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Abstract: We develop a two-sector model to analyze which kind of social organization generates trust. Social capital is defined as trust. We examine two communities: the bedroom community in which people commute long distance to work and the virility community in which people do not commute to work. The hypothesis is that people do not have time to interact spontaneously outside work in the bedroom community. We show that in the bedroom community social capital cannot accumulate. Hence our results show that time spent interacting with your neighbor must be added as an important production factor when considering the formation of social capital in society. Thus, in a community where agents only interact when producing output, social capital may not accumulate To our knowledge, no such attempt to model social capital has yet been undertaken and this gap or 'missing link' in economic debates has to be developed to grasp a more holistic understanding of the big differences in the wealth of nations or regions

JEL classification: A12, C61, D90, O41.

Keywords: Social capital, Two-Sector Model, Indeterminacy.

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1 Introduction

Social capital is probably the scientific concept that has gathered most attention and most followers ever within a short period of time. It provides a common language for all social sciences[1] and has become a new buzzword (Paldam, 2000). Overall the social capital approach can be regarded as an attempt to combine sociology (social norm) and economics (production factor). Concerning a thorough review of the interdisciplinary development and theoretical foundations of social capital within economics, political science, sociology, development theory and philosophy, see Ostrom and Ahn (2003). More recently much research in economics has accumulated linking levels of high trust with higher level of economic growth (Fukuyama (1995), Knack and Keefer (1997) and Zack and Knack (2001)). If social capital really is a new production factor which must be added to the conventional concepts of human and physical capital, the concept will be of extreme interest to all social scientists.

Social capital was first defined by the American sociologist James S. Coleman (1988) as "the ability to cooperate in groups" and thereby achieve a common goal. Such ability to cooperate assures an individual that he or she will not be taken advantage of by another individual, even if the latter might get an economic net benefit from doing it. Even if it pays economically to commit a crime, free-ride or ignore the rules in a contract, fewer will do it in the presence of trust because social norms tell them not to do so. Thus, the community members' preferences can be affected and shaped, due to social norms and social pressures (see Becker, 1996; Green and Shapiro, 1994; North 1990, for further discussions on unstable preferences). The concept, however, is a broad concept in strong need of both deductive modeling and inductive empirical surveys (Paldam, 2000; Poulsen and Svendsen, 2004; Solow 2000). Despite the variety of definitions that prevail in the literature there is a widely accepted consensus that, as any other form of capital, social capital yields a profit by facilitating the exchange of information and resources and by lowering transaction costs in the economy. Individuals invest in social interactions in order to earn a payoff that would otherwise not be earned. Such approach may eventually give a more holistic understanding of the big differences in the wealth of nations or regions (Svendsen and Svendsen, 2003).

Our contribution is to make a first attempt to model the informal institution of social capital as a new production factor and to investigate which type of community that generates social capital. We develop a two-sector model to analyze which kind of social organization generates social capital in relation to the case of commuting. Arguably, the main element in social capital[2] is the level

[1] Overall the social capital approach can be regarded as an attempt to combine sociology (social norm) and economics (production factor). Concerning a thorough review of the interdisciplinary development and theoretical foundations of social capital within economics, political science, sociology, development theory and philosophy, see Ostrom and Ahn (2003).

[2] Note, that we only use the social capital concept in a 'positive' sense, namely when group formation enhances overall economic growth. We ignore the socalled 'Hells Angels' problem or the 'dark side' of social capital, e.g. 'negative' economic effects following from criminal gangs etc.

of trust, which so far is the most applied measure (see Paldam, 2000). Fukuyama (1995) defines trust in the following way: "Trust arises when a community shares a set of moral values in such a way as to create regular expectations of regular and honest behavior.". Fukuyama (1995, 153).

Such trust-association connection fits neatly into already existing game-theoretical concepts such as reputation effects (Bjørnskov, 2004). Such approach is also noted by Putnam (1993b), who, in an article about democracy writes that those who have social capital tend to accumulate more. These 'stocks of social capital', that is, the civic traditions of a society defined as its, through history, accumulated sum of trust, norms and networks, thus form the basis of further accumulation of social capital (ibid.). More specifically, one may argue that what also Putnam (2000) has viewed as trust produced by regular face-to-face contact between citizens may solve the fundamental problem in new institutional economics, namely by compensating for the presence of asymmetrical information and consequently reducing the level of transaction costs in society.

