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The Missing Link: Are Individuals with More Social Capital in Better Health? Evidence from Low-Income Countries

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Keywords

Social Capital, Human Capital, Health, Endogenous Growth

JEL Classification

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The Missing Link: Are Individuals with More Social Capital in Better Health? Evidence from Low-Income Countries

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Abstract

This paper offers a new model to critically examine associations between human capital, social capital, and health outcomes within the context of a two-period Overlapping Generations (OLG) model of endogenous growth model. Basically, individuals with higher level of human capital can build strong social ties, and those individuals who have more robust social networks are less likely to have health problems and are physically healthier. In an attempt to gain a better understanding of broader policy implications, a numerical analysis for low-income countries has been utilised and a sensitivity analysis under a different set of parameter values has been employed in the paper. We provide a comparison of three main experiments: an increase in the share of public spending on education, social capital-related activities, and health. The results confirm the association between education, social capital, and health outcomes, and its favourable effect on long-run growth in low-income countries.

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1 Introduction

In recent years, social capital has long been a question of great interest in a wide range of fields. Along with this growth in discussion on the subject, to date, however, there has been little agreement on the term "social capital" among social and political scientists, and economists alike, yet it is now well established from a proliferation of studies (e.g., Hanifan, 1916; Jacobs, 1961; Loury, 1987; Coleman, 1990; Putnam, 1993 and 2000; Fukuyama, 1995; Putterman, 1995; Knack and Keefer, 1997; Dasgupta, 2003; Durlauf and Fafchamps, 2005; Sabatini, 2005) that social capital is a sociological concept which is generally understood to mean connections within and among social networks. In his incisive book *"Bowling Alone: The Collapse and Revival of American Community"*, Putnam (2000), for instance, provided a critical analysis of key perspectives and debates on the term "social capital". In its broadest sense, social capital is a commonly used notion in political science and social sciences, including economics.

In the last few decates, there is, however, an ever-increasing number of studies that recognises the importance of the relationship between human capital and social capital (e.g., Wolfinger and Rosenstone, 1980; Coleman, 1988; Smith, 1994; Wilson, 2000; OECD, 2001; Putnam, 2000; Jones, 2006; OECD, 2010; Alpaslan, 2015). On the other hand, there is a growing body of literature (e.g., Kawachi and Berkman, 2000; Kawachi and Berkman, 2001; Stephens et al., 2004; Viswanath et al., 2006; McKenzie, 2006; Scheffler and Brown, 2008) that describes the link between social capital and health. Scheffler and Brown (2008), for example, considered three key ways in which both individual- and area-level social capital can determine health: the diffusion of health information, access to health services and resources, which could be facilitated more by political organising, and psychosocial support. In fact, in a fashion similar to human capital which is already known in the literature to be among the most important factors for health[1], prior studies (e.g., Rose, 2000; Hyyppä and Mäki, 2001; Lindström, 2004; Mohseni and Lindström, 2007; d'Hombres et al., 2009; OECD, 2010) have consistently shown that individual-level social capital is fast becoming a key instrument in improving the health status and productivity of individuals and groups. Moreover, this is evident in the case of the *"Roseto Mystery"*, which was broadly discussed in Gladwell (2008)'s landmark book entitled "*Outliers: the Story of Success"*, implying that people who are more socially connected to community are physically healthier and live longer than people who are less connected. Conversely, people who are more isolated from the community find that their health and well-being decline earlier in midlife, and they even experience mental health disorders and live shorter lives.

However, in view of all that has been mentioned so far, one may suppose that what remains poorly understood is the actual relationship between social capital, human capital, and health outcomes. Indeed, results from earlier studies (e.g., Ross and Wu, 1995; Miller et al., 2006) demonstrate a strong and consistent association between social capital, human capital, and health. For example, Ross and Wu (1995) have reported that social capital can act as a moderating factor between education and health outcomes. Likewise, Miller et al. (2006) provide evidence for Indonesia that social capital and human capital could be both a contributing factor to health outcomes. The core idea is that individuals with higher levels of education and social integration tend to live a longer and healthier life than their worse-off counterparts. Or more precisely, highly-educated individuals would develop better social networks and become more socially integrated in a community; but at the same time previous studies, for instance, for the U.S. (e.g., Berkman and Syme, 1979; House et al.,

[1]See, for instance, Grossman (1972), Rosenzweig and Schultz (1983), Grossman and Kaestner (1997), Grossman (2000), Grossman (2005), Goldman and Smith (2005), Arendt (2005), Lleras-Muney (2005), Tamura (2006), Grimard and Parent (2007), De Walque (2007), Albouy and Lequien (2009), Cutler and Lleras-Muney (2010), Webbink et al. (2010), Agénor (2012), and Clark and Royer (2013), among others.

