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Abstract

This paper develops a two-period Overlapping Generations (OLG) model of endogenous growth in which a two-way relationship between social capital and human capital is studied. In order to illustrate the impact of public policies, the model is calibrated using the data for a low-income country, India and a sensitivity analysis is reported under different parameter configurations. Based on the numerical analysis, this paper focuses on possible trade-offs in the allocation of government spending between two productive components, that is, social capital-related activities and education. The results of this paper show that a higher share of spending on education promotes growth despite an offsetting cut in social capital-related activities; however, the reverse entails trade-offs. In other words, an increase in the share of spending on social capital-related activities through a concomitant cut in education is detrimental to long-run growth.

JEL Classification Numbers: H54, I25, O33, O41.

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1 Introduction

Recently, researchers have shown an increased interest in the role of social capital in economic growth and development. To date the concept and measurement of social capital have been a controversial and much disputed subject within the field of development economics. Hanifan (1916, p.130) was apparently the first to use the term "social capital" to refer to "those tangible substances [that] count for most in the daily lives of people: namely goodwill, fellowship, sympathy, and social intercourse among the individuals and families who make up a social unit". Since then, in reviewing the literature, there has been a large volume of published studies using the term "social capital" (eg. Jacobs, 1961; Loury, 1987; Coleman, 1988 and 1990; Putnam, 1993 and 2000; Fukuyama, 1995; Putterman, 1995; Knack and Keefer, 1997; Dasgupta, 2003; Durlauf and Fafchamps, 2005; Sabatini, 2005). For example, according to Putnam (1993), social capital may be broadly defined as "informal social networks between individuals" and "social norms and values" that would all create externalities for a society, whereas other studies define social capital as "number of formal institutions", rather than informal social networks. In the study of Putterman (1995) for the case of Rural Tazania, social capital is for instance defined as an expended form of human capital and helps countries promote economic development through changes in attitudes, practices and knowledge. Conversely, Knack and Keefer (1997) suggest that social capital may be defined as a systematic process, which consists of two elements or components: trust and norms of civic cooperation.

In general, therefore, it seems that although the term "social capital" embodies a multitude of concepts and is a concept difficult to define precisely, in the literature there appears to be some agreement that social capital refers to "social factors" (informal networks, social norms and values etc.) and "formal institutions and organizations". No matter how we define the term "social capital", in the literature it is widely believed that social capital is critical for shaping social structure as well as the quality and quantity of a society's interactions. In other words, social capital plays an active role in facilitating coordination and cooperation within and among groups. Recent evidence also shows that a higher level of social capital is an important factor in accounting for better health, higher education and better employment outcomes, and sustainable development.

In recent years, a considerable amount of literature has been published on the role of social capital in economic growth. Several studies, for instance, Routledge and von Amsberg (2003), Chou (2006), Bofota et al. (2012), Growiec and Growiec (2012), Ponzetto and Troiano (2014), and Agénor and Dinh (2015) have suggested models in which social capital is an instrument of economic growth and notably emphasized the role of social capital from different perspectives in the process of economic growth and development. Agénor and Dinh (2015) is however the first systematic study that developed a two-period (adulthood and old age) Overlapping Generations (OLG) model of endogenous economic growth with endogenous time allocation in which the links between social capital, human capital, and product imitation have been analyzed. In their model where social capital (which is determined by time and access to infrastructure) encourages imitation activities, they have drawn our attention to a two-way interaction between human capital and imitation. Their model also includes endogenous life expectancy, which is linked to the process of human capital so the savings rate, and time allocated to market work and social capital accumulation are also endogenously determined in the model. The results of their numerical analysis for low-income countries indicate that despite an offsetting cut in another productive share of government spending (education), a policy in improving social capital accumulation might well be the key to achieving in promoting economic growth; however, the findings show dynamic trade-offs in the case where a higher share of public spending on social capital-related activities is offset by a cut in infrastructure investment.

This paper extends a simplified version of the model presented in Agénor and Dinh (2015). The contributions of this paper are threefold: Firstly, unlike Agénor and Dinh (2015), we have brought to the fore a two way relation between social and human capital. Secondly, this paper calibrates the model for a low-income country, India which houses a federation of 25 states with ethnic, linguistic, and cultural diversity. This allows us to capture so far unexplored relationship between social and human capital and its impact on the long-run economic growth for the country, which still has one-third of the population living below the official poverty line. This is highly relevant to a country like India where economic and social performance matters. Finally, as opposed to Agénor and Dinh (2015) that considered dynamic trade-offs in the allocation of public spending between social capital-related activities, education, and infrastructure investment, in an attempt to capture the interaction between these two variables, this paper focuses on possible trade-offs in the allocation of government spending only between two categories of productive government spending, that is, social capital-related activities and education.

Based on the numerical analysis using the data for a particular low-income country, India, the findings of this paper show that a higher share of spending on education promotes growth despite an offsetting cut in social capital-related activities; however, an increase in the share of spending on social capital through a cut in education entails trade-offs. In other words, a policy in improving social capital accumulation at the expense of education is detrimental to long-run growth.

The remainder of the paper has been organized in the following way. Section 2 begins by laying out the simplified version of model presented in Agénor and Dinh (2015). Section 3 characterizes the balanced growth equilibrium. Section 4 calibrates the model for India, whereas Section 5 focuses on policy experiments to illustrate potential trade-offs between productive components of public spending, that is, education and social capital-related activities. Section 6 offers some concluding remarks.

2 The Model

Consider a two-period (adulthood and old age) OLG model of endogenous economic growth where the economy is populated by nonaltruistic individuals endowed with one unit of time in adulthood and zero units in old age, firms and a government, which cannot borrow but run a balanced budget, thus financing its spending on investment in infrastructure, education, and other items by taxing only wage incomes of adult workers. There are only two sectors in the economy: the first produces a physical good, whereas the latter produces human capital. Wages in the second period of life (adulthood) are the source of income and savings are in the form of physical capital. Agents are only endowed with an initial stock of physical capital at the beginning of the period. Total population is assumed to be constant and the number of adult workers is set to $\bar{N}$. And finally, all markets clear in equilibrium.

2.1 Households

The individual's discounted utility function is given by

$$U_t^h = \eta_C \ln c_t^{t,h} + \frac{\ln c_{t+1}^{t,h}}{1+\rho}, \tag{1}$$

where $c_t^{t,h}(c_{t+1}^{t,h})$ consumption of individual h at period $t(t+1)$, $\eta_C > 0$ the individual's relative preference parameter for current consumption, and $\rho > 0$ the subjective discount rate.