Following these authors we will argue that social capital is Trust Two community models are analyzed. In both communities social capital contributes positively to the production of goods in society by facilitating the flow of information between individuals. In economic terms this translates into assuming the externalities enter the production of both goods. Furthermore we can restrict these externalities to be positive. The first community is called, the bedroom community. In this community people commute a long distance to work. Here, we argue that because agents commute long distance they less leisure time. This means that they have no time to engage in close social interactions with their neighbors. The second community we look at is called the virility community. There, people do not commute to work: hence they have time to engage in spontaneous social interactions with their neighbors. Our results show that in the Bedroom community social capital will not accumulate and is associated with low levels of economic activities. In contrast, in the virility community, social capital accumulates over time and is associated with higher levels of per capita consumption. Our findings therefore indicate that the time you spend interacting with your neighbors in the informal sector is a key determinant in the accumulation of social capital. As in Zack and Knack (2001) higher levels of social capital are associated with higher levels of economic growth. To our knowledge, no such attempt to model social capital has yet been undertaken and this 'missing link' in economic debates will be dealt with in the following sections.

The paper is organized as follows. In Section 2 we present the framework common to both community models. In section 3, we describe the process of accumulation of social capital in the centralized society. In section 4, we analyze the case of the decentralized society. Section 5 gives a conclusion. All the proofs are gathered in the Appendix in section 6.

2 The common framework of both models

The economy is populated by a continuum of identical consumers indexed by h, where $h \in [0,1]$. All consumers are infinitely lived and rational. Social capital is embedded in each consumer h in an equal fraction . In other words we have $k_0^h = \overline{k}$ where k is the aggregate social capital stock.

Fukuyama (1995) and Putman both see social capital as function of Trust within a society, and a high degree of spontaneous social interactions between members of the society. Society's overall level of trust will be used in producing output and will be denoted by k_1. Trust will also be used in the informal sector of the economy when two agents meet face to face spontaneously, and will be denoted by k_2. Each individual also has a fixed amount of time available, l_t,that for simplicity be normalized to unity. We assume that sector 1 is the output sector. Production of output in this economy requires trust and that agents spend some of their of time in the output sector. The number of units of leisure time spend in commuting and therefore, allocated to the production level will be labelled by l_t^1. Sector 2 is the informal sector in which social capital is produced. The number of units of time spend socializing in the informal sector will be labelled by l_t^2. Social capital also generate positive externalities that affect the production of both sectors. To sum up we have

$$\begin{aligned} y &= F^1(k^1, l^1, X), \\ c &= F^2(k^2, l^2, X), \end{aligned}$$

In both sectors we suppose that along a path with external effects, the marginal productivities of both inputs are positive. The production of output is assumed to exhibit diminishing marginal productivities in private inputs for a given level of the aggregate capital stock X. We restrict the spillovers to be labor augmenting[3] In other words, we assume the following:

Assumption 1: $F^i : \Re_+^3 \to \Re_+$, is a continuous functions, $i = 1, 2$. For a given $X \in \Re_+$:

(i) $F^i(.,.,.)$ is C^2 on $\Re_{++} \times \Re_{++} \times \Re_+$;
(ii) $F^i(.,.,X)$ is homogenous of degree one and increasing over $\Re_{++} \times \Re_{++}$;
(iii) $F_{11}^i(., l^i, X) < 0$, for all $k^i \in \Re_{++}$ and $\lim_{k^i \to 0} F_1^i(k^i, l^i, X) = \infty$;
(iv) $F_{22}^i(k^i, ., X) < 0$, for all $l^i \in (0, 1]$ and $\lim_{l^i \to 0} F_2^i(k^i, l^i, X) = \infty$.
(v) External effects in sector 1 are Harrod-Neutral. $F^i(k, l^1, X) = \mathcal{F}^i(k, l^1 X)$, where $\mathcal{F}^1(.,.)$ is homogenous of degree 1 in k and $l^1 X$.