1988; Kawachi et al., 1996; Eng et al., 2002; Lochner et al., 2003; Scheffler et al., 2008) have revealed that individuals who have more robust social networks and community ties are less likely to have high mortality rates and health problems such as cardiovascular disease and stroke than people who are less socially integrated. A number of studies in other OECD countries such as United Kingdom, Sweden, and Finland (e.g., Mohan et al., 2005; Poortinga, 2006; Lofors and Sundquist, 2007; Sundquist and Yang, 2007; Olsen and Dahl, 2007) have also provided reasonably consistent evidence of an association between social capital and health. However, Helliwell and Putnam (2007) hold the view that the extent to which social capital determines health is causally associated with the average level of education. In other words, education level exerts an indirect effect through social capital, which in turn shapes health. Considering all of this evidence, while numerious studies have postulated the link between education, social capital, and health outcomes, it seems that previous research has failed to demonstrate any convincing evidence of the connection between them and their collective effect on economic growth for low-income countries.

Recently, a considerable growth literature has, however, grown up around the theme of social capital (e.g., Routledge and von Amsberg, 2003; Chou, 2006; Bofota et al., 2012; Growiec and Growiec, 2012; Ponzetto and Troiano, 2014; Agénor and Dinh, 2015; Alpaslan, 2015), yet Alpaslan (2015) has gone some way towards enhancing our understanding of the relationship between social capital and human capital. In a two-period Overlapping Generations (OLG) model, Alpaslan (2015) provided endogenous growth model-based evidence of a two-way relationship between social capital and human capital for a low-income country, India which has been reported to have one-third of population living below the official poverty line. In a numerical analysis of his study, a trade-off has been found to be related to two productive components of public spending: social capital-related activities and education, and this trade-off may go either way. Interestingly, further analysis showed that the trade-off fades away under a different set of parameter values, provided that a higher share of public spending on education is achieved at the expense of social capital-related activities.

This paper ties together the various theoretical strands in the literature. The present study makes several noteworthy contributions to the growth literature: To the best of our knowledge, this is the first study of substantial duration which offers a new model to critically examine associations between human capital, social capital, and health outcomes in the context of an endogenous growth model. Secondly, this study establishes a numerical analysis for low-income countries in order to detect the interaction effect between the above mentioned variables. Last but not least, the findings from this study should help to improve policy implications and provide a basis for further research.

The remaining part of the paper proceeds as follows: Section 2 begins by laying out the theoretical model. Section 3 presents the balanced growth equilibrium. Section 4 discusses the specific calibration methods by which the research and analyses were conducted. Section 5 summarises the principal findings of the research and policy experiments. The final section gives a brief summary and includes a discussion of the implication of the findings for further research.

2 The Model

Following Alpaslan (2015) for the model definition, which itself draws on Agénor and Dinh (2015), we briefly identify the characteristics of a two-period (adulthood and old age) OLG model of endogenous economic growth: The economy we consider is populated by nonaltruistic individuals, firms and a government. Firms produce a single, nonstorable physical good. The government chooses to run a balanced budget and government spending includes productive items: education, social capital-related activities, and health as well as other (unproductive) items; however, the government imposes a tax on only wage incomes of adult workers to finance its expenditures. And finally, all markets clear in equilibrium.

We now turn our attention to the identification of the model in detail: individuals, firms, human capital, social capital, health status, productivity, and survival rate, government, market-clearing conditions, and balanced growth equilibrium respectively.

2.1 Individuals

The individual's discounted utility function is given by

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

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, which is further discussed later, $q_t \in (0,1)$ the probability of survival from adulthood to old age, and $\rho > 0$ the subjective discount rate.

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

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

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

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

As in Agénor and Canuto (2015), firms are identical and their number is normalised to unity so production of a single nonstorable good requires the use of effective labour, $A_tE_tN_t^i$, where A_t is average adult labour productivity, E_t 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, $K_t^{P,i}$. However, in accordance with the evidence in Guiso et al. (2009), the firm production function also depends on average social capital of the previous generation, K_t^S. Suppose that the production function has constant returns to scale in private inputs, the production function of individual firm i follows that:

$$Y_t^i = (K_t^S)^\beta (A_tE_tN_t^i)^\beta (K_t^{P,i})^{1-2\beta}, \tag{4}$$

where $\beta \in (0,1)$ is the elasticity with respect to social capital stock and effective labour and therefore $1-2\beta$ is the elasticity with respect to private capital respectively. The elasticities with respect to social capital stock and effective labour are assumed to be the same for simplicity.