Assuming that there are no debts or bequests between generations, the period-specific budget constraints are given by

$$c_t^{t,h} + s_t^h = (1-\tau)H_t^h w_t, \tag{2}$$

$$c_{t+1}^{t,h} = (1+r_{t+1})s_t^h, \tag{3}$$

where w_t is the economy-wide wage rate, H_t^h individual human capital, $\tau \in (0,1)$

a constant tax rate, s_t^h savings, and r_{t+1} the rental rate of private capital between periods t and $t+1$.

2.2 Firms

Firms are identical and their number is normalized to unity. Production of a single nonstorable good requires the use of effective labor, $H_t N_t^i$, where H_t is average human capital of individuals born in $t-1$ and N_t^i the number of adult workers employed by firm i, and private capital of firm i, $K_t^{P,i}$.[1] Assuming constant returns to scale in private inputs, the production function of individual firm i is:

$$Y_t^i = (H_t N_t^i)^{\beta} (K_t^{P,i})^{1-\beta}, \tag{4}$$

where $\beta \in (0,1)$ the elasticity with respect to effective labor and therefore $1-\beta$ the elasticity with respect to private capital respectively.

Aggregate output is linear in private capital:

$$Y_t = \int_0^1 Y_t^i di = h_t^{\beta} \bar{N}^{\beta} K_t^P, \tag{5}$$

where $K_t^P = K_t^{P,i}$, $\forall i$, $\bar{N} = \int_0^1 N_t^i di$ is total population, and $h_t = H_t / K_t^P$ is the human-private capital ratio.

2.3 Human Capital

The individual stock of human capital at the beginning of period $t+1$ depends on government spending per capita, $G_t^H/\bar{N}$, the average stock of social capital of the previous generation, K_t^S, and the average human capital of the previous generation, H_t. At the same time, social capital accumulation depends on human capital; thus, as noted earlier, we have brought to the fore a two-way interaction between these

[1] Alternatively, the production function of firm i would also depend on an Arrow-Romer type externality associated with aggregate private capital stock; however, it is exogenous in this setting.

two stocks of capital.[2]

$$H_{t+1}^{h} = (\frac{G_t^H}{\bar{N}})^{\nu_1}(K_t^S)^{\nu_2}H_t^{1-\nu_1-\nu_2}, \tag{6}$$

where $\nu_i \in (0,1)$, $i = 1,2$; the elasticity with respect to government spending on education and the stock of social capital respectively.

2.4 Social Capital

As noted earlier, although the term "social capital" embodies a multitude of concepts, "social factors" and "formal institutions and organizations" are a commonly used notion in the literature. The individual stock of social capital at the beginning of period $t+1$ is determined by government spending on social capital-related activities as well as parent's average human and social capital:[3]

$$K_{t+1}^{S,h} = (\frac{G_t^S}{\bar{N}})^{\lambda_1}H_t^{\lambda_2}(K_t^S)^{1-\lambda_1-\lambda_2}, \tag{7}$$

where G_t^S government spending on social capital-related activities, H_t and K_t^S parent's average human and social capital respectively. Also $\lambda_i \in (0,1)$, $i = 1,2$; the elasticity with respect to public spending on social capital and average human capital respectively.

[2] In the study of Agénor and Dinh (2015), human capital technology also depends on a fixed fraction of time allocated by individuals to schooling and the stock of imitated goods in order to capture a two-way interaction between imitation and human capital; however, we have abstracted from these issues.

[3] As in Agénor and Dinh (2015), the stock of social capital would also be determined by endogenous time allocation by individuals to social capital accumulation as well as access to public infrastructure; however, given that this paper is to study a two-way relationship between human and social capital accumulation, it would complicate the analysis without adding substantial additional insights.

2.5 Government

Assuming that the government taxes only wages of adult workers, its balanced budget is:

$$G_t = \sum G_t^j = \tau H_t w_t \bar{N}. \quad j = H, S, O \tag{8}$$

where G_t^H, share of public spending on education; G_t^S, social capital-related activities; and G_t^O, other items.

Assuming that shares of public spending are constant fractions of government revenues:

$$G_t^j = \upsilon_j \tau H_t w_t \bar{N}, \quad j = H, S, O \tag{9}$$

where $\upsilon_j \in (0, 1)$ for all j.

Combining (8) and (9) therefore yields

$$\sum_j \upsilon_j = 1. \tag{10}$$

2.6 Market-Clearing Conditions

The asset market clearing condition requires period $t+1$ private capital stock to be equal to savings in period t by individuals born in $t-1$:

$$K_{t+1}^P = \bar{N} s_t, \tag{11}$$

where s_t is savings per individual, $\bar{N}$ is the number of adult workers, as noted earlier, and for simplicity, physical capital is assumed to depreciate fully in one period.

3 Balanced Growth Equilibrium

As in Agénor and Dinh (2015, p.13-14), a *competitive equilibrium* in this model is a sequence of allocations $\{c_t^t, c_{t+1}^t, s_t\}_{t=0}^{\infty}$, physical capital stock $\{K_t^P\}_{t=0}^{\infty}$, human capital stock $\{H_t\}_{t=0}^{\infty}$, social capital stock $\{K_t^S\}_{t=0}^{\infty}$, factor prices $\{w_t, r_t\}_{t=0}^{\infty}$, a constant tax rate, and public spending shares such that, given initial stocks $K_0^P > 0$, $K_0^S > 0$, $H_0 > 0$, individuals maximize utility, firms maximize profits, markets clear, and the government budget is balanced. In a symmetric equilibrium, it must be also that $c_t^{t,h}(c_{t+1}^{t,h}) = c_t^t(c_{t+1}^t)$, $s_t^h = s_t$, $H_t^h = H_t$, $K_t^{S,h} = K_t^S$, $\forall h$. A *balanced growth equilibrium* is a competitive equilibrium in which c_t^t, c_{t+1}^t, s_t, K_t^P, K_t^S, H_t, and Y_t grow at the constant rate $1+\boldsymbol{\gamma}$, the rate of return on private capital, r_t, and the economy-wide wage rate, w_t, are constant.