The representative consumer maximizes his (discounted) intertemporal welfare. At any point of time (which is discrete), welfare is measured by a utility

[3] This form of labor augmenting technological progress has been extensively used by the learning by doing literature see Arrow (1962), Uzawa (1961), Sheshinski (1967), Harrod (1973), Romer (1986) and Lucas (1988).

function of current consumption per capita $u(c_t)$. We assume the following restriction on the utility function:

Assumption 2 :
$$u(y) = \frac{y^\alpha}{\alpha}.$$
At time $t = 0$, the representative agent maximizes

$$U_0 = \sum_{t=0}^{\infty} \beta^t \frac{y_t^\alpha}{\alpha}, \tag{1}$$

where β is the discount rate, $0 < \beta < 1$. Any consumer $h \in [0, 1]$ is initially endowed with an equal fraction of the aggregate capital stock $k_0^h = \overline{k}$. . The production side is composed of two continua of firms indexed by i, where $i = 1, 2$. Within each sector firms are identical. We assume that, the production technology of both representative firms also depends on the aggregate stock of social capital in any given period. We denote this variable by X, where $X = \int_0^1 k(h)dh$.

Social Capital is assumed to depreciate in each time period. Denoting by δ the depreciation rate, this amounts to

Assumption 3 : $0 < \delta < 1$ for all $t \geq 0$.

If y_t denotes the current production of the informal sector, then the the stock of social capital for next period, k_{t+1} is equal to

$$k_{t+1} = y_t + (1 - \delta)k_t. \tag{2}$$

We define the social production possibility frontier, $T(k, y, X)$. It is the value function of the maximization problem in which the representative firm chooses its output level given the existing stock of social capital, full employment of inputs, and the aggregate social capital stock X. In other words,

$$T(k, y, X) = \max_{\{k^1, l^1\}} \mathcal{F}^1(k^1, l^1 X) \tag{3}$$
$$\text{subject to}$$
$$y = \mathcal{F}^2(k^2, l^2 X),$$
$$k = k^1 + k^2,$$
$$1 = l^1 + l^2,$$
$$k^i \geq 0,\ l^i \geq 0,\ i = 1, 2.$$

For all given $X \geq 0$

Assumption 4 : $T(k, y, X)$ is of class C^2 on $\Re_{++} \times \Re_{++} \times \Re_+$.

Using a standard argument it can be shown that for any given $X \geq 0$, $T(k, y, X)$ is concave. The set of feasible interior solutions to (3) is is non-empty and convex and defined as

$$D(X_t) = \{(k_{t,} k_{t+1}) \in \Re_+ \times \Re_+ : (1-\delta)k_t \leq k_{t+1} \leq \mathcal{F}^2(k_t, X_t)\}.$$

Drugeon and Venditti (1998) establish that the input demand functions $k^i(k_t, y_t, X_t)$ and $l^i(k_t, y_t, X_t)$, $i = 1, 2$, are homogenous of degree 1 and 0, respectively if external effects in both sectors are Harrod-Neutral. Hence $T(k_t, y_t, X_t)$ is homogenous of degree 1. For interior solutions to (5) for all given $X_t \geq 0$ the feasible set $D(X_t)$ can then be restricted to

$$\{(k_{t,} k_{t+1}) \in \Re^+ \times \Re : (1-\delta)k_t \leq k_{t+1} \leq g(k, X_t) + (1-\delta)k_t\}.$$

Using the standard definition of the indirect utility function given by $V(k_t, k_{t+1}, X_t) \equiv [T(k_t, k_{t+1} - (1-\delta)k_t, X_t)]^\alpha/\alpha$, we can reformulate the representative agent's problem as

$$\max_{\{k_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \frac{\left[\mathcal{F}^1(k_t^1 - k^2(k, y, X), X)\right]^\alpha}{\alpha}$$

subject to:

$$\begin{aligned} k_o &= \bar{k}, \\ (k_t, k_{t+1}) &\in D(X_t). \end{aligned} \tag{4}$$

$\{X_t\}_{t=0}^{\infty}$ given.

