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# Social Capital and its Role in Production: Does the Depletion of Social Capital Depress Economic Growth?

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**Abstract -** We augment a Solow-Ramsey growth model by including: i) a labor-leisure choice, ii) social capital entering the production functions, iii) negative externalities affecting social capital and increasing with the level of activity, iv) the possibility for economic agents to substitute social capital with produced goods. It is shown that the erosion of social capital may lead to a higher steady-state level of activity. Hence, the possibility of substituting social capital in production functions may generate dynamics whereby agents compensate for negative externalities by increasing their labor supply and accumulation in order to increase the output used to substitute diminishing social capital. By so doing, they contribute further to the decline in social capital, which feeds back into the mechanism that induces agents to increase output. This result is at odds with the literature on social capital, which generally considers the latter to be an important growth-enhancing factor and its erosion as an obstacle to obtaining higher per-capita output.

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## 1. INTRODUCTION

In this paper we show that even when a larger endowment of social capital enhances productivity, its erosion may lead the economy toward a steady state characterized by a higher level of per-capita output. This result contradicts the literature on the subject, which generally focuses on the role played by social capital in favoring the growth process, consequently considering its decline to be a factor which damages the growth prospects of an economic system. Hence, the literature on social capital has never explored the possibility that its erosion may be a stimulus rather than a limit to growth. This is perhaps due to the 'imprinting' of this concept, which was first developed in order to take account of the importance of socio-cultural factors in development. There is a long tradition of thought, one which precedes the existence itself of the term 'social capital', founded on the idea that capitalism has a socio-cultural basis laid down over the centuries. The origin itself of capitalism has been explained in terms of ethical culture (Weber, Tawney).

Given the imprinting of the concept, it has seemed natural to interpret the apparent tendency of market societies to erode social capital as a potential limit to growth [1] However also with a long history behind it is the idea that the greatest danger to the social capital on which the efficacy of the market is founded arises from the market system itself. The expansion of the market system carries with it the risk of erosion of the social capital on which the efficient functioning of the system itself depends. Consistently with this view, the survival of the market system can be jeopardized by that progressive weakening of its cultural and ethical base which is a consequence of its expansion and success. In other words, the individualistic and competitive values system connected with the rise of a market economy is the greatest threat to the efficient working of markets. Some authors have gone so far as to claim that capitalism contains within itself the mechanism of its own destruction (see Hirschman, Hirsch): the decline of the values that prevent the spread of the opportunism generated by the market society will end up by destroying the latter.

[1] See Putnam. Fukuyama fully embraces the idea that capitalism tends to erode social capital but offers an optimistic view of its ability to regenerate that capital.

The model presented here is consistent with the view that capitalism tends to erode the socio-cultural sediment which makes market transactions work, but it does not share the view that the erosion of social capital worsens the growth performance of the economy. In fact it shows that this erosion does not necessarily generate a decline in per-capita output. However, the decline in social capital worsens the welfare prospects of the individuals populating the economy. Indeed, the higher per-capita output brought about by the degradation of social capital is accompanied by a decline in individual well-being. Since in this model growth in per- capita output appears to be a coordination failure what is questioned here is the implicit persuasion that the economy's potential for long run growth is the ultimate measure of the efficiency of the market system.

The paper is organized as follows: section 2 discusses the impact of economic growth on social capital, while section 3 focuses on the reaction of individuals to the decline in social capital. Section 4 presents the model, section 5 characterizes the trajectories of the economy and section 6 presents some concluding remarks.

## 2. SOCIAL CAPITAL AND GROWTH

In the past two decades the perception has spread among economists that the virtues of the capitalist system derive not only from the advantages of competition but also from those of cooperation. On this view, capitalism consists of a delicate balance between competitive and cooperative forms of behaviour, the latter being important in both exchanges and organizations. A major stimulus to the spread of these ideas has come from the development of games theory and of neo-institutionalism.