Aggregate output takes a linear form in private capital:

$$Y_t = \int_0^1 Y_t^i di = (k_t^S)^\beta e_t^\beta A_t^\beta \bar{N}^\beta K_t^P, \tag{5}$$

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

2.3 Human Capital

In line with Agénor and Dinh (2015), the individual stock of human capital at the beginning of period $t+1$ depends on government spending per capita, $G_t^E/\bar{N}$, and the average human capital of the previous generation, E_t.[2,3]

$$E^h_{t+1} = (\frac{G^E_t}{\bar{N}})^{\nu_1} E_t^{1-\nu_1}, \tag{6}$$

where $\nu_1 \in (0, 1)$ is the elasticity with respect to government spending on education and therefore $1 - \nu_1$ is the elasticity with respect to the average human capital of the previous generation respectively.

2.4 Social Capital

Although there has been much division between economists on the subject of "capital", as was mentioned in the introduction, it is clear that similar to human capital, social capital is an asset that individuals can invest in and is an important aspect of economic development, and therefore needs to be addressed. As argued by Alpaslan (2015), the individual stock of social capital at the beginning of period $t+1$ is determined by parent's average human and social capital, as well as government spending on social capital-related activities, which can strengthen legal system, contract enforcement, and institutional trust in political institutions, the judiciary, police, the media or other institutions and so on.[4,5]

$$K^{S,h}_{t+1} = (\frac{G^S_t}{\bar{N}})^{\lambda_1} E_t^{\lambda_2} (K^S_t)^{1-\lambda_1-\lambda_2}, \tag{7}$$

[2] In addition to these variables, Agénor and Dinh (2015) also considered the stock of imitated goods, as well as a fixed fraction of time spent in schooling to account for the human capital stock of individuals; however, we have abstracted from these issues.

[3] Alternatively, the individual stock of human capital would also depend on the productivity of individuals and teaching quality which is a continuing concern, especially for low-income countries; however, given the issue at stake, it is beyond the scope of this study.

[4] See, for instance, Scrivens and Smith (2013) for further discussion.

[5] However, in Agénor and Dinh (2015), public-private capital ratio, the amount of time individuals dedicate to enhancing their social capital stock, and an index, which can be defined as a proxy to measure social norms and values, are those variables that can also determine the individual stock of social capital. In fact, the Petris Social Capital Index (PSCI), which is concerned with the measurement of the supply side of social capital, has been a matter of ongoing discussion among economists (See OECD (2010) further discussion). However, given the importance of the issue at stake, those variables would significantly complicate the model yet provide no deeper insights into the analysis.

where G_t^S government spending on social capital-related activities, E_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-related activities and average human capital of the previous generation respectively.

2.5 Health Status, Productivity, and Survival Rate

As in Agénor (2012, Chapter 3), health status of individuals depends on the government provision of health care services, which is assumed to be linear in public spending on health services, G_t^H. This is, however, subject to congestion by the private capital stock, K_t^P, due to the excessive use of public infrastructure assets by the private sector.[6] The evidence reviewed in the introduction supports the notion that individuals' health status hinges on the average social capital of the previous generation, K_t^S, which is, however, scaled by average human capital as level of human capital increases, the marginal benefit of an increase in social capital stock becomes less and less relevant in accounting for health status of individuals:

$$H_{t+1}^h = (\frac{G_t^H}{K_t^P})^{\kappa_1}(\frac{K_t^S}{E_t})^{1-\kappa_1}, \tag{8}$$

where $\kappa_1 \in (0,1)$.

In line with Agénor and Canuto (2015), adult productivity depends on health status of individuals but is subject to decreasing marginal returns:[7]

$$A_{t+1}^h = (H_{t+1}^h)^{\kappa_p}, \tag{9}$$

where $\kappa_p \in (0,1)$.

As stated in Agénor and Dinh (2015), we assume that individuals with higher levels of education are more likely to have healthier lifestyles so the survival rate

[6] See, for instance, Agénor et al. (2012) for further discussion.
[7] See Bloom and Canning (2005), and Cole and Neumayer (2006) for further discussion.

from adulthood to old age takes the form:

$$q_t = q_L + \bar{q}(\frac{e_t}{1+e_t})^{\nu_Q}, \tag{10}$$

where $q_0 = q_L$ and $\lim_{e_t \to \infty} q_t = q_L + \bar{q} < 1$, $\nu_Q > 0$, and $e_t = E_t/K_t^P$ is the human capital-private capital ratio, as noted earlier.

2.6 Government

As discussed earlier, the government taxes only wage incomes of adult workers, its balanced budget is:

$$G_t = \sum G_t^j = \tau E_t A_t w_t \bar{N}, \quad j = E, S, H, O \tag{11}$$

where G_t^E, G_t^S, G_t^H, or G_t^O share of public spending on education, social capital-related activities, health, and other (not directly productive) items respectively.