Appendix A shows that the dynamic system is comprised of two nonlinear first-order difference equations in $h_t = H_t/K_t^P$, the human-private capital ratio and $k_t^S = K_t^S/K_t^P$, the social-private capital ratio. The steady-state values of $\tilde{h}$ and $\tilde{k}^S$ are given by respectively:

$$\tilde{h} = \left\{\Psi_2(\tilde{k}^S)^{\nu_2}\right\}^{1/(1-\mu_1)}, \tag{12}$$

$$\tilde{k}^S = \left\{\Psi_4\tilde{h}^{\mu_2}\right\}^{1/(1-\mu_2)}, \tag{13}$$

where

$$\Psi_1 = (\upsilon_H\tau\beta\bar{N}^{\beta-1})^{\nu_1},$$

$$\Psi_2 = \Psi_1[\sigma(1-\tau)\beta\bar{N}^{\beta}]^{-1},$$

$$\Psi_3 = (\upsilon_S\tau\beta N^{\beta-1})^{\lambda_1},$$

$$\Psi_4 = \Psi_3[\sigma(1-\tau)\beta\bar{N}^{\beta}]^{-1},$$

$$\mu_1 = \beta(\nu_1 - 1) - (\nu_1 + \nu_2) + 1,$$

$$\mu_2 = \beta(\lambda_1 - 1) + \lambda_2.$$

As also shown in Appendix A, the steady-state growth rate of the economy is given by:

$$1 + \boldsymbol{\gamma} = \tilde{h}^{\beta}\bar{N}^{\beta}\sigma(1-\tau)\beta. \tag{14}$$

In order to illustrate analytically the long-run effects of public policy, suppose for instance a budget-neutral increase in the share of government spending on education in the case where it is financed by a cut in other items (not directly productive), $d\upsilon_H + d\upsilon_O = 0$. From equations (12) and (14),

$$\frac{d\ln\tilde{h}}{d\upsilon_H}\mid_{d\upsilon_H+d\upsilon_O=0}=\frac{\nu_1}{\upsilon_H(1-\mu_1)}=\frac{\nu_1}{\upsilon_H[(\nu_1+\nu_2)-\beta(\nu_1-1)]}>0, \tag{15}$$

$$\frac{d\ln(1+\gamma)}{d\upsilon_H}\mid_{d\upsilon_H+d\upsilon_O=0}=\beta(\frac{d\ln\tilde{h}}{d\upsilon_H})\mid_{d\upsilon_H+d\upsilon_O=0}>0, \tag{16}$$

where $\nu_1 < 1$ due to decreasing marginal returns to government spending on education, which is consistent with the literature (See Agénor (2012) for a more detailed discussion) so the expression $[(\nu_1+\nu_2)-\beta(\nu_1-1)] > 0$ is always positive.

As can be inferred from equations (15) and (16), a higher share of government spending on education unambiguously increases the human-private capital ratio and the net impact on long-run growth is therefore positive.

Consider now a budget-neutral increase in the share of public spending on social capital-related activities again financed by a cut in other items:

$$\frac{d\ln\tilde{h}}{d\upsilon_S}\mid_{d\upsilon_S+d\upsilon_O=0}=\frac{\nu_2}{(1-\mu_1)}(\frac{d\ln\tilde{k}^S}{d\upsilon_S})\mid_{d\upsilon_S+d\upsilon_O=0}=\frac{\nu_2\lambda_1}{\upsilon_S(1-\mu_1)(1-\mu_2)},$$

which can be rewritten explicitly to give

$$\frac{d\ln\tilde{h}}{d\upsilon_S}\mid_{d\upsilon_S+d\upsilon_O=0}=\frac{\nu_2\lambda_1}{\upsilon_S[(\nu_1+\nu_2)-\beta(\nu_1-1)]\{1-[\beta(\lambda_1-1)+\lambda_2]\}}\gtreqless 0, \tag{17}$$

where $\lambda_1, \lambda_2 \in (0,1)$ and whether the expression $\{1-[\beta(\lambda_1-1)+\lambda_2]\}$ is positive or not depends on the magnitude of the expression $[\beta(\lambda_1-1)+\lambda_2] \gtreqless 1$.

$$\frac{d\ln(1+\gamma)}{d\upsilon_S}\mid_{d\upsilon_S+d\upsilon_O=0}=\beta(\frac{d\ln\tilde{h}}{d\upsilon_S})\mid_{d\upsilon_S+d\upsilon_O=0}\gtreqless 0. \tag{18}$$

One can see from equations (17) and (18) that a budget-neutral increase in the share of government spending on social capital-related activities has in general an ambiguous effect on the human-private capital ratio and thus on long-run growth.

Suppose for instance an increase in the share of government spending on education but financed by a cut in another productive component of public spending, that is, social capital-related activities, $d\upsilon_H + d\upsilon_S = 0$. From equations (12), (13), and (14)

$$\frac{d\ln(1+\gamma)}{d\upsilon_H}\,|_{d\upsilon_H+d\upsilon_S=0}= \frac{\beta}{[(\nu_1+\nu_2)-\beta(\nu_1-1)]}\left\{\frac{\nu_1}{\upsilon_H}-\frac{\nu_2\lambda_1}{\upsilon_S\left\{1-[\beta(\lambda_1-1)+\lambda_2]\right\}}\right\} \lesseqgtr 0, \tag{19}$$

Appendix B shows the long-run effects of a budget-neutral increase in the share of government spending on education on welfare. Equation (B9) implies that regardless of the value for t (either $t = 0$ or $t > 0$), an increase in government spending on education, υ_H increases $\tilde{h}$ thus increasing the welfare of individuals. However, this may not be the case if a higher share of government spending on education is financed by another productive share of government spending, that is, social capital-related activities.

4 Calibration

To study the steady-state effects of public policies, the model is calibrated. For households, to capture the evidence that households in India have a lower degree of impatience, the annual discount rate, ρ, is set at 0.03, which is higher than the standard choice in the literature. Interpreting a period as 22 years in this OLG framework yields the intergenerational discount factor $[1/(1+0.03)]^{22} = 0.511$.

The family's propensity to save for India, $\sigma = 1/[1+\eta_C\,(1+\rho)]$ is set at 23.3 percent, the household savings rate in proportion of GDP which is estimated by the Planning Commission (2011, Table 3) during the period 2000-11. Using the intergenerational discount rate and family's propensity to save, $\eta_C = (\sigma^{-1}-1)/(1+\rho)$ can be calibrated at 1.718. Total population is normalized to unity.

The elasticity with respect to effective labor, $\beta = 0.65$ is similar to the value for the average share of labor income in net output for developing countries reported by

Guerriero (2012), whereas the elasticity with respect to private capital, $1-\beta = 0.35$ is consistent with the empirical evidence in the literature.

In the human capital sector, the elasticity with respect to government spending on education services, $\nu_1 = 0.45$ is close to the value reported by De la Croix and Vander Donckt (2010), whereas the elasticity with respect to the stock of social capital, ν_2, is set equal to 0.1 to begin with. Therefore, the elasticity with respect to the stock of average human capital is equal to 0.45.

In the social capital sector, the elasticity with respect to public spending on social capital-related activities, λ_1, is equal to 0.3, as in Agénor and Dinh (2015), whereas given the parsimonious feature of the model, the elasticity with respect to human capital, λ_2, is initially set to a relatively high value, 0.5. As a result, the elasticity with respect to the stock of social capital is set equal to 0.2.