3 The Bedroom Community

3.1 The Model

We omit the time subscripts whenever they are not necessary. We assume that production of output in sector 1 requires the use of trust. In this community agents commute long distance. We assume for simplicity that the time they spend commuting is part of the production of output in sector 1. We analyze the case in which agents commute very long distance and have no time left to interact in the informal sector. In other words we assume $l^1 = 1$. We assume that the production technology used in sector 2 is linear[4]. Social capital also generate positive externalities that affect the production of both sectors.

$$\begin{aligned} c &= \mathcal{F}^1(k^1, l^1 X), \\ y &= \mathcal{A}k^2 X. \end{aligned}$$

For this class of economies, the Production Possibility Frontier (P.P.F.) is given by the following maximization problem:

$$\begin{aligned} T(k_t, y_t, X_t) &= \max_{k_t^1} \mathcal{F}^1(k_t^1, l^1 X_t) \qquad (5) \\ & \quad \text{subject to} \\ y_t &= \mathcal{A}k_t^2 X_t \\ 1 &= l_t^1, \\ k_t^i &\geq 0, \ \{X_t\}_{t=0}^{\infty} \text{ given.} \end{aligned}$$

Under Assumption 1, and given that $k_t^i \in \Re_+^*$, Problem (5) is a standard concave maximization problem, for $\{X_t\}_{t=0}^{\infty}$ given. Assumption 1 ensures interiority of solutions to (5). We can then define a function

$$h(k^2, y, X) = \mathcal{F}^2(k^2, X) - y.$$

Under Assumption 1 we know that, for all given $X \geq 0$, we have $\mathcal{F}_1^2(k^2, X) > 0$. So, applying the implicit function theorem for all given $X \geq 0$ we find that

$$k^2 = \varphi(y, X). \qquad (6)$$

This function is continuous and has continuous partial derivatives that can be derived as

$$\varphi_1 = \frac{1}{\mathcal{F}_1^2} > 0, \qquad (7)$$

$$\varphi_2 = -\frac{\mathcal{F}_2^2}{\mathcal{F}_1^2} < 0. \qquad (8)$$

For interior solutions to (5) for all given $X_t \geq 0$ the feasible set $D(X_t)$ can then be restricted to

$$\{(k_t, k_{t+1}) \in \Re^+ \times \Re : (1-\delta)k_t \leq k_{t+1} \leq g(k, X_t) + (1-\delta)k_t\}.$$

Using the standard definition of the indirect utility function given by $V(k_t, k_{t+1}, X_t) \equiv [T(k_t, k_{t+1} - (1-\delta)k_t, X_t)]^{\alpha}/\alpha$, we can reformulate the representative agent's problem as

[4] This assumption guarantees that private returns are constant in the investment good sector. The same result would be obtained had we assumed that the investment good sector were to use a factor in fixed supply and labor as inputs.

$$\max_{\{k_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \frac{\left[\mathcal{F}^1(k_t^1 - \varphi(y,X), X)\right]^{\alpha}}{\alpha}$$

subject to:

$$\begin{aligned} k_o &= \bar{k}, \\ (k_t, k_{t+1}) &\in D(X_t). \end{aligned} \tag{9}$$

$\{X_t\}_{t=0}^{\infty}$ given.

An *equilibrium path* $\{k_t\}$, is an interior solution to Problem (9) if it solves a fixed point problem[5] $\{k_t\{X_t\}\} = \{X_t\}$ together with the necessary and sufficient conditions given in the next Lemma:

Lemma 1 *Let $\{k_t\}_{t=0}^{\infty}$ be feasible path from k_0. Then it solves the maximization Problem (9) if the following conditions are satisfied.*

Euler equation:

$$-\gamma_t^{1-\alpha} V_2(1, \gamma_t, 1) + \beta V_1(1, \gamma_{t+1}, 1) = 0, \tag{10}$$

Transversality condition:

$$\lim_{t\to\infty} \beta^t k_t^{\alpha-1} V_1(1, \gamma_{t+1}, 1) = 0. \tag{11}$$

Summability condition:

$$\sum_{t=0}^{t=\infty} \beta^t V(1, \gamma_t, 1) < \infty. \tag{12}$$

Proof. See Boldrin, Nishimura, Shigoka and Yano (2003), Drugeon, Poulsen and Venditti (2003). ■

3.2 Existence, uniqueness and stability of the growth ray

We have define the growth factor of capital as

$$\frac{k_{t+1}}{k_t} = \gamma_t. \tag{13}$$

In this framework since $\overline{\gamma} = \mathcal{A} + 1 - \delta$ and $\underline{\gamma} = 1 - \delta$. The Transversality Condition (11) will be satisfied if the following assumption holds:

Assumption 5: $\beta\overline{\gamma}^{\alpha} < 1$.