It has been assumed that shares of public spending are constant fractions of government revenues:

$$G_t^j = \upsilon_j \tau E_t A_t w_t \bar{N}, \quad j = E, S, H, O \tag{12}$$

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

Combining (11) and (12) therefore yields

$$\sum_j \upsilon_j = 1. \tag{13}$$

2.7 Market-Clearing Conditions

As argued by Alpaslan (2015, p.8), the asset market clearing condition is that tomorrow's private capital stock is a linear function of today's savings by adult workers. In addition, for simplicity, we assume full depreciation:

$$K_{t+1}^P = \bar{N} s_t, \tag{14}$$

where s_t is savings per individual and $\bar{N}$ is the number of adult workers, as noted earlier.

3 Balanced Growth Equilibrium

As in Agénor et al. (2014, p.138) and Agénor and Dinh (2015, p.47-48), 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 $\{E_t\}_{t=0}^{\infty}$, 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 and health status $K_0^P > 0$, $K_0^S > 0$, $E_0 > 0$, $H_0 > 0$, individuals maximise utility, firms maximise profits, markets clear, and the government budget is balanced. In a symmetric equilibrium, it must be also that $c_t^{t,h}(c_{t+1}^{t,h}) = c_t^t(c_{t+1}^t)$, $s_t^h = s_t$, $E_t^h = E_t$, $K_t^{S,h} = K_t^S$, $H_t^h = H_t$, $A_t^h = A_t$, $\forall h$. 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, E_t, 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.

As can be seen from the appendix, the dynamic system consists of three nonlinear first-order difference equations in $e_t = E_t/K_t^P$, the human capital-private capital ratio, $k_t^S = K_t^S/K_t^P$, the social capital-private capital ratio, and health status in adulthood, H_t, steady-state values of which (denoted by superscript "$\sim$" over each relevant variable) are respectively given by:

$$\tilde{e} = \left\{\Psi_2 \tilde{\sigma}^{-1} (\tilde{k}^S)^{\mu_2} \tilde{H}^{\kappa_p \mu_2}\right\}^{1/(1-\mu_1)}, \tag{15}$$

$$\tilde{k}^S = \left\{\Psi_4 \tilde{\sigma}^{-1} \tilde{e}^{\mu_3} \tilde{H}^{\kappa_p \mu_5}\right\}^{1/(1-\mu_4)}, \tag{16}$$

$$\tilde{H} = \left\{\Psi_5 (\tilde{k}^S)^{\mu_6} \tilde{e}^{\mu_7}\right\}^{1/\mu_8}, \tag{17}$$

where the marginal propensity to save is

$$\tilde{\sigma} = \frac{\tilde{q}}{\eta_C(1+\rho) + \tilde{q}} < 1, \tag{18}$$

together with the survival rate from adulthood to old age:

$$\tilde{q} = q_L + \bar{q}(\frac{\tilde{e}}{1+\tilde{e}})^{\nu_Q},$$

and

$$\Psi_1 = (\upsilon_E \tau \beta \bar{N}^{\beta-1})^{\nu_1}, \ \Psi_2 = \Psi_1[(1-\tau)\beta\bar{N}^{\beta}]^{-1}, \ \Psi_3 = (\upsilon_S \tau \beta N^{\beta-1})^{\lambda_1},$$

$$\Psi_4 = \Psi_3[(1-\tau)\beta\bar{N}^{\beta}]^{-1}, \ \Psi_5 = (\upsilon_H \tau \beta \bar{N}^{\beta})^{\kappa_1},$$

$$\mu_1 = (\beta-1)(\nu_1-1), \ \mu_2 = \beta(\nu_1-1), \ \mu_3 = \beta(\lambda_1-1)+\lambda_2, \ \mu_4 = (\beta-1)(\lambda_1-1)-\lambda_2,$$

$$\mu_5 = \beta(\lambda_1-1), \ \mu_6 = \kappa_1(\beta-1)+1, \ \mu_7 = \kappa_1(\beta+1)-1, \ \mu_8 = 1-\kappa_1\beta\kappa_p.$$

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

$$1+\boldsymbol{\gamma} = (\tilde{k}^S)^{\beta}\tilde{e}^{\beta}\tilde{H}^{\beta\kappa_p}\bar{N}^{\beta}\tilde{\sigma}(1-\tau)\beta. \tag{19}$$

4 Calibration Exercise

In order to investigate the growth effects of public policies, a calibration exercise has been employed. For the purpose of the analysis, the experiments were conducted for a low-income country.

For households, the annual discount rate, $\rho = 0.04$ has long been reported in the literature. An OLG framework over a 20-year period yields the intergenerational discount factor: $[1/(1+0.04)]^{20} \cong 0.456$.

The most common method for estimating the survival probability from adulthood to old age is the use of the probability of dying. In a recent paper, Agénor and Dinh (2015) argue that the probability of survival to old age, q, has been estimated as 93.7 percent for a sample of five low-income Sub-Saharan African countries: Benin, Burundi, Senegal, Tanzania, and Uganda.