When assessing the impact of economic growth on ocial capital we must consider that the expansionary dynamic of capitalism seems to erode cooperative behaviour. Indeed, the Smithian process of increased markets size and the division of labour has been accompanied by an increase in transaction costs connected with a decline in trust – which is the mainspring of cooperative behaviour. There are at least two reasons why the expansion of the size of the relational networks through which a society produces and exchanges its output reduces trust among agents, this being the sense in which the term ‘social capital’ is used in this paper.

a) the increased opportunism of individuals. The erosion of communitarian bonds provokes a decline in the shared values and social norms that prevent the spread of opportunism. In this sense, social capital is undermined by the diffusion of capitalist values. In fact, the diffusion of the values system connected to a market economy based on competition and individual success subverts values of crucial importance for the simplification of transactions (like honesty, business ethics, etc.). As said in the introduction, this interpretation of social capital as the historically established social-cultural sediment that reduces transaction costs is widely present in the literature on the topic. In this view, the degree of opportunism of individuals is historically determined.

b) the reduced effectiveness of reputational mechanisms. As the network expands, people find it increasingly difficult to obtain information about the subjects with whom they enter into economic relations. Because individuals tend to be anonymous, the effectiveness of reputational mechanisms has diminished. The process has been exacerbated by the erosion of communitarian bonds, for the effectiveness of reputational mechanisms also depends on the strength of social ties and the cohesion of networks. As long as the village priest had social influence and prestige, he could inform his flock about the reliability of certain individuals because he was better able to gather information, and his opinion was more likely to be listened to. But when social bonds dissolve, the circulation of information diminishes and the figures appointed to transmit reputational judgement disappear. Differently from the preceding one, this mechanism is consistent with the hypothesis that individuals are wholly opportunistic. This hypothesis, too, is widely put forward in the literature on the topic (see for instance Annen 2003, Routledge and von Amsbergh 2003).

Both these mechanisms are compatible with the way in which we model negative externalities and the social capital that they affect. The latter we model as a public good on which no property right is defined: that is, we treat it as a ‘common’ which enters the production function.

It should be stressed that previous models of social capital have concentrated exclusively on the hypothesis that individuals are opportunistic. Hence an innovative feature of our model is that it is also consistent with an interpretation which instead emphasises that social capital is a cultural sediment laid down over time. In this interpretation social capital is regarded as determining the degree of opportunism considered on average to be ethically acceptable. Hence we do not suppose that agents are intrinsically opportunistic, rather that the degree of opportunism is a cultural feature that derives from the past. The perception of what is considered to be honest and the value attributed to it are, we maintain, cultural traits.

## 3. DEFENSIVE EXPENDITURES IN PRODUCTION

Our model shows that the erosion of social capital due to the two above mechanisms may not depress the long-run equilibrium level of per-capita output but may instead boost it.[2] The reason for this is that individuals can avert the decline of social capital by using its costly substitutes: that is, by undertaking defensive expenditures. Transaction costs, expecially those connected with asymmetries in information among individuals, are intrinsically defensive in nature because they consist of expenditures aimed at self-protecting against opportunism. For example, it is possible to substitute trust in someone with a television security camera. If I lose trust in my commercial partners, I can find a legal consultant to draw up contracts to ensure that I am protected. The examples are intended to suggest that agents may react to negative externalities by switching to transactional modes which employ private rather than public goods. By increasing the production of private goods intended to substitute for social capital, individuals foster the further deterioration of social capital, which feeds back into the mechanism that induces agents to substitute for it. Hence, if individuals react to the erosion of social capital by expanding the production of private goods, the

[2] On this see also Smulders, who, in a model where a common resource enters both the utility function and production functions, shows that the effect of the erosion of this resource on growth is ambiguous and depends on the value of certain parameters. Although Smulders offers an interpretation of the resource only as an environmental good, this interpretation can be straightforwardly extended to social capital as well.

unintended result may be a further erosion of social capital which generates a self-feeding mechanism boosting growth.

Consequently, in the case where social capital enters the production functions, its deterioration may drive a self-reinforcing growth process. The message of this model is therefore that even if social capital is of great importance for the efficient working of markets, its erosion may generate undesirable growth: that is, it may lead the economy toward an inefficiently high level of per-capita output. The harmful impact of the destruction of social capital reduces individual welfare but not the prospects of growth, which may be enhanced.

In this model, output overestimates well-being. In fact, output overestimates the increase in final goods because it also comprises intermediate goods. One can easily imagine, for example, expenditure that could be augmented by increased opportunism, and which should therefore be counted as intermediate expenditure: for example, expenditures on business and legal advisors, on the protection of property rights or of industrial secrets, on protection against crime, the costs of monitoring, of writing and enforcing contracts, information costs like expenditure on personnel recruitment or the search for commercial partners, the acquisition of personal knowledge to defend oneself against opportunism (being equipped to swim in a sea full of sharks may be very costly, and not only psychologically).

