumulation of human capital is of vital importance. This implies, not only in an accumulation of knowledge through the benefits of education, but also in an accumulation of integral human capital that encompasses quality health for the work factor and its welfare, in general terms. In the same context, physical capital has been included in the analysis of the endogenous capital model through private investment, considering the existence of a State that first encourages private saving and, thus, private investment in physical capital; that is, if physical capital is endogenous.

Consider that the model poses the intervention of the State for the accumulation of human capital through public spending, which can be done, among other sources, through tax revenues. So, it is necessary that the government avoids distortions in the economy due to the tax burden on the business sector. Ergo, that the State is able to reduce the consumption rate and encourage the increase in the rate of savings for investment, without affecting, as far as possible, the economic agents, or the government coffers that will promote the accumulation of human capital. With these conditions, the accumulation of physical and human capital would be guaranteed and, with it, the economic growth of the nation. In a more general context, social capital turns out to be the control and efficiency factor of the model that generates positive externalities for physical capital and human capital and creates the necessary conditions for sustained endogenous economic growth.

As has been emphasized in this research and as the empirical evidence shows, the main endogenous source is human capital. Following Romer (1986), the companies that invest also acquire experience or knowledge through learning by doing and knowledge spillovers. These externalities of capital also allow the accumulation of human capital, a factor whose effects are perceptible in the long run. One of the characteristics of human capital is 'knowledge', which is growing. It is not a factor that can be stagnated within a production function and its externalities, which can be considered infinite, are important in the

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[1] According to Vázquez (2007), local initiatives include business development and the creation of business networks, promote the diffusion of innovations and knowledge, improve urban development, and stimulate the dynamics of the institutional structure.

economic, social, technological and institutional sphere. A large stock of this factor, in addition to generating positive externalities linked to the investment of physical capital, allows for social peace, citizen responsibility, a more just and egalitarian society, better legal and governmental structure; which will lead to the existence of a strengthened institutionality that positively affects economic efficiency.

Recall that the analysis of the model has left aside technological progress or research and development (R&D) activities that contribute to this progress of technology. It is considering that there must first be sufficient human capital to optimize resources destined for this transcendental sector in economic terms. With a high human capital stock, a developing country could in the long run endogenize the "technology" factor (transcendental in conventional economic growth models). This model quantitatively prioritizes the contribution of human beings to growth, considering their long-term contribution.

The evidence for Ecuador allows us to conclude that economic growth may be subject to endogenous constraints such as physical, human and social capital, factors that must be closely correlated. Private investments need macroeconomic and political stability (an optimal democratic environment) to generate accumulation of physical capital. It is also necessary for the State to ensure, through expenditure, the accumulation of human capital. For this, it is necessary strong institutionalization processes, at the territorial level, to create an environment with legal certainty. In that sense, the interaction between State, business and education (as the fundamental pillar of human capital) is very important for economic growth.

Results ponder physical capital as a determinant of per capita income in Ecuador and, secondarily, the accumulation of human capital. The hypothesis of the different temporal effects has been corroborated with the empirical application. As expected, the accumulation of the first factor generates short-term returns in the dependent variable, while education, as a proxy for human capital, has significant effects in the medium and long term. Theoretically, and considering the temporality of effects, the results should show that the accumulation of human capital has a greater positive impact than physical capital, which opens the debate that, if the economic model of Ecuador has neoclassical or endogenous characteristics and, consequently, the implication of policy would be the formulation of policies of growth and endogenous development or the strengthening of them. It should be mentioned that the social capital stock of previous periods also has a statistically significant effect, according to the control variables that arise (although it is a very poor predictor). However, its synergistic effects on the stock of physical and human capital are considerable.

The model itself suggests structuring the economy with institutional changes where the State creates a political and legal climate that encourages it to behave in an economically productive way. From this scenario, sensible savings and investments are possible; the acquisition of information that generates useful knowledge and skills and the provision of productive public goods and services. To this end, a stable political and institutional stability is also required, within a Rights State and legal security, which guarantees respect for private property and free economic initiative; in other words, through the provision of a regulatory (non-distorting) framework of economic activity that promotes free competition and entrepreneurship, with a pricing system aimed at allocating resources to those areas where the nation has its greatest advantages competitive. Trust is also a fundamental pillar that literature related to social capital stands out. Through it, economic

*Business and Economic Horizons*

agents trust the government and accept measures that in the short term may affect interests, but in the medium and long term strengthen the economy.

Finally, as recommendations for future research, as complements to this one, the discussion about the true institutional stability and its apparent point of inflection regarding economic growth remains pending. Ecuador has had a political instability peculiar to its idiosyncrasy that could be an even more destructive factor of institutionality than democratic power itself. On the other hand, the management of the tax policy is also a pending task of the model proposed. It is considered convenient, within the model, the inclusion of optimal taxation that promote the accumulation of human capital, without distorting the accumulation of physical capital, through calibration processes. This is a key issue, considering that inadequate taxes can discourage entrepreneurship (physical capital stock) and promote corruption (little social capital).

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