The family's propensity to save, $\sigma = q/[\eta_C(1+\rho)+q] = 12$ percent has been used as a baseline value; this is the average value of private savings for low-income countries, which has been noted in Agénor et al. (2014). Given the above variables: the intergenerational discount rate, the family's propensity to save, and the estimated value of the survival probability, the preference parameter for current consumption η_C, which can be solved backward from equation (18), can be calibrated at 3.136, as in Agénor and Dinh (2015).

The estimated value for the elasticity with respect to effective labour, $\beta = 0.35$ has been taken from Agénor (2011), whereas the elasticity with respect to private capital, $1 - 2\beta = 0.3$ is consistent with the value that has been considered in Agénor and Alpaslan (2013).

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). Therefore, the elasticity with respect to the stock of average human capital is equal to 0.55.

In the social capital sector, as in Agénor and Dinh (2015), the elasticity with respect to public spending on social capital-related activities, λ_1, is set equal to 0.3; however, in some way analogous to Alpaslan (2015), the elasticity with respect to human capital, λ_2, is initially set to 0.2. As a result, the elasticity with respect to the stock of social capital is set equal to 0.5.

As reported by Osang and Sarkar (2008), the elasticity of health status in adulthood with respect to government spending on health services, κ_1, is equal to 0.55, thus the elasticity with respect to the average social capital of the previous generation, $1 - \kappa_1$, is equivalent to 0.45. The elasticity of adult productivity with respect to health status, $\kappa_p = 0.8$ is in line with the estimated value in Cole and Neumayer (2006). Shift parameter, $\bar{q} = 0.137$, which can be obtained from the limit condition ($\lim_{e_t \to \infty} q_t = q_L + \bar{q}$), minimum value, $q_L = 0.8$, and curvature parameter of the survival rate function, $\nu_Q = 1$, are all in agreement with the values that have been acknowledged in Agénor and Dinh (2015).

The tax rate on wage income is equal to 15.05 percent, which corresponds to the average ratio of tax revenues to GDP for low-income countries for a 8-year period

(2001-08), as argued by Baldacci et al. (2004, Table 1). In line with the evidence in Guerriero (2012), this value is, however, divided by 0.701, which is the estimated average share of labour income in final output for developing countries. Consequently, the effective tax rate on wages, τ, is 21.47 percent.

The initial share of government spending on education, $\upsilon_E = 0.171$ is consistent with the value that has been established in Agénor and Alpaslan (2013), whereas the share of government spending on social capital-related activities, υ_S, is initially set equal to 0.05, which has been taken from Alpaslan (2015). Lastly, the share of public spending on health, $\upsilon_H = 0.103$ has been selected as a baseline value, as in Agénor et al. (2014). Therefore, equation (13) implies that the share of spending on other items, υ_O, is 0.676.

The benchmark parameter values are summarised in Table 1. We have introduced a multiplicative constant into the growth equation and the steady-state growth rate of final output is calibrated at 3.3 percent per annum, which has been reported by Baldacci et al. (2004, Table 1) to be the average growth rate of output for developing countries over the period 1975-2000. However, it is not possible to analytically assess if the dynamic system is stable due to the nonlinear behaviour and parsimonious nature of the model; therefore, using parameter and starting values for the dynamic variables: the human capital-private capital ratio, $e_t = E_t/K_t^P$ and social capital-private capital ratio, $k_t^S = K_t^S/K_t^P$, and health status of an individual, H_t^h, the dynamic system is solved numerically and the model proved to be stable within less than 30 periods.

Table 1: Calibrated Parameter Values: Benchmark Case

Sectors	Parameters
Individuals	$\rho = 0.04, \sigma = 0.12, \eta_C = 3.136$
Final goods	$\beta = 0.35$
Human capital	$\nu_1 = 0.45$
Social capital	$\lambda_1 = 0.3, \lambda_2 = 0.2$
Health status	$\kappa_1 = 0.55, \kappa_p = 0.8$
Survival rate	$\bar{q} = 0.137, q_L = 0.8, \nu_Q = 1$
Government	$\tau = 0.215, \upsilon_E = 0.171, \upsilon_S = 0.05, \upsilon_H = 0.103, \upsilon_O = 0.676$

5 Policy Experiments

The set of calibration analyses examined the long-run impacts of policy experiments. In this sense, we focus on the following variables: individual savings rate, life expectancy, social capital-private capital ratio, human capital-private capital ratio, social capital-human capital ratio, health status, and growth rate of final output, baseline values of which have been all shown in Table 2. To that end, we consider three main experiments: a 30 percent increase in the share of public spending on education, social capital-related activities, and health respectively. The results obtained from the analysis are also set out in Table 2, which compares both benchmark values and alternative values of the key parameters in response to each particular experiment.