Our model also admits an environmental interpretation of the free resource entering the production functions, which can be viewed as natural capital. However, it is of more importance in this context to interpret this resource as social capital, because in industrial countries the depletion of natural capital is unlikely to restrict the expansion of production. In fact, the age when production relied largely on natural resources has now been superseded in the industrial countries, given that it was an age essentially comprising economies based on traditional agriculture. In fact the environment is used by the industrial sector mainly as a repository for waste. There are only rare examples of industries which require good quality environmental resources as inputs, and whose productive capacities are consequently vulnerable to a decline in the quality or quantity of such resources. Hence, unlike social capital, environmental capital is much more likely to have a direct influence on individual utility rather than on production.

## 4. THE MODEL

We consider an economy in discrete time with an infinite time horizon. For simplicity and without loss of generality, it is assumed that population is constant and that each household contains one adult, working member of the current generation. Thus, there is a fixed and large number (normalized to be one) of identical adults who take account of the welfare and resources of their actual and prospective descendants. Following Barro and Sala-i-Martin (1995) we model this intergenerational interaction by imagining that the current generation maximizes utility and incorporates a budget constraint over an infinite future. That is, although individuals have finite lives, we consider immortal extended families ("dynasties").[3] Current adults expect the size of their extended family to remain constant, since expectations are rational (in the sense that they are consistent with the real processes followed by the relevant variables). In this framework, in which there is no source of random disturbances, this implies perfect foresight.

In each period t, the utility of the representative household is an increasing function of consumption and leisure:

$$U_t=\ln(C_t)+\varphi\ln(1-L_t),\ \varphi>0,\ L_t\leq 1, \qquad (1a)$$

where $C_t$ is consumption and $L_t$ is the time spent working in period t by the representative household (the total amount of time available to each household in t is normalized to be one).

Each household produces the single good $Y_t$ according to the technology

$$Y_t = L_t^{\alpha} K_t^{1-\alpha} A_t^{\beta},\ 0<\alpha<1,\ 0<\beta\leq 1, \qquad (1b)$$

[3] As Barro and Sala-i-Martin (1995, p. 60) point out, "this setting is appropriate if altruistic parents provide transfers to their children, who give in turn to their children, and so on. The immortal family corresponds to

where $K_t$ is physical capital and $A_t$ is a variable affecting factor productivity.

Physical capital evolves according to

$K_{t+1}=I_t+(1-\delta)K_t$, $K_0$ given, $0<\delta<1$, (1d)

where $I_t$ is investment.

The variable affecting factor productivity depends on a state variable that evolves in time, and on the amount of output that each household decides to devote in period t to boosting factor productivity:

$A_t=R_t+\phi X_t$, $\phi>0$, (1c)

where $R_t$ is the state variable and $X_t$ is the amount of output devoted by the representative household to boosting productivity. Note that for simplicity it is assumed that $R_t$ and $X_t$ are perfect substitutes. The state variable $R_t$ evolves according to

$R_{t+1}=\gamma R_t+S-\eta Y_t$, $R_0$ given, $0<\gamma<1$, $S>0$, $\eta \gtreqless 0$, $R_t \geq 0$ $\forall t$, (1d)

where S is a constant influencing the growth rate of $R_t$. Equation (1d) is open to several interpretations (see the preceding sections), but common to all of them is that the evolution of $R_t$ may be influenced (if $\eta \neq 0$) by the productive activities undertaken by households.

Finally, the representative household must satisfy its period resource constraint:

$Y_t \geq I_t+X_t+C_t$. (1e)

Therefore, the intertemporal optimization problem amounts to choosing $\{L_t\}_0^\infty, \{I_t\}_0^\infty, \{X_t\}_0^\infty$ and $\{C_t\}_0^\infty$ in order to

$$\max \sum_{t=0}^{\infty} \theta^t U_t, \ 0<\theta<1, \quad (2)$$

subject to (1).

finite-lived individuals who are connected via a pattern of operative intergenerational transfers that are based on altruism".