The tax rate on wage income is equal to 9.4 percent, which corresponds to the average ratio of tax revenues to GDP reported by the World Development Indicators (WDI) database of the World Bank over the period 1990-2012. To match the model's definition, this value is divided by the average share of labor income in final output, $\beta = 0.65$ so the effective tax rate on wages, τ, is 14.5 percent.

The initial share of government spending on education, υ_H, is estimated from WDI for the years 2009-2012 and is set to 0.108. There is no actual evidence in the literature on the share of government spending on social capital-related activities for India therefore the initial share of government spending, υ_S, is set equal to 0.05 to begin with, which is slightly higher than the average value for low-income countries used by Agénor and Dinh (2015). However, this allows us to capture the trade-offs between two categories of productive public spending, especially in the case where a higher share of spending on education is financed by a concomitant cut in the share of government spending on social capital-related activities. Therefore, equation (10) implies that the share of spending on other items, υ_O, is 0.842.

The benchmark parameter values are summarized in Table 1. We have introduced a multiplicative constant in the growth equation and the steady-state growth rate of final output is calibrated at 6.5 percent per annum, which is the average growth rate of real GDP for India over the period 1990-2012. Given that the model behaves in a nonlinear fashion, we cannot study the stability of the dynamic system analytically. Therefore, using parameter and starting values for the dynamic variables; the human-private capital ratio, $h_t = H_t/K_t^P$ and social-private capital ratio, $k_t^S = K_t^S/K_t^P$, the dynamic system is solved numerically and the model proved to be stable. Figures 1 and 2 show that the social capital-human capital ratio, k_t^S/h_t and growth rate of final output, both of which have a monotonic pattern, converge to a steady-state value in the benchmark case.

Table 1: Calibrated Parameter Values: Benchmark Case

Sectors	**Parameters**
Households	$\rho = 0.03, \sigma = 23.3, \eta_C = 1.718, \bar{N} = 1$
Final goods	$\beta = 0.65$
Human capital	$\nu_1 = 0.45, \nu_2 = 0.1$
Social capital	$\lambda_1 = 0.3, \lambda_2 = 0.5$
Government	$\tau = 0.145, \upsilon_H = 0.108, \upsilon_S = 0.05, \upsilon_O = 0.842$

5 Policy Experiments

In order to show the results of policy experiments, we focus on the following variables: the social capital-human capital ratio and growth rate of final output. We first consider a permanent budget-neutral increase in the share of public spending on education from an initial value of 0.108 to 0.140, that is, a 30 percent increase, under two alternative assumptions: first, financed by a cut in unproductive spending ($d\upsilon_H + d\upsilon_U = 0$) and second, financed by a cut in another productive share of government spending, social capital-related activities ($d\upsilon_H + d\upsilon_S = 0$) to capture the potential trade-offs between these two productive components of public spending.

Table 2 shows the findings of these experiments for the benchmark case, as shown in bold in the table, as well as alternative values of some key parameters in the model. For instance, in the benchmark case where a higher share of public spending on education, υ_H, is financed by a cut in unproductive spending, υ_U, in the long run, an increase in government spending on education will promote the rate of human capital, thereby enhancing the benefit associated with social capital-related activities. In turn, a higher level of social capital further stimulates the stock of human capital. Therefore, the increase in the stock of human capital is more than in the stock of social capital. As a result, the social capital-human capital ratio falls in the long run so the absolute deviation of the ratio from baseline turns negative. However, the solution of the model gives a long-run growth rate of 7.07 percent, that is, an increase of 0.57 percentage points in comparison with the baseline value.

Consider now the case where a higher share of public spending on education through a concomitant cut in another productive component of government spending, social capital-related activities. Despite an offsetting cut in another productive component of public spending, no trade-off exists and therefore the net effect on long-run growth is still positive because the positive effect on steady-state growth that higher spending on education creates (not only directly through its effect on the productivity but also indirectly through the benefit associated with social capital) dominates the negative effect caused by a cut in government spending on social capital-related activities. In fact, spending more on education leads to the production of productive inputs and therefore the offsetting cut in the share of spending on social capital-related activities is beneficial in terms of growth; as can be seen from Table 2, the net impact on long-run growth increases by 0.50 percentage points. The table also shows two alternative values of the elasticity of social capital with respect to average human capital, $\lambda_2 = 0.7$ and 0.9. Depending on the relative strength of the parameter λ_2, higher spending on education further enhances the growth rate of final output. For instance, when $\lambda_2 = 0.9$, the growth rate in the long run increases by 0.55 percentage points. Figure 3 shows the absolute deviations of long-run growth rate of final output from baseline under alternative parameter values for the elasticity of human capital with respect to government spending on education, ν_1 and the elasticity of social capital with respect to average human capital, λ_2, which are both in the range of $0.1 - 0.7$. As can be seen from Figure 3, due to the increase in the share of spending on education, the positive effect compensates the adverse effect that is induced by the offsetting cut in government spending on social-capital related activities. Depending on the strength of both parameters, either individually or in combination, the positive impact on long-run growth becomes a lot stronger.

We next consider a permanent budget-neutral increase in the share of spending on social capital-related activities from 5 percent to 6.5 percent either through a cut in unproductive spending ($d\upsilon_S + d\upsilon_U = 0$), in which case there are no trade-offs, or through a cut in another productive of public spending, in other words, education ($d\upsilon_S + d\upsilon_H = 0$), which enables us to capture the trade-offs in the allocation of public spending. Financing a higher share of government spending on social capital-related activities through an offsetting cut in unproductive spending increases individuals' stock of social capital, which also promotes their human capital stock through the learning externality. In turn, a higher level of human capital further stimulates stock of social capital, thereby boosting growth in the long run. It can be seen from Table 2 that the net impact on long-run growth, albeit negligible, increases by 0.05 percentage points when compared to the baseline value.

Conversely, suppose now the case where a higher share of public spending on social capital-related activities, υ_S, is offset by a concomitant reduction in education, υ_H. Although an increase in υ_S has a direct, positive effect on the stock of social capital, the offsetting cut in productive government spending on education reduces the rate of human capital, thereby impeding the benefit associated with the social capital-based learning externality. Consequently, the social capital-human capital ratio increases by more than in the baseline value therefore the deviation of the ratio from baseline turns out to be a positive value. However, the trade-off persists in the allocation of public spending between social capital-related activities and education; as Table 2 shows, the net effect on long-run growth is negative and falls by 0.68 percentage points. Table 2 also reports two higher values of the parameter $\nu_2 =$ 0.2 and 0.4, which measures the response of human capital with respect to social capital. Depending on the strength of the parameter ν_2, financing a higher share of public spending on social capital-related activities through a cut in education cannot generate a positive growth rate in the long-run due to a fall in the rate of human capital accumulation. However, when $\nu_2 = 0.4$, although the trade-off still persists, the negative impact on long-run growth is mitigated; growth falls by 0.43 percentage points, whereas it falls by more when ν_2 is set to a relatively lower value, 0.2.