[5] We do not consider the question of existence to the fixed point problem for which the sequence of externalities $\{X_t\}$ satisfies $\{k_t\{X_t\}\} = \{X_t\}$ for all $t \geq 0$. A detailed treatment of this issue is beyond the scope of this paper. We refer the reader to Romer (1983) and Mitra (1998). They both address the existence issue of the fixed point problem $\{k_t\{X_t\}\} = \{X_t\}$ for all $t \geq 0$ in a slightly different framework.

Lemma 2 *A sufficient condition for the existence of an interior equilibrium balanced growth path* $\widetilde{\gamma} > 1$ *is that*

$$\mathcal{F}_1^2(\varphi(1,\delta,1),1) + 1 - \delta > \frac{1}{\beta}.$$

.

Proof. See the Appendix. ■

Lemma 3 *There exists a unique interior growth ray that satisfies the conditions of Lemma* 1*.*

Proof. See the Appendix. ■

Proposition 4 *The balanced growth path is locally unstable.*

Proof. See the Appendix. ■

Corollary 5 *If* $\{c_t\}_{t=0}^{\infty} > 0$ *for all* $t \geqslant 0$*, then the stock of social capital in the decentralized economy will fall forever.*

Proof. See the Appendix. ■

Proposition 4 and Corollary 5 imply that unless an economy starts initially in the interior equilibrium, it will never converge to it. Suppose that the economy is initially in the equilibrium and that $\gamma > 1$. In this case the stock of social capital grows at a constant rate $\mathcal{G} = \gamma - 1 > 0$. Suppose now that an exogenous shock hits the economy, then the economy will converge either to the equilibrium where $\underline{\mathcal{G}} = \underline{\gamma} - 1 = -\delta$ or towards $\overline{\mathcal{G}} = \mathcal{A} - \delta$. In the first equilibrium, as time goes by the stock of social capital will disappear. In the second equilibrium, the stock of social capital would grow at a positive rate but all productive resources would be allocated to the production of social capital at the expense of consumption.

4 The Virility Community

4.1 The Model

As above we assume that sector 1 is the output sector. As above the production of output requires the use of trust and that agents spend some time producing output. But here, agents do not spend time commuting to work. Hence they have some time left they can use interacting in the informal sector. Here, members get to know each personally due to repeated social encounter and therefore social capital is arguably produced using a fraction of the trust and some leisure time that the individuals use to interact spontaneously among themselves. Social capital also generate positive externalities that affect the production of both sectors.

$$
\begin{aligned}
y &= \mathcal{F}^1(k^1, l^1 X), \\
c &= \mathcal{F}^2(k^2, l^2 X), .
\end{aligned}
$$

2

For this class of economies, the Production Possibility Frontier (P.P.F.) is given by the following maximization problem:

$$
\begin{aligned}
T(k_t, c_t, X_t) &= \max_{k_t^1} \mathcal{F}^1(k_t^1, l^1 X_t) \\
& \quad \text{subject to} \\
c_t &= \mathcal{F}^2(k_t^2, l^2 X_t) \\
1 &= l_t^1, \\
k_t^i &\geq 0, \ \{X_t\}_{t=0}^{\infty} \text{ given.}
\end{aligned} \tag{14}
$$

Benhabib and Nishimura (1985) show that the sign of T_{21} is positive (negative) if the investment good sector is more (less) capital intensive than the consumption good sector. The consumption good sector is said to be more social capital intensive if the net social capital stock, k^1/l^1, in the output sector is higher than the net social capital stock in the investment good sectork^2/l^2. Drugeon, Poulsen and Venditti (2003) and Poulsen (2003)establish:

Lemma 6 *$T(k_t, y_t, X_t)$ is homogenous of degree 1. Furthermore,*

$$T_{21} = \frac{\mathcal{F}_{12}^1 \mathcal{F}_{12}^2 q \mathcal{F}^2 l^1}{\Delta k^2 k^1} \left(\frac{k^1}{l^1} - \frac{k^2}{l^2} \right), \tag{15}$$

$$T_{22} = T_{21} \frac{l^2}{\mathcal{F}^2} \left(\frac{k^1}{l^1} - \frac{k^2}{l^2} \right) < 0, \tag{16}$$

$$T_{23} = -T_{21} \frac{k^1}{l^1 X} + \frac{2l^2}{\mathcal{F}_1^2} \left(\mathcal{F}_{12}^1 + q \mathcal{F}_{12}^2 \right), \tag{17}$$

where

$$\Delta = -\frac{\mathcal{F}_{12}^1 (\mathcal{F}^1)^2 (\mathcal{F}_1^2)^2}{(\mathcal{F}_1^1)^2 k^1 l^1 X} - \frac{\mathcal{F}_{12}^1 (\mathcal{F}^2)^2 \mathcal{F}_1^1}{\mathcal{F}_1^2 k^2 l^2 X} < 0.$$

Proof. See Drugeon and Venditti (1998) and Drugeon, Poulsen and Venditti (2003), Poulsen (2001). ■

Corollary 7 *Suppose the consumption good sector is capital intensive. Then, $T_{23} > 0$.*

5 Existence, Uniqueness and Indeterminacy

The *growth factor* of social capital can be defined as $k_{t+1}/k_t = \gamma_t$. The maximum feasible growth factor is $\overline{\gamma}$ and $\underline{\gamma}$ is the minimum feasible growth factor. Under Harrod-Neutrality, $\overline{\gamma} = \mathcal{F}^2(1,1)$ and $\underline{\gamma} = 1 - \delta$. For the model to display endogenous growth we need $\overline{\gamma} > 1$. To ensure existence of an interior growth ray with endogenous growth we also need $\mathcal{F}^2(1,1) > \delta$. In this case the model does not have a steady state. A growth ray is defined as follows:

Definition 8 *An equilibrium path* $\{k_t\}$ *is a growth ray if there exists a growth factor* $\gamma \in [0, \overline{\gamma}]$ *such that for all* $t \geq 0$, $k_t = \gamma^t k_0$, *where* $k_0 \neq 0$.

An equilibrium path is a solution to Problem 3 if it the following necessary and sufficient conditions:

$$\gamma_t^{1-\alpha} V_2(1, \gamma_t, 1) + \beta V_1(1, \gamma_{t+1}, 1) = 0, \tag{18}$$

$$\lim_{t \to \infty} \beta^t k_t V_1(1, \gamma_t, 1) = 0, \tag{19}$$

$$\sum_{t=0}^{t=\infty} \beta^t V(1, \gamma_t, 1) < \infty. \tag{20}$$

The transversality condition (19) is satisfied along a growth ray if the following assumption holds:

Assumption 6: $\beta[\mathcal{F}^2(1,1) + 1 - \delta]^\alpha < 1$.

Proposition 9 *There exists an interior growth ray,* $\widetilde{\gamma} \in (1, \overline{\gamma})$ *if* $\mathcal{F}^2(1,1) > \delta$ *and*

$$\beta[\mathcal{F}_1^2(k^2(1, \widetilde{\gamma}, 1), l^2(1, \widetilde{\gamma}, 1)) > 1.$$

Proof. See Goenka and Poulsen (2004). ■

Following Boldrin and Rusticchini (1998) we give next a more precise definition of what is meant by indeterminacy.

Definition 10 *A growth ray* $k_t = \gamma^t k_0$ *is locally indeterminate if for every* $\epsilon > 0$, *there exists another equilibrium sequence* $\{k_t'\}$ *with* $\acute{\gamma_t} = \acute{k}_{t+1}/\acute{k_t}$ *such that* $|k_1 - k_1'| < \epsilon$ *with* $k_0 = k_0'$.

For a system of dimension two, indeterminacy occurs when the two roots of the characteristic polynomial are inside the unit circle. We see, from (18), that in our model the dynamic system is of dimension 1. Therefore, if the root associated with (18) is within $(-1, 1)$, then the growth ray will be locally indeterminate. In this model stability means indeterminacy .In what follows we show that local indeterminacy arises no matter which sector is more social capital intensive. Drugeon, Poulsen and Venditti (2003) show that the allocation of productive resources between the two sectors affects the uniqueness property of the growth ray. Furthermore, a necessary condition for the occurrence of multiple growth ray is that the investment good sector is capital intensive at the private level at the growth ray. The multiplicity results are not affected by the time structure of the model. We therefore refer the reader to this paper for a more detailed exposition.