## 5. CHARACTERIZATION OF THE TRAJECTORIES OF THE ECONOMY

We consider two possible cases: the first deals with the situation in which the decision-making process ignores the impact of production on the evolution of $R_t$, while in the second case this impact is fully internalized.

Case 1: no internalization of production's impact on the evolution of $R_t$

This case occurs typically when there is a productive asset to which all producers have free access. In this case, $R_t$ has the nonexclusive nature of a commonly-owned asset, with a good that can be privately appropriated as its substitute in production. Indeed, $\phi$ measures the efficiency of $X_t$ as a substitute for $R_t$. In this situation, each single household acting in full autonomy can ignore the impact of its productive activity on the future state of $R_t$, since the impact of its own activity is negligible. Indeed, the effect of the producer activities on the future state of $R_t$ is significant only because of the large number of households populating the economy.

If one interprets $R_t$ as an environmental asset affecting productivity, equation (1d) may model a productive technology that has a negative impact on the environment ($\eta>0$). In this case, $\eta Y_t$ may represent the pollution generated by the total production taking place in t and affecting $R_{t+1}$ ($\eta$ is a parameter capturing the "dirtiness" of the technology). Moreover, $S-(1-\gamma)R_t$ is nature's absorption capacity, that is, the amount of pollution that can be assimilated without a change in environmental quality (see Smulders, 2000). A high level of environmental quality can be preserved either if the level of production is low (small $Y_t$) or if the technology is "clean" ($\eta$ close to zero). Consistently with this interpretation, one may suppose that an increasing amount of current output has to be used to preserve factor productivity as environmental quality worsens (for instance, more fertilizers and irrigation are needed to preserve land fertility as the global climate becomes less favorable to farming, or more medical care is needed to preserve labor productivity as air quality deteriorates).

However, in the preceding sections we insisted on a sociological interpretation of $R_t$ according to which $R_t$ is social capital, namely a resource connected with group membership and social networks (see Bourdieu, 1986) which tends to deteriorate as private production becomes more pervasive. The deterioration of this resource can be interpreted as a decline in social cohesion and general trust that forces individuals to raise their expenditure aimed at self-protecting from increased opportunism.

Finally, note that the model can be applied also to the situation in which the externalities generated by private production are positive ($\eta<0$). In this situation, $R_t$ can be interpreted as the state of knowledge that may improve thanks to learning by doing, so that the same output level can be achieved with the use – other things being equal – of less intermediate input, i.e. of less $X_t$ (for instance, of less energy).

In case 1, one can solve the problem of the representative household by maximizing

$$\sum_{i=0}^{\infty}\theta^{i}\left\{\ln[L_{t+i}^{\alpha}K_{t+i}^{1-\alpha}(R_{t+i}+\phi X_{t+i})^{\beta}-I_{t+i}-X_{t+i}]+\varphi\ln(1-L_{t+i})+\lambda_{t+i}[I_{t+i}+(1-\delta)K_{t+i}-K_{t+i+1}]\right\} \quad (3)$$

with respect to $I_t$, $L_t$, $X_t$, $K_{t+1}$ and $\lambda_t$, where $\lambda_t$ is a multiplier that measures the marginal increment in discounted utility due to a marginal increment in the stock of capital along an optimal path. From this maximization one can derive the conditions that an optimal path must satisfy (see the Appendix), which – together with (1d) – can be used to obtain the system of difference equations in $R_t$, $I_t$ and $X_t$ governing the motion of the economy:

$$\Omega(R_{t+1},I_{t+1},X_{t+1},R_t,I_t,X_t)=\theta\left[\frac{\dfrac{(1-\alpha)(R_{t+1}+\phi X_{t+1})}{k(R_{t+1},I_{t+1},X_{t+1})}+(1-\delta)\beta\phi}{R_{t+1}+\phi(1-\beta)X_{t+1}-\beta\phi I_{t+1}}\right]-\frac{\beta\phi}{R_t+\phi(1-\beta)X_t-\beta\phi I_t}=0\,, \quad (4a)$$

$$\Psi(R_{t+1},I_{t+1},X_{t+1},R_t,I_t,X_t)=k(R_{t+1},I_{t+1},X_{t+1})-I_t-(1-\delta)k(R_t,I_t,X_t)=0\,, \quad (4b)$$