As can be seen from the table, in response to an increase in the share of government spending on social capital-related activities, υ_S, through a concomitant cut in education, υ_H, a lower value of the elasticity of human capital with respect to government spending on education, $\nu_1 = 0.2$ can magnify the benefit associated with that policy in terms of growth; however, the trade-off in the allocation of public spending between social capital-related activities and education still exists yet growth falls by less than in the benchmark case where $\nu_1 = 0.45$. Also, Figure 4 shows the response of long-run growth rate of final output to alternative values of both the elasticity of human capital with respect to government spending on education, ν_1 and the elasticity of social capital with respect to average human capital, λ_2, which are initially set to 0.45 and 0.5 respectively in the benchmark case. Despite the fact that a higher share of spending on social-capital related activities promotes long-run growth, not only directly through its effect on social capital accumulation but also indirectly through the benefit associated with social capital, as a result of the offsetting cut in government spending on education, the net impact on long-run growth is always negative; however, this negative effect becomes more significant, along with higher values of both parameters.

6 Concluding Remarks

This paper extended the simplified version of the model presented in Agénor and Dinh (2015) in several important directions. Firstly, we accounted for a two way interaction between social and human capital. Secondly, this paper calibrated the model for a low-income country, India to capture the so-called relationship between social and human capital and its impact on long-run growth. Finally, this paper focused on possible trade-offs in the allocation of public spending between two productive categories of productive government spending, that is, social capital-related activities and education.

Using the data for India, numerical experiments of this paper showed that a higher share of spending on education promotes growth despite an offsetting cut in social capital-related activities; however, an increase in the share of spending on social capital-related activities through a cut in education entails trade-offs. Put it differently, a policy in improving social capital accumulation at the expense of education is detrimental to long-run growth.

The evidence reviewed so far shows that although social infrastructure has social and economic benefits in the sense that it is important for improving well-being and health, and helping people to find jobs, the role of government in sustaining social capital is less clear than in the context of human capital. Conversely, government and other public agencies have in fact a potential role in enhancing social capital, which supports economic growth. The main question is then adressed: What policies should be implemented for enhancing social capital? The first option would probably be to support families; for instance, the provision of fiscal support, flexibility in working hours, which would allow parents for more time off and therefore facilitate more parental involvement in children's lives. The second option would be to encourage people involved in voluntary work, which serves as a critical element in community network. Thirdly, new forms of ICTs would allow people to connect to their local neighbourhoods and distant communities, which creates a social fabric in the community. Lastly, the provision of health care services at the local community level would allow elderly people and other groups, who are in need of care and support, to stay closer to their families and communities and to sustain social ties.[4]

[4] See OECD (2001) for a more detailed discussion.

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Appendix A
Dynamic System and Steady-State Growth

Substituting for s_t^h from (3) in (2) yields the lifetime budget constraint,

$$c_t^{t,h} + \frac{c_{t+1}^{t,h}}{1+r_{t+1}} = (1-\tau)H_t^h w_t. \tag{A1}$$

Each individual maximizes (1) with respect to $c_t^{t,h}, c_{t+1}^{t,h}$, subject to (A1) and $c_t^{t,h}, c_{t+1}^{t,h} > 0$. In a symmetric equilibrium, the first-order conditions yield the Euler equation

$$\frac{c_{t+1}^t}{c_t^t} = \frac{1+r_{t+1}}{\eta_C(1+\rho)}. \tag{A2}$$

Substituting (A2) in (A1) yields

$$c_t^t = [\frac{\eta_C(1+\rho)}{1+\eta_C(1+\rho)}](1-\tau)H_t w_t,$$

or equivalently,

$$c_t^t = (1-\sigma)(1-\tau)H_t w_t, \tag{A3}$$

Equation (A3) can be substituted into (2) to give

$$s_t = \sigma(1-\tau)H_t w_t, \tag{A4}$$

where the marginal propensity to save is

$$\sigma = \frac{1}{1+\eta_C(1+\rho)} < 1.$$

Substituting (A4) in (11) yields

$$K_{t+1}^P = \sigma(1-\tau)H_t w_t \bar{N}. \tag{A5}$$

Each firm i maximizes its profit, subject to (4), with respect to labor services and private capital, taking human capital as given:

$$\Pi_t^i = Y_t^i - w_t H_t N_t^i - r_t K_t^{P,i}. \tag{A6}$$

In a symmetric equilibrium, the first-order conditions yield

$$w_t = \beta\frac{Y_t}{H_t\bar{N}}, \;\; r_t = (1-\beta)\frac{Y_t}{K_t^P}, \tag{A7}$$

where all firms are identical and $\bar{N} = \int_0^1 N_t^i di$.

From (A7), substituting w_t into (A5) yields

$$K_{t+1}^P = \sigma(1-\tau)\beta Y_t, \tag{A8}$$

which can be rearranged, together with (5), to give the dynamics of K_t^P:

$$K_{t+1}^P = \sigma(1-\tau)\beta \bar{N}^\beta h_t^\beta K_t^P,$$

or equivalently

$$\frac{K_{t+1}^P}{K_t^P} = \sigma(1-\tau)\beta \bar{N}^\beta h_t^\beta. \tag{A9}$$

Equation (6) can be rewritten as

$$\frac{H_{t+1}}{H_t} = (\frac{G_t^H}{\bar{N} H_t})^{\nu_1} (\frac{K_t^S}{H_t})^{\nu_2}. \tag{A10}$$