Proposition 11 *(i) A necessary condition for the growth ray to be locally indeterminate is*

$$\left.\frac{V_{23}}{V_{12}}\right|_{(1,\widetilde{\gamma}+1-\delta,1)} < 0. \tag{21}$$

(ii) A necessary and sufficient condition for the growth ray to be locally indeterminate is

$$\left|\frac{1}{\beta\widetilde{\gamma}^{\alpha}} + \frac{V_{23}}{\beta\widetilde{\gamma}^{\alpha}V_{12}}\right|_{(1,\widetilde{\gamma}+1-\delta,1)} < 1.$$

Proof. See Goenka and Poulsen (2004). ■

Proposition 11 and the uniqueness result of Drugeon, Poulsen and Venditti (2003) imply that when the consumption good sector is more social capital intensive, then the stock of social capital will grow at a constant rate $\mathcal{G}$. It may stay there forever if $V_{21}(1,\gamma,1) < 0$ i.e. if social capital does not depreciate too slowly and if the marginal utility of consumption is relatively inelastic[6]. In this case they would also exists an infinity of social capital sequences all growing asymptotically at the same rate.

If the investment good sector is more social capital intensive then the Drugeon, Poulsen and Venditti (2003) have established the following result

Proposition 12 *(i) A sufficient condition for the occurrence of at least three growth rays is that*

$$\left.\frac{\mathcal{F}^1_{11}\mathcal{F}^1_{12}\mathcal{F}^1}{q\Delta k^1}\left(\frac{k^2}{l^2} - \frac{k^1}{l^1}\right)\right|_{(1,\widetilde{\gamma}-1+\delta,1)} > \frac{1-\alpha}{\beta\widetilde{\gamma}^{\alpha}}.$$

(ii) A necessary condition for the occurrence of at least three growth rays is that the investment good sector is more capital intensive.

Proof. See Drugeon, Poulsen and Venditti (2003). ■

This would imply that there exists at least one equilibrium with a low growth rate, one equilibrium with a medium growth rate and one equilibrium with a

[6] Goenka and Poulsen (2004) shows that $V_{21} < 0$ if $T\left[T_{12} - (1-\delta)T_{22}\right] + (\alpha - 1)T_2\left[T_1 - (1-\delta)T_2\right] < 0$. Under the results of Lemma this requires both that

$$\delta > 1 + \frac{T_{12}}{T_{22}}$$

and

$$\frac{T\left[T_{12} - (1-\delta)T_{22}\right]}{T_2\left[T_1 - (1-\delta)T_2\right]} > 1 - \alpha.$$

high growth rate for social capital. If the medium equilibrium is stable then it follows that the low one and the high one are unstable. The economy 's stock of social capital would be growing at a positive growth rate. We can now establish the following result.

Corollary 13 *Suppose there exists three equilibria. Then a necessary condition for the stock of social capital will growth forever at the constant rate $\widetilde{\gamma}-1$ is*

$$\widetilde{\gamma} > \left(\frac{1-\alpha}{\beta}\right)^{1/\alpha} > 1$$

Proof. See the Appendix. ■

6 Conclusion

Social capital is becoming a buzzword in the policy debates around the world, but this should not discourage the development of a more precise and detailed understanding of it; hence this paper. How to model the level of social capital within a country is not a trivial question and a gap in the literature exists. If social capital really matters, it is important to understand how it works. Here, theory suggested that social capital may be one of the 'missing links' in explaining and creating a coherent theory of the role of trust in society, here exemplified as the case of commuting. Eventually such insight may help explaining the big differences in the wealth of nations or regions.

We developed a two-sector social capital model to answer whether social capital is a new production factor and what social organization that may foster it. By focusing on the case of commuting and defining social capital as Trust, we demonstrated that the presence of time spent in spontaneous social interactions in the virility community (and the option of spending leisure time for civic activities rather than driving the long and winding road) must be added as an important production factor when considering the formation of social capital in society. In contrast, the bedroom community cannot accumulate social capital when all time is devoted to producing output. Thus, in a community where social capital may not accumulate.