$$\Lambda(R_{t+1}, R_t, X_t) = R_{t+1} - S - \gamma R_t + \frac{\eta}{\beta\phi}(R_t + \phi X_t) = 0, \qquad (4c)$$

where

$$k(R_t, I_t, X_t) = K_t = \left\{ \frac{(R_t + \phi X_t)^{1-\beta}}{\beta\phi[l(R_t, I_t, X_t)]^{\alpha}} \right\}^{\frac{1}{(1-\alpha)}}, \; l(R_t, I_t, X_t) = L_t = \frac{\alpha(R_t + \phi X_t)}{(\alpha+\varphi)(R_t + \phi X_t) - \varphi\beta\phi(I_t + X_t)}.$$

By setting $R_{t+1}= R_t=R$, $I_{t+1}=I_t=I$ and $X_{t+1}=X_t=X$ in (4), one can characterize the steady state of the economy for the case in which the production's impact on $R_t$ is ignored in the decision-making process:

$$R=f(X)=\frac{\phi(S\beta - \eta X)}{\beta\phi(1-\gamma)+\eta}, \qquad (5a)$$

$$I=g(X)= \frac{\delta\theta(1-\alpha)[f(X)+\phi X]}{\beta\phi[1-\theta(1-\delta)]}, \qquad (5b)$$

where X must satisfy the following equation:

$$\frac{\alpha[f(X)+\phi X]^{\beta/\alpha}}{\varphi}\left[\frac{\theta(1-\alpha)}{1-\theta(1-\delta)}\right]^{(1-\alpha)/\alpha} - \frac{[f(X)+\phi X](1+\alpha)}{\beta\phi} + X + g(X) = 0. \qquad (5c)$$

<u>Case 2: full internalization of production's impact on the evolution of $R_t$</u>

This case applies to two possible situations. The first arises when the property rights to $R_t$ are well defined, thus allowing each household to exert full control over the evolution of that portion of $R_t$ entering its production function (for instance, this is what happens when each farmer is able to reduce the future productivity of his/her piece of land by over-exploiting it in the present). The second situation arises when $R_t$ is common property, but a benevolent planner has the policy instruments with which to induce households to fully internalize the externalities generated by their individual activities.

In this case, one can solve the decision–maker's problem by maximizing

$$\sum_{i=0}^{\infty}\theta^{i}\Big\{\ln[L_{t+i}^{\alpha}K_{t+i}^{1-\alpha}(R_{t+i}+\phi X_{t+i})^{\beta}-I_{t+i}-X_{t+i}]+\varphi\ln(1-L_{t+i})+\lambda_{t+i}[I_{t+i}+(1-\delta)K_{t+i}-K_{t+i+1}]+$$
$$+\mu_{t+i}[S+\gamma R_{t+i}-\eta L_{t+i}^{\alpha}K_{t+i}^{1-\alpha}(R_{t+i}+\phi X_{t+i})^{\beta}-R_{t+i+1}]\Big\}, \qquad (6)$$

with respect to $I_t$, $L_t$, $X_t$, $K_{t+1}$, $R_{t+1}$, $\lambda_t$ and $\mu_t$, where $\mu_t$ is a multiplier that measures the marginal increment in discounted utility due to a marginal increment in the stock of $R_t$ along an optimal path. From this maximization one can derive the conditions that an optimal path must satisfy (see the Appendix), which can be used to obtain the system of difference equations in $R_t$, $I_t$ and $X_t$ governing the motion of the economy:

$$\Gamma(R_{t+1},K_{t+1},X_{t+1},L_{t+1},R_t,K_t,X_t,L_t)=\frac{\theta(R_{t+1}+\phi X_{t+1})}{\beta\phi K_{t+1}}+\theta(1-\delta)-$$
$$-\left[\frac{K_{t+1}^{1-\alpha}L_{t+1}^{\alpha}(R_{t+1}+\phi X_{t+1})^{\beta}-X_{t+1}-i(R_{t+1},K_{t+1},X_{t+1},L_{t+1})}{K_t^{1-\alpha}L_t^{\alpha}(R_t+\phi X_t)^{\beta}-X_t-i(R_t,K_t,X_t,L_t)}\right]=0, \qquad (7a)$$