Substituting (9) for $j = H$ into (A10) and rearranging this yields

$$\frac{H_{t+1}}{H_t} = (\frac{\upsilon_H \tau H_t w_t \bar{N}}{\bar{N} H_t})^{\nu_1} (\frac{K_t^S}{H_t})^{\nu_2},$$

which can be rearranged, using (A7) to eliminate w_t, together with (5), noting that $h_t = H_t/K_t^P$ and $k_t^S = K_t^S/K_t^P$,

$$\frac{H_{t+1}}{H_t} = \Psi_1 h_t^{(\beta-1)\nu_1 - \nu_2} (k_t^S)^{\nu_2}, \tag{A11}$$

where

$$\Psi_1 = (\upsilon_H \tau \beta \bar{N}^{\beta-1})^{\nu_1},$$

Dividing (A11) by (A9) yields the dynamics of $h_t = H_t/K_t^P$,

$$h_{t+1} = \Psi_2 h_t^{\mu_1} (k_t^S)^{\nu_2}, \tag{A12}$$

where

$$\Psi_2 = \Psi_1 [\sigma(1-\tau)\beta \bar{N}^\beta]^{-1},$$

$$\mu_1 = \beta(\nu_1 - 1) - (\nu_1 + \nu_2) + 1.$$

Equation (7) can be rewritten as

$$\frac{K_{t+1}^S}{K_t^S} = (\frac{G_t^S}{\bar{N} K_t^S})^{\lambda_1} (\frac{H_t}{K_t^S})^{\lambda_2}. \tag{A13}$$

Substituting (9) for $j = S$ into (A13) and rearranging this yields

$$\frac{K_{t+1}^S}{K_t^S} = (\frac{\upsilon_S \tau H_t w_t \bar{N}}{\bar{N} K_t^S})^{\lambda_1} (\frac{H_t}{K_t^S})^{\lambda_2},$$

which can be rearranged to give, using (A7) and (5),

$$\frac{K_{t+1}^S}{K_t^S} = \Psi_3 h_t^{\beta\lambda_1+\lambda_2} (k_t^S)^{-(\lambda_1+\lambda_2)}, \tag{A14}$$

where

$$\Psi_3 = (\upsilon_S \tau \beta N^{\beta-1})^{\lambda_1}.$$

Dividing (A14) by (A9) yields the dynamics of $k_t^S = K_t^S / K_t^P$,

$$k_{t+1}^S = \Psi_4 h_t^{\mu_2} (k_t^S)^{\mu_3}, \tag{A15}$$

where

$$\Psi_4 = \Psi_3 [\sigma(1-\tau)\beta \bar{N}^\beta]^{-1},$$
$$\mu_2 = \beta(\lambda_1 - 1) + \lambda_2,$$
$$\mu_3 = 1 - (\lambda_1 + \lambda_2).$$

From (A12) and (A15), the steady-state values of h_t and k_t^S are given respectively

$$\tilde{h} = \left\{ \Psi_2 (\tilde{k}^S)^{\nu_2} \right\}^{1/(1-\mu_1)}, \tag{A16}$$

$$\tilde{k}^S = \left\{ \Psi_4 \tilde{h}^{\mu_2} \right\}^{1/(1-\mu_2)}. \tag{A17}$$

From equations (5) and (A8), the growth rate of final output for $t+1$ during the transition:

$$Y_{t+1} = {h_{t+1}}^\beta \bar{N}^\beta \sigma(1-\tau)\beta Y_t, \tag{A18}$$

which can be rearranged to derive the steady-state growth rate of output:

$$1 + \boldsymbol{\gamma} = \tilde{h}^\beta \bar{N}^\beta \sigma(1-\tau)\beta. \tag{A19}$$

Appendix B
Welfare Maximization

Let W_t be a government's welfare function which may be defined as a discounted sum of the utility of the representative individual of the present and all future cohorts:[5]

$$W_t = \sum_{t=0}^{\infty} \omega^t U_t, \tag{B1}$$

where $\omega \in (0, 1)$ is the constant discount factor.

From equation (1), the utility function can be repeated:

$$U_t = \eta_C \ln c_t^t + \frac{\ln c_{t+1}^t}{1+\rho}. \tag{B2}$$

From (A3),

$$c_t^t = (1-\sigma)(1-\tau)H_t w_t. \tag{B3}$$

Equation (B2) can be substituted in (A2) to give

$$c_{t+1}^t = (1 + r_{t+1})\sigma(1-\tau)H_t w_t. \tag{B4}$$

Substituting (B3) and (B4) into (B1) yields the equilibrium level of lifetime utility

$$U_t = \eta_C \ln[(1-\sigma)(1-\tau)H_t w_t] + \Lambda \ln[(1+r_{t+1})\sigma(1-\tau)H_t w_t], \tag{B5}$$

where $\Lambda = 1/(1+\rho)$.

Equation (B5) can be rearranged to give

$$U_t = \Gamma_1 + \Lambda \ln(1 + r_{t+1}) + (\eta_C + \Lambda)\ln(H_t w_t), \tag{B6}$$

where

$$\Gamma_1 = (\eta_C + \Lambda)\ln(1-\tau) + \ln(1-\sigma) + \Lambda \ln \sigma.$$

Substituting out for w_t and r_{t+1} from (A7) into (B6) yields

$$U_t = \Gamma_1 + \Lambda \ln(1-\beta)(\frac{Y_{t+1}}{K_{t+1}^P}) + (\eta_C + \Lambda)\ln \beta Y_t,$$

or equivalently,

$$U_t = \Gamma_2 + \Lambda \ln(\frac{Y_{t+1}}{K_{t+1}^P}) + (\eta_C + \Lambda)\ln Y_t, \tag{B7}$$

[5] See Agénor (2012, Chapter 1, p. 42) for a detailed explanation.

where

$$\Gamma_2 = \Gamma_1 + \Lambda \ln(1-\beta) + (\eta_C + \Lambda)\ln \beta.$$

In the steady-state, equation (5) implies that $Y_{t+1}/K^P_{t+1} = Y_t/K^P_t = \tilde{Y}/\tilde{K}^P = \tilde{h}^{\beta}\bar{N}^{\beta}$. In addition, along the steady-state equilibrium path, $\tilde{Y} = Y_0(1+\boldsymbol{\gamma})^t$. Equation (B7) takes the form:

$$\tilde{U} = \Gamma_3 + \beta\Lambda \ln \tilde{h} + (\eta_C + \Lambda)t \ln(1+\boldsymbol{\gamma}), \tag{B8}$$

where

$$\Gamma_3 = \Gamma_2 + (\eta_C + \Lambda)\ln Y_0.$$

Equation (B8) implies that welfare increases in the growth rate, $1+\boldsymbol{\gamma}$ and depends on time. From equation (A19),

$$1+\boldsymbol{\gamma} = \tilde{h}^{\beta}\bar{N}^{\beta}\sigma(1-\tau)\beta,$$

which can be substituted into (B8) to give

$$\tilde{U} = \Gamma_3 + \beta[\Lambda + (\eta_C + \Lambda)t]\ln \tilde{h} + (\eta_C + \Lambda)t \ln \sigma(1-\tau)\beta. \tag{B9}$$

If $t \rightarrow 0$, then expression (B9) boils down to

$$\tilde{U} = \Gamma_3 + \beta\Lambda \ln \tilde{h}, \tag{B10}$$

which implies that an increase in government spending on education, υ_H unambiguously increases $\tilde{h}$, thus increasing the welfare of individuals. However, in the case where $t > 0$, as can be seen from equation (B9), an increase in υ_H raises the second term directly.