Consider first a permanent budget-neutral increase in the share of public spending on education from an initial value of 0.171 to 0.222. In the benchmark case, an increase in government spending on education promotes the rate of human capital, which tends to increase life expectancy and therefore individual savings rate. At the same time, this increase in the rate of human capital will enhance the benefit associated with social capital-related activities, thereby increasing the social capital-human capital ratio, which in turn improves health status of individuals. As a result, the net effect on growth rate of final output is positive and of the order of

0.40 percentage points. Table 2 also reports the findings for alternative values of the elasticity of human capital with respect to government spending on education, $\nu_1 = 0.55$, elasticity of social capital with respect to government spending on social capital-related activities, $\lambda_1 = 0.4$, elasticity of social capital with respect to human capital of the previous generation, $\lambda_2 = 0.3$, and elasticity of health status in adulthood with respect to government spending, $\kappa_1 = 0.65$. For instance, for a higher value of the elasticity of human capital with respect to government spending on education, $\nu_1 = 0.55$, a higher share of spending on education further enhances the growth rate of final output not only directly through its effect on the production of productive inputs but also indirectly through the positive externality associated with social capital accumulation, thereby the net impact on long-run growth is positive and of the order of 0.47 percentage points.

We next consider a 30 percent budget-neutral increase, that is, from an initial value of 0.05 to 0.065, in the share of public spending on social capital-related activities. From the table, it can be seen that an increase in the share of public spending on social capital-related activities has a direct, positive impact on the social capital stock, thereby the social capital-private capital ratio increases. However, perhaps the most interesting finding is the fall in the human capital-private capital ratio. This result may be explained by the fact that an increase in the share of spending on social capital-related activities indirectly affects not only human capital stock but also private capital stock through its productivity effect. It may be the case therefore that the increase in the private capital stock becomes more than in the human capital stock; as a result, the human capital-private capital ratio increases by less than in the benchmark case and therefore the absolute deviation of the ratio from the benchmark turns negative. Consequently, the reason why the absolute deviations of life expectancy, and accordingly individuals savings rate also turn out to be negative could be attributed to the fall in the human capital-private capital ratio. However, as the elasticity of human capital with respect to government spending on education, ν_1 increases, this adverse effect that we observe in the human capital-private capital ratio, life expectancy, and individual savings rate is, however, mitigated. Nevertheless, what stands out in Table 2 is that despite the fall in the human capital-private capital ratio, the increase in the social capital-human capital ratio has a favourable effect on health status of individuals. From the findings in Table 2, it is also apparent that the extent to which a higher share of public spending on social capital-related activities influences health status and growth rate of final output depends on the magnitude of the elasticity of social capital with respect to social capital-enhancing government spending, λ_1. Indeed, this is evident in the case of $\lambda_1 = 0.4$; health status and long-run growth increase by about 6.9 percentage points and 0.10 percentage points respectively.

Turning now to a permanent budget-neutral increase in the share of public spending on health from 0.103 to 0.133, the results, as shown in Table 2, indicate that higher spending on health has a health-enhancing effect and as a result of the improving health spending, the net impact on long-run growth is positive. The benefit of an increase in the share of health spending on health status of individuals is further enhanced and such a policy further stimulates growth rate of final output if the elasticity of health status in adulthood with respect to government spending on health, $\kappa_1 = 0.65$ is greater than the benchmark value, 0.55.

6 Concluding Remarks

This paper offered a new model for better understanding the relationship between education, social capital, and health outcomes within the context of a two-period Overlapping Generations (OLG) model of endogenous growth. Fundamentally, individuals with higher levels of human capital and social capital tend to live longer and healthier life than their worse-off counterparts. To be more precise, highly-educated individuals would, in fact, develop better social networks and become more socially integrated in a community. Accordingly, individuals who are more socially connected to community are physically healthier and less likely to have health problems, as discussed earlier.

The paper also provided a comprehensive numerical analysis under a different set of parameter values for low-income countries. To that end, we compared three main experiments: an increase in the share of public spending on education, social capital-related activities, as well as health. According to the findings of the numerical analysis, social capital stock accompanied by higher levels of human capital stock can act as a contributing factor to health outcomes and is conducive to long-run growth in low-income countries yet its effect becomes stronger depending on the magnitude of the key parameter values in the model.