$$\Sigma(R_{t+1},K_{t+1},X_{t+1},L_{t+1},R_t,K_t,X_t,L_t)=\frac{K_t^{1-\alpha}L_t^{\alpha}}{(R_t+\phi X_t)^{1-\beta}}\left[\theta(\gamma\phi+\eta)\beta-\frac{\theta\gamma(R_{t+1}+\phi X_{t+1})^{1-\beta}}{K_{t+1}^{1-\alpha}L_{t+1}^{\alpha}}\right]-$$

$$-\left[\frac{K_{t+1}^{1-\alpha}L_{t+1}^{\alpha}(R_{t+1}+\phi X_{t+1})^{\beta}-X_{t+1}-i(R_{t+1},K_{t+1},X_{t+1},L_{t+1})}{K_t^{1-\alpha}L_t^{\alpha}(R_t+\phi X_t)^{\beta}-X_t-i(R_t,K_t,X_t,L_t)}\right]\left[\frac{\beta\phi K_t^{1-\alpha}L_t^{\alpha}}{(R_t+\phi X_t)^{1-\beta}}-1\right]=0, \quad (7b)$$

$$\Theta(K_{t+1},R_t,K_t,X_t,L_t)=K_{t+1}-i(R_t,K_t,X_t,L_t)-(1-\delta)K_t=0, \qquad (7c)$$

$$\Xi(R_{t+1},R_t,K_t,X_t,L_t)=R_{t+1}-S-\gamma R_t+\eta K_t^{1-\alpha}L_t^{\alpha}(R_t+\phi X_t)^{\beta}=0, \qquad (7d)$$

where $i(R_t,K_t,X_t,L_t)=I_t=K_t^{1-\alpha}L_t^{\alpha}(R_t+\phi X_t)^{\beta}-X_t-\dfrac{\alpha(R_t+\phi X_t)(1-L_t)}{\varphi\phi\beta L_t}$.

By setting $R_{t+1}=R_t=R$, $K_{t+1}=K_t=K$, $X_{t+1}=X_t=X$ and $L_{t+1}=L_t=L$ in (7), one can characterize the steady state of the economy for the case in which production's impact on $R_t$ is fully internalized in the decision-making process:

$$R=h(X)=\frac{S\beta[\phi(1-\gamma\theta)-\eta\theta]-\eta\phi(1-\gamma\theta)X}{\beta(1-\gamma)[\phi(1-\gamma\theta)-\eta\theta]+\eta(1-\gamma\theta)}, \qquad (8a)$$

$$K=n(X)= \frac{\theta(1-\alpha)[h(X)+\phi X]}{\beta\phi[1-\theta(1-\delta)]}, \qquad (8b)$$

$$L = p(X) = n(X)\left[\frac{[1-\theta(1-\delta)]\phi(1-\gamma\theta)}{\theta(1-\alpha)[h(X)+\phi X]^{\beta}[\phi(1-\gamma\theta)-\eta\theta]}\right]^{1/\alpha}, \qquad (8c)$$

where X must satisfy the following equation:

$$\alpha[h(X)+\phi X][1-p(X)]-\beta\phi\varphi p(X)\left\{\frac{[h(X)+\phi X](1-\gamma\theta)}{\beta[\phi(1-\gamma\theta)-\eta\theta]}-X-\delta n(X)\right\}=0. \qquad (8d)$$