Figure 1: Social-Human Capital Ratio (Baseline Scenario)

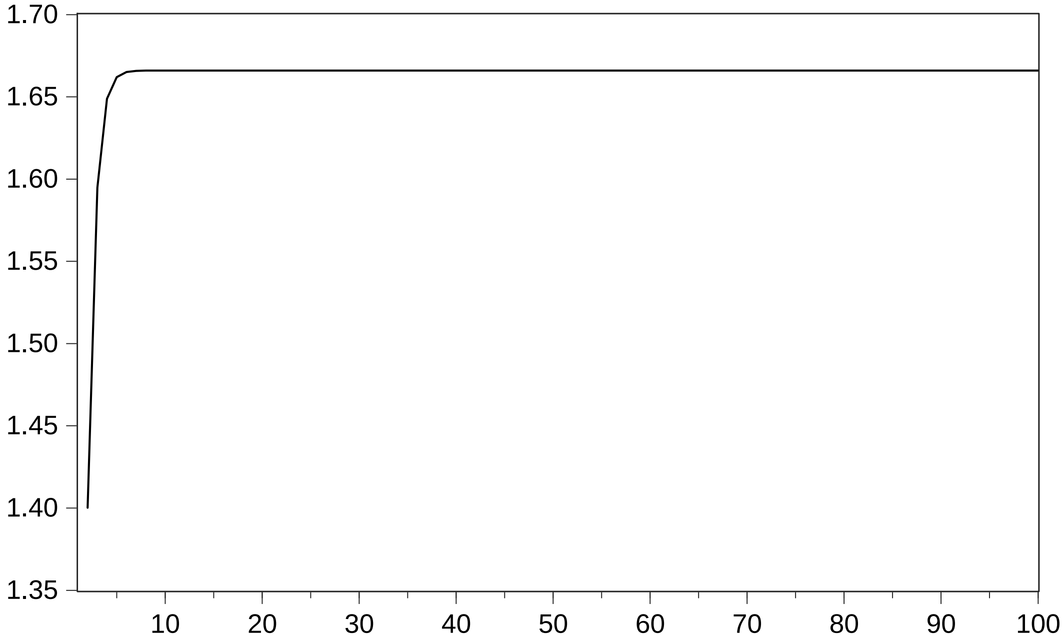


Figure 2: Growth Rate of Final Output (Baseline Scenario)

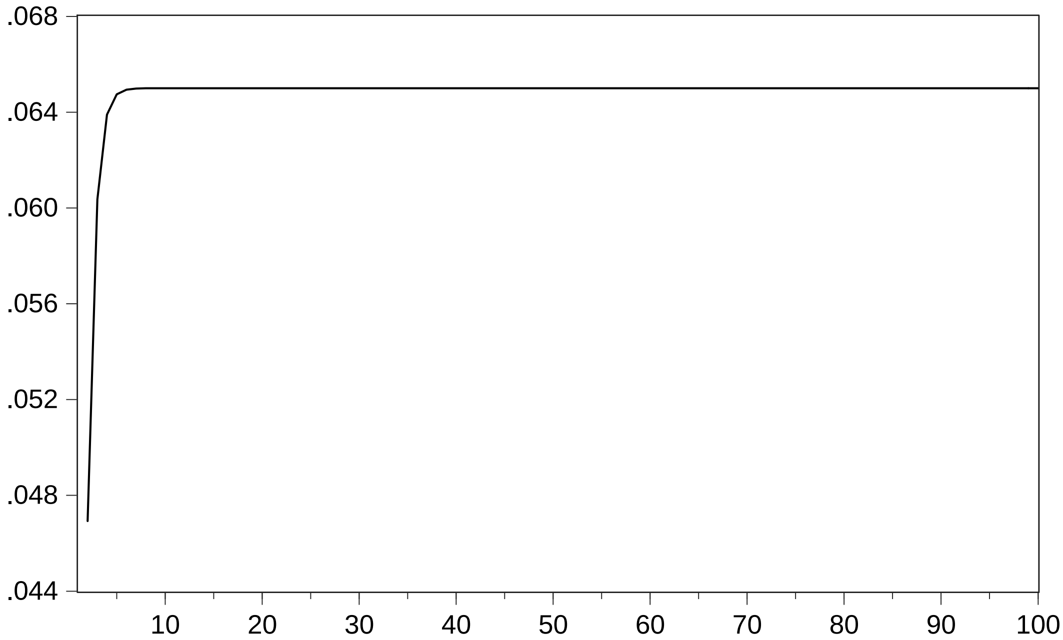
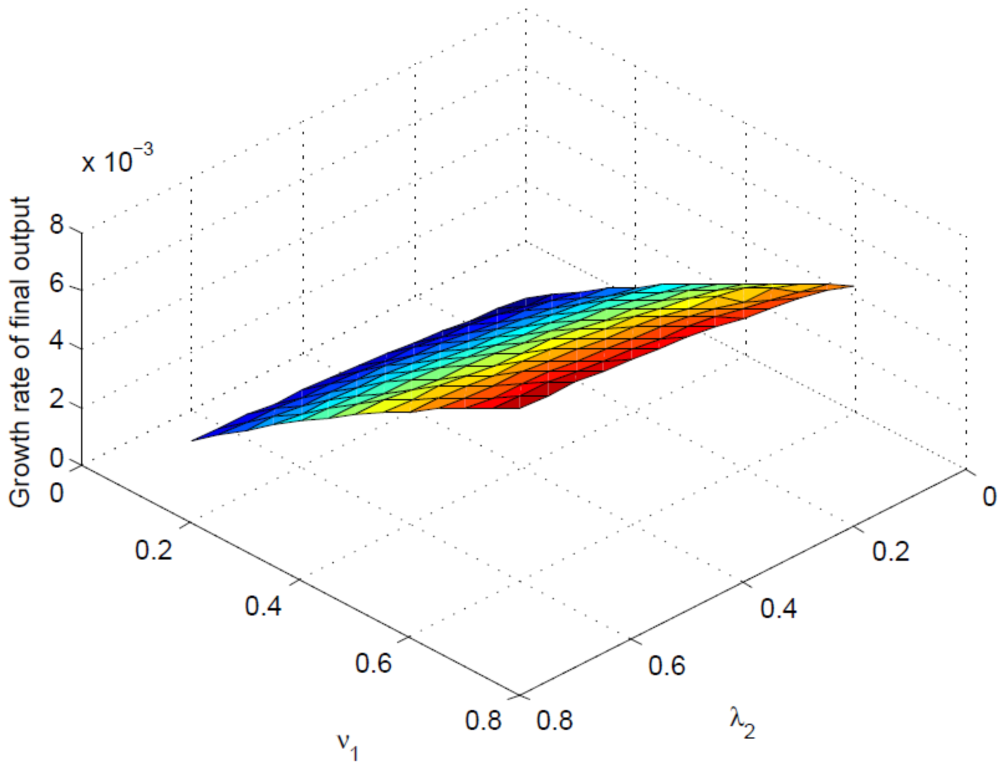
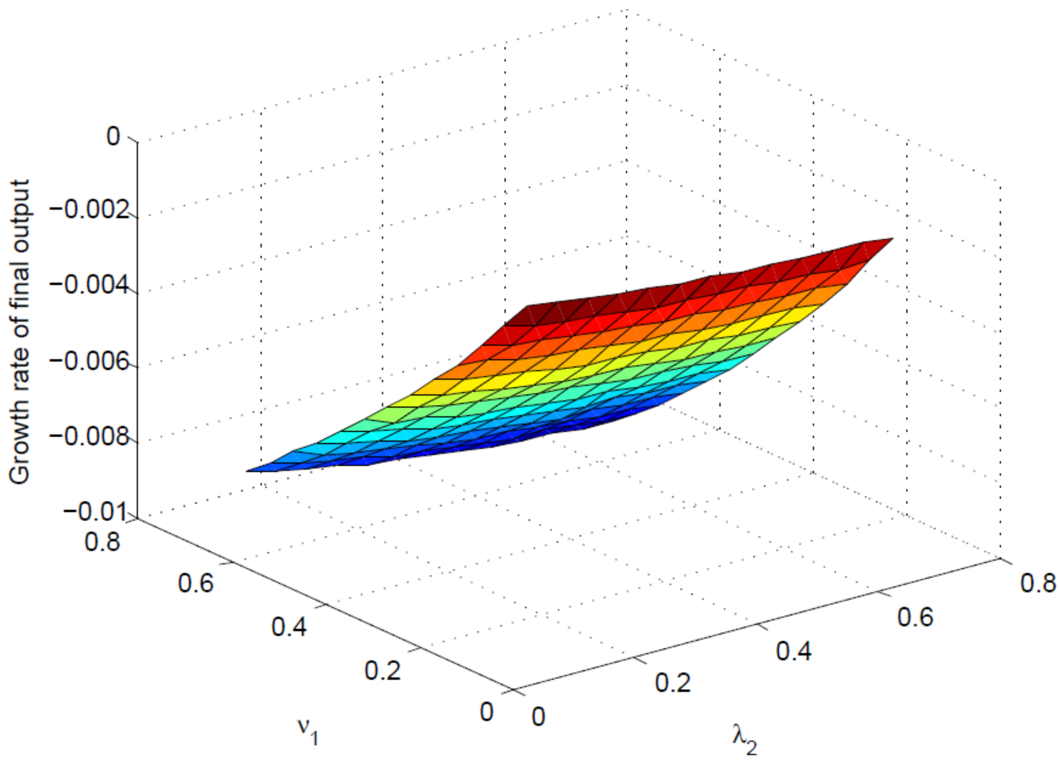