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Appendix
Dynamic System and Steady-State Growth

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

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

Each individual maximises (1) with respect to $c_t^{t,h}, c_{t+1}^{t,h}$, subject to (7), (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

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

or equivalently,

$$c_t^t = (1-\sigma_t)(1-\tau)E_t A_t w_t, \tag{A3}$$

where the marginal propensity to save is

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

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

$$s_t = \sigma_t(1-\tau)E_t A_t w_t. \tag{A4}$$

Substituting (A4) in (14) yields

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

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

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

In a symmetric equilibrium, the first-order conditions yield

$$E_t A_t w_t = \beta \frac{Y_t}{\bar{N}}, \;\; r_t = (1-2\beta)\frac{Y_t}{K_t^P}, \tag{A7}$$

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

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

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

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

$$K_{t+1}^P = \sigma_t(1-\tau)\beta(k_t^S)^\beta e_t^\beta A_t^\beta \bar{N}^\beta K_t^P,$$

or equivalently, using (9),

$$\frac{K_{t+1}^P}{K_t^P} = \sigma_t(1-\tau)\beta(k_t^S)^\beta e_t^\beta H_t^{\kappa_p\beta}\bar{N}^\beta. \tag{A9}$$

Equation (6) can be rewritten as

$$\frac{E_{t+1}}{E_t} = (\frac{G_t^E}{\bar{N}E_t})^{\nu_1}. \tag{A10}$$

Substituting (12) for $j = E$ into (A10) and rearranging this yields

$$\frac{E_{t+1}}{E_t} = (\frac{\upsilon_E\tau E_t A_t w_t \bar{N}}{\bar{N}E_t})^{\nu_1},$$

which can be rearranged, using (A7) to eliminate w_t, together with (5) and (9), noting that $e_t = E_t/K_t^P$ and $k_t^S = K_t^S/K_t^P$,

$$\frac{E_{t+1}}{E_t} = \Psi_1 e_t^{(\beta-1)\nu_1}(k_t^S)^{\beta\nu_1} H_t^{\kappa_p\beta\nu_1}, \tag{A11}$$

where

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

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

$$e_{t+1} = \Psi_2\sigma_t^{-1}e_t^{\mu_1}(k_t^S)^{\mu_2}H_t^{\kappa_p\mu_2}, \tag{A12}$$

where

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

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

$$\mu_2 = \beta(\nu_1-1).$$

Equation (7) can be rewritten as

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

Substituting (12) for $j = S$ into (A13) and rearranging this yields

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

which can be rearranged to give, using (A7) for w_t, (5) for Y_t/K_t^P, and (9),

$$\frac{K_{t+1}^S}{K_t^S} = \Psi_3 e_t^{\beta\lambda_1+\lambda_2}(k_t^S)^{(\beta-1)\lambda_1-\lambda_2}H_t^{\kappa_p\beta\nu_1}, \tag{A14}$$

where

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

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

$$k_{t+1}^S = \Psi_4 \sigma_t^{-1} e_t^{\mu_3}(k_t^S)^{\mu_4}H_t^{\kappa_p\mu_5}, \tag{A15}$$

where

$$\Psi_4 = \Psi_3[(1-\tau)\beta\bar{N}^\beta]^{-1},$$
$$\mu_3 = \beta(\lambda_1 - 1) + \lambda_2,$$
$$\mu_4 = (\beta-1)(\lambda_1-1) - \lambda_2,$$
$$\mu_5 = \beta(\lambda_1 - 1).$$

Equation (8) can be written again for convenience:

$$H_{t+1} = (\frac{G_t^H}{K_t^P})^{\kappa_1}(\frac{K_t^S}{E_t})^{1-\kappa_1},$$

which can be rearranged to give, using (12) for $j = H$ and (A7) for w_t,

$$H_{t+1} = (\upsilon_H \tau\beta)^{\kappa_1}(\frac{Y_t}{K_t^P})^{\kappa_1}(\frac{K_t^S}{E_t})^{1-\kappa_1}. \tag{A16}$$

Substituting (5) into (A16) yields, noting that $K_t^S/E_t = k_t^S/e_t$,

$$H_{t+1} = (\upsilon_H \tau\beta)^{\kappa_1}[(k_t^S)^\beta e_t^\beta A_t^\beta \bar{N}^\beta]^{\kappa_1}(\frac{k_t^S}{e_t})^{1-\kappa_1},$$

which gives, using (9),

$$H_{t+1} = \Psi_5 (k_t^S)^{\kappa_1(\beta-1)+1} e_t^{\kappa_1(\beta+1)-1} (H_t)^{\kappa_1 \beta \kappa_p},$$

or alternatively,

$$\begin{aligned} H_{t+1} &= \Psi_5 (k_t^S)^{\mu_6} e_t^{\mu_7} (H_t)^{\kappa_1 \beta \kappa_p}, \\ \Psi_5 &= (\upsilon_H \tau \beta \bar{N}^{\beta})^{\kappa_1}, \\ \mu_6 &= \kappa_1(\beta - 1) + 1, \\ \mu_7 &= \kappa_1(\beta + 1) - 1. \end{aligned} \tag{A17}$$