<u>A numerical example</u>

Considering a limiting situation in which production has neither a positive impact nor a negative impact on the motion of $R_t$ ($\eta$=0), it is straightforward that (5) and (8) characterize the same steady state: R*=R°, K*=K°, L*=L° and X*=X°, entailing Y*=Y°, where "*" and "°" denote, respectively, the steady-state value of a variable in the absence of internalization of production's impact on the motion of $R_t$ and under full internalization. In particular, let $\phi=\varphi=1$, $\alpha=0.6$, $\beta=0.3$, $\delta=\gamma=0.05$, $\theta=0.98$ and S=0.1. By setting $\eta$=0, one obtains: R*=R°=0.10526, K*=K°=4.7763212, L*=L°=0.5257867 and X*=X°=0.1469559, entailing Y*=Y°=0.84073 and C*=C°=0.454958. One can check that in the neighborhood of this steady state the economy is saddle-path stable.[4] One can also check that $\left.\frac{\partial K^*}{\partial\eta}\right|_{\eta=0}>0$, $\left.\frac{\partial L^*}{\partial\eta}\right|_{\eta=0}>0$, $\left.\frac{\partial X^*}{\partial\eta}\right|_{\eta=0}>0$ and $\left.\frac{\partial Y^*}{\partial\eta}\right|_{\eta=0}>0$; while $\left.\frac{\partial K^\circ}{\partial\eta}\right|_{\eta=0}<0$, $\left.\frac{\partial L^\circ}{\partial\eta}\right|_{\eta=0}<0$, $\left.\frac{\partial X^\circ}{\partial\eta}\right|_{\eta=0}<0$ and $\left.\frac{\partial Y^\circ}{\partial\eta}\right|_{\eta=0}<0$. In particular, by setting $\eta$=0.01 (negative impact) , one obtains R*=0.0962<R°=0.0967, K*=4.891>K°=4.57, L*=0.532>L°=0.5233 and X*=0.162>X°=0.14466, entailing Y*=0.86>Y°=0.8129 and C*=0.454295>C°=0.4397; while by

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[4] With $\eta$=0, the system of difference equations (4) can be split into two autonomous subsystems (4a)-(4b) and (4c). In particular, one can see immediately from (4c) that $R_t$ converges monotonically to $R^* = R^\circ = \frac{S}{(1-\gamma)} = 0.10526$, since $0<\gamma<1$. The characteristic equation of the system obtained by linearizing (4a)-(4b) around (I*=I°, X*=X°, R*=R°) is the following: $\chi^2-2.0239451\chi+1.0204079=0$, which can be solved for the characteristic roots $\chi_1=0.9513$ and $\chi_2=1.0726$, implying saddle-path stability.

setting $\eta = -0.01$ (positive impact), one obtains $R^*=0.1139<R^\circ=0.1144$, $K^*=4.665<K^\circ=4.096$, $L^*=0.5196<L^\circ=0.5281$ and $X^*=0.1324<X^\circ=0.1489$, entailing $Y^*=0.821178<Y^\circ=0.868768$ and $C^*=0.455469<C^\circ=0.4705$.

From this example, one can draw two conclusions:

**Proposition 1** Without internalization of the effects of individual productive activities on the evolution of a resource which positively affects productivity, a shift toward a productive technology with more detrimental (beneficial) effects on the resource may raise (reduce) the long-term levels of output and working time.

**Proposition 2** In the presence of a technology causing negative (positive) effects on the evolution of a resource which positively affects productivity, the shift toward an institutional framework implying the full internalization of these effects may reduce (raise) the long-term levels of output and working time.

## 6. CONCLUDING REMARKS: DEFENSIVE EXPENDITURES IN CONSUMPTION

Beside influencing the production process, social capital has also a direct impact on individual utility. Well-being depends closely on social assets, and in particular on 'relational goods'.[5]

It has been shown that if social (or environmental) capital enters utility functions, negative externalities generate growth under very general conditions.[6] In these models individuals seek to avert the erosion of their social capital, and in particular the increasing poverty of their relational

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[5] On the concept of relational good see Uhlaner. The importance of relations in determining human happiness has recently been much debated, besides economists (e.g. Easterlin), by psychologists (e.g. Argyle or Kahneman), sociologists (Baumann, Venhoven) and political scientists (Lane).

[6] This model is part of a broader research project intended to explore the formal robustness and the explanatory capacity of the idea that negative externalities may be an engine of growth. The thesis that negative externalities generate growth if social (or environmental) capital enters utility functions has been demonstrated in an evolutionary game (see Antoci and Bartolini 2002), in models of exogenous growth (Bartolini and Bonatti 2003a), endogenous growth (Bartolini and Bonatti 2003b) or growth without capital accumulation (Bartolini and Bonatti 2002). For an overview of this research program see Bartolini 2003)

lives, by resorting to the greater consumption of private goods. This scenario depicts a world of the relationally impoverished who seek compensation in consumption and by so doing contribute to worsening their relational condition. The undesirable result of this process is called growth. In these models, too, the common resource can be interpreted as environmental capital – an extremely important interpretation in this case, where the resource enters utility functions. In this case, unlike the model presented here, where the resource only enters production functions, negative externalities generate growth under all conditions. We may therefore conclude that the erosion of social capital certainly fuels growth when it enters utility functions, and it may possibly lead to a higher output level when it only enters production functions.