Figure 3
Increase in Spending on Education
Financed by a Cut in Spending on Social Capital-Related Activities
(Absolute Deviations from Baseline)



Notes: Increase in υ_H from 0.108 to 0.140, financed by a cut in υ_S. ν_1 is the elasticity of human capital with respect to government spending on education and λ_2 is the elasticity of social capital with respect to average human capital. They are set equal to 0.45 and 0.5 respectively in the benchmark case.

Figure 4
Increase in Spending on Social Capital-Related Activities
Financed by a Cut in Spending on Education
(Absolute Deviations from Baseline)



Notes: Increase in υ_S from 0.05 to 0.065, financed by a cut in υ_H. ν_1 is the elasticity of human capital with respect to government spending on education and λ_2 is the elasticity of social capital with respect to average human capital. They are set equal to 0.45 and 0.5 respectively in the benchmark case.

Table 2

Increase in Share of Government Spending on Education and Social Capital 1,2/

(Absolute Deviations from Baseline)

	$d\upsilon_H+d\upsilon_U = 0$	$d\upsilon_H + d\upsilon_S = 0$	$d\upsilon_S+d\upsilon_U = 0$	$d\upsilon_S+d\upsilon_H = 0$
Benchmark Values	Long run	Long run	Long run	Long run
Social capital-human capital ratio	**-0.1916**	**-0.3580**	**0.1534**	**0.4943**
Growth rate of final output	**0.0057**	**0.0050**	**0.0005**	**-0.0068**
Experiment: $\nu_1 = 0.2$ 3/	Long run	Long run	Long run	Long run
Social capital-human capital ratio	-0.0256	-0.0717	0.0399	0.0821
Growth rate of final output	0.0027	0.0020	0.0005	-0.0032
Experiment: $\lambda_2 = 0.7$ 4/	Long run	Long run	Long run	Long run
Social capital-human capital ratio	-0.1442	-0.2722	0.1133	0.3589
Growth rate of final output	0.0058	0.0053	0.0004	-0.0071
Experiment: $\lambda_2 = 0.9$	Long run	Long run	Long run	Long run
Social capital-human capital ratio	-0.1152	-0.2190	0.0893	0.2797
Growth rate of final output	0.0059	0.0055	0.0003	-0.0072
Experiment: $\nu_2 = 0.2$ 5/	Long run	Long run	Long run	Long run
Social capital-human capital ratio	-0.1662	-0.3122	0.1318	0.4209
Growth rate of final output	0.0051	0.0039	0.0008	-0.0058
Experiment: $\nu_2 = 0.4$	Long run	Long run	Long run	Long run
Social capital-human capital ratio	-0.1310	-0.2480	0.1023	0.3224
Growth rate of final output	0.0043	0.0023	0.0014	-0.0043

1/ Increase in υ_H from 0.108 to 0.140 financed by a concomitant cut in υ_U and a cut in υ_S.

2/ Increase in υ_S from 0.05 to 0.065 financed by a concomitant cut in υ_U and a cut in υ_H.

3/ ν_1 is the elasticity of human capital with respect to government spending on education and set equal to 0.45 in the benchmark case.

4/ λ_2 is the elasticity of social capital with respect to average human capital and set equal to 0.5 in the benchmark case.

5/ ν_2 is the elasticity of human capital with respect to the stock of social capital and set equal to 0.1 in the benchmark case.

Source: Author's calculations.