From (A12), (A15), and (A17),

$$\tilde{e} = \left\{ \Psi_2 \tilde{\sigma}^{-1} (\tilde{k}^S)^{\mu_2} \tilde{H}^{\kappa_p \mu_2} \right\}^{1/(1-\mu_1)}, \tag{A18}$$

$$\tilde{k}^S = \left\{ \Psi_4 \tilde{\sigma}^{-1} \tilde{e}^{\mu_3} \tilde{H}^{\kappa_p \mu_5} \right\}^{1/(1-\mu_4)}, \tag{A19}$$

$$\tilde{H} = \left\{ \Psi_5 (\tilde{k}^S)^{\mu_6} \tilde{e}^{\mu_7} \right\}^{1/\mu_8}, \tag{A20}$$

where

$$\mu_8 = 1 - \kappa_1 \beta \kappa_p.$$

From equations (5) and (A8), together with (9), the growth rate of final output for $t + 1$ during the transition:

$$Y_{t+1} = (k_{t+1}^S)^{\beta} e_{t+1}^{\beta} H_{t+1}{}^{\beta \kappa_p} \bar{N}^{\beta} \sigma_t (1 - \tau) \beta Y_t,$$

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

$$Y_{t+1}/Y_t = 1 + \boldsymbol{\gamma} = (\tilde{k}^S)^{\beta} \tilde{e}^{\beta} \tilde{H}^{\beta \kappa_p} \bar{N}^{\beta} \tilde{\sigma} (1 - \tau) \beta. \tag{A21}$$

Table 2

Increase in Share of Government Spending on Education, Social Capital-Related Activities, and Health

Higher Share of Spending on Education 1/		**Absolute Deviations from Baseline**				
	Baseline	Benchmark	$\nu_1 = 0.55$	$\lambda_1 = 0.4$	$\lambda_2 = 0.3$	$\kappa_1 = 0.65$
Individual savings rate	0.120	0.0005	0.0006	0.0005	0.0005	0.0005
Life expectancy	0.940	0.0044	0.0053	0.0045	0.0046	0.0044
Social capital-private capital ratio	0.958	0.1412	0.1667	0.1373	0.1351	0.1358
Human capital-private capital ratio	1.087	0.1384	0.1640	0.1406	0.1419	0.1368
Social capital-human capital ratio	0.881	0.0157	0.0189	0.0093	0.0036	0.0132
Health status	1.000	0.0703	0.0858	0.0656	0.0614	0.0798
Growth rate of final output	0.033	0.0040	0.0047	0.0039	0.0038	0.0040
Higher Share of Spending on Social Capital 2/		**Absolute Deviations from Baseline**				
	Baseline	Benchmark	$\nu_1 = 0.55$	$\lambda_1 = 0.4$	$\lambda_2 = 0.3$	$\kappa_1 = 0.65$
Individual savings rate	0.120	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
Life expectancy	0.940	-0.0010	-0.0008	-0.0013	-0.0010	-0.0010
Social capital-private capital ratio	0.958	0.0555	0.0592	0.0734	0.0533	0.0573
Human capital-private capital ratio	1.087	-0.0297	-0.0233	-0.0381	-0.0273	-0.0289
Social capital-human capital ratio	0.881	0.0772	0.0776	0.1030	0.0751	0.0782
Health status	1.000	0.0525	0.0557	0.0686	0.0489	0.0465
Growth rate of final output	0.033	0.0008	0.0009	0.0010	0.0007	0.0008
Higher Share of Spending on Health 3/		**Absolute Deviations from Baseline**				
	Baseline	Benchmark	$\nu_1 = 0.55$	$\lambda_1 = 0.4$	$\lambda_2 = 0.3$	$\kappa_1 = 0.65$
Individual savings rate	0.120	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
Life expectancy	0.940	-0.0006	-0.0004	-0.0006	-0.0006	-0.0007
Social capital-private capital ratio	0.958	-0.0508	-0.0460	-0.0467	-0.0490	-0.0613
Human capital-private capital ratio	1.087	-0.0161	-0.0126	-0.0187	-0.0177	-0.0197
Social capital-human capital ratio	0.881	-0.0342	-0.0337	-0.0282	-0.0309	-0.0415
Health status	1.000	0.1431	0.1449	0.1483	0.1469	0.1782
Growth rate of final output	0.033	0.0004	0.0005	0.0005	0.0005	0.0005

1/ Increase in υ_E from 0.171 to 0.222 financed by a concomitant cut in υ_U.

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

3/ Increase in υ_H from 0.103 to 0.133 financed by a concomitant cut in υ_U.

Notes: 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. λ_1 and λ_2 are the elasticity of social capital with respect to government spending on social capital-related activities and human capital of the previous generation. They are set equal to 0.3 and 0.2 respectively in the benchmark case. κ_1 is the elasticity of health status in adulthood with respect to government spending on health and set equal to 0.55 in the benchmark case.

Source: Author's calculations.