Note the similarity and the difference between the two cases. The similarity is that growth is a process of substitution between free goods and costly goods, and the difference is that this substitution involves intermediate goods when the common resource enters production functions, whereas it involves final goods when it enters utility functions. Output mismeasures well-being in both cases: whereas in the case where the common resource enters utility functions, this mis-measurement derives from a failure to take account of the destruction of final goods, in the case considered by this paper it derives from the fact that output overestimates the increase in final goods, given that it comprises intermediate goods as well.

**Appendix**

Case 1: conditions to be satisfied along an optimal path

By maximizing (3) with respect to $I_t$, $L_t$, $X_t$, $K_{t+1}$ and $\lambda_t$, one can derive the optimality conditions

$$\frac{1}{[L_t^{\alpha}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta}-I_t-X_t]}-\lambda_t=0, \qquad \text{(A1a)}$$

$$\frac{\alpha L_t^{\alpha-1}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta}}{[L_t^{\alpha}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta}-I_t-X_t]}-\frac{\varphi}{(1-L_t)}=0, \qquad \text{(A1b)}$$

$$\frac{\beta\phi L_t^{\alpha}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta-1}-1}{[L_t^{\alpha}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta}-I_t-X_t]}=0, \qquad \text{(A1c)}$$

$$\frac{\theta(1-\alpha)L_{t+1}^{\alpha}K_{t+1}^{-\alpha}(R_{t+1}+\phi X_{t+1})^{\beta}}{[L_{t+1}^{\alpha}K_{t+1}^{1-\alpha}(R_{t+1}+\phi X_{t+1})^{\beta}-I_{t+1}-X_{t+1}]}+\theta(1-\delta)\lambda_{t+1}-\lambda_t=0 \qquad \text{(A1d)}$$

and

$$I_t+(1-\delta)K_t-K_{t+1}=0. \qquad \text{(A1e)}$$

Moreover, an optimal path must satisfy (1d) and the transversality condition

$$\lim_{t\to\infty}\theta^t\lambda_t K_t=0. \qquad \text{(A1f)}$$

Case 2: conditions to be satisfied along an optimal path

By maximizing (3) with respect to with respect to $I_t$, $L_t$, $X_t$, $K_{t+1}$, $R_{t+1}$, $\lambda_t$ and $\mu_t$, one can derive the optimality conditions (A1a), (A1e)

$$\frac{\alpha L_t^{\alpha-1}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta}}{[L_t^{\alpha}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta}-I_t-X_t]}-\frac{\varphi}{(1-L_t)}-\eta\mu_t\alpha L_t^{\alpha-1}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta}=0, \qquad \text{(A2a)}$$

$$\frac{\beta\phi L_t^{\alpha}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta-1}-1}{[L_t^{\alpha}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta}-I_t-X_t]}-\eta\mu_t\beta\phi L_t^{\alpha}K_t^{1-\alpha}(R_t+\phi X_t)^{\beta-1}=0, \qquad \text{(A2b)}$$

$$\frac{\theta(1-\alpha)L_{t+1}^{\alpha}K_{t+1}^{-\alpha}(R_{t+1}+\phi X_{t+1})^{\beta}}{[L_{t+1}^{\alpha}K_{t+1}^{1-\alpha}(R_{t+1}+\phi X_{t+1})^{\beta}-I_{t+1}-X_{t+1}]}+\theta(1-\delta)\lambda_{t+1}-\lambda_{t}-\eta\mu_{t+1}\theta(1-\alpha)L_{t+1}^{\alpha}K_{t+1}^{-\alpha}(R_{t+1}+\phi X_{t+1})^{\beta}=0 \quad \text{(A2c)}$$

and

$$S+\gamma R_{t}-\eta L_{t}^{\alpha}K_{t}^{1-\alpha}(R_{t}+\phi X_{t})^{\beta}-R_{t+1}=0. \quad \text{(A2d)}$$

Moreover, an optimal path must satisfy the transversality conditions (A1f) and

$$\lim_{t\to\infty}\theta^{t}\mu_{t}R_{t}=0. \quad \text{(A2e)}$$

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