This comparison between two different community models indicates that as one moves from a non-commuting to a commuting society, some social capital is lost. Basically, not driving the long and winding road in your car leaves you free to interact with other people in the tennis club, for example. In modelling terms this amounted to assuming that leisure time is no longer used as an input in the production of social capital. The model showed that in communities where no agents have not time interacting in the informal sector, then the economy moves to an unstable equilibrium.

Tracing the very origins of social capital in society, however, requires more research. Some future research could be to analyze the determinants of trust. Fukuyama (1995) sees social capital as function of two factors: a high degree of generalized trust within a society, and a high degree of spontaneous social interactions between members of the society. Putnam (1993a) has argued that Particularized Trust arising from interactions in voluntary organizations spill over into General Trust. Future research should therefore do more rigorous empirical research and try to establish the exact relationship between particularized and generalized trust. Such investigations may demonstrate why the level of social capital differ across countries and how policy makers can stimulate the accumulation of 'positive' social capital in a society. These, and many other questions, will help establishing the exact importance of social capital, not only in everyday life, but also for the role of the State and public policy, e.g. in relation to long-distance commuting.

7 Appendix

Proof of Lemma 2

Under Assumption 1, $\mathcal{F}^2(k^2, X)$ is homogenous of degree one in its arguments. The Euler theorem on homogenous functions tells us that $y = \mathcal{F}_1^2(k^2, X)k^2 + \mathcal{F}_2^2(k^2, X)X$. We can also apply this theorem to deduct that $\mathcal{F}_1^2(k^2, X)$ and $\mathcal{F}_1^2(k^2, X)$ are homogenous of degree 0. Since, $\varphi(y, X)$ is homogenous of degree 1, along an equilibrium path we have

$$\gamma_t - 1 + \delta = \mathcal{F}_1^2(\varphi(\gamma_t - 1 + \delta, 1), 1)\varphi(\gamma_t - 1 + \delta, 1) + \mathcal{F}_2^2(\varphi(\gamma_t - 1 + \delta, 1), 1). \quad (22)$$

We know under Assumption 1 that $\mathcal{F}_2^2(\varphi(\gamma_t - 1 + \delta, 1), 1) > 0$. It must then be true for all $\gamma_t \in (1, \overline{\gamma})$ that

$$\gamma_t - 1 + \delta > \mathcal{F}_1^2(\varphi(\gamma_t - 1 + \delta, 1), 1)\varphi(\gamma_t - 1 + \delta, 1). \quad (23)$$

At $\gamma_t = \overline{\gamma}$, $\overline{\gamma} = \mathcal{F}^2(1, 1) + 1 - \delta$. This implies that at $\gamma_t = \overline{\gamma}$ we have $\varphi(\overline{\gamma} - 1 + \delta, 1) = 1$. Hence, at $\gamma_t = \overline{\gamma}$ we can rewrite (23) as

$$\overline{\gamma} > \mathcal{F}_1^2(1, 1) + 1 - \delta. \quad (24)$$

In the balanced growth path we have

$$\frac{\widetilde{\gamma}^{1-\alpha}}{\beta} = \mathcal{F}_1^2(\varphi(\widetilde{\gamma} - 1 + \delta, 1), 1) + 1 - \delta. \quad (25)$$

Defining

$$\begin{aligned} \varepsilon(\gamma) &= \frac{\gamma^{1-\alpha}}{\beta}, \quad (26) \\ \sigma(\gamma) &= \mathcal{F}_1^2(\varphi(\gamma - 1 + \delta, 1), 1) + 1 - \delta \end{aligned}$$

we can rewrite (25) as $\varepsilon(\gamma) = \sigma(\gamma)$. It follows that (24) is equivalent to

$$\lim_{\gamma \to \overline{\gamma}} \sigma(\gamma) < \overline{\gamma}. \quad (27)$$

Multiplying both sides by $\overline{\gamma}$, we get

$$\frac{\overline{\gamma}^{1-\alpha}}{\beta} > \overline{\gamma}.$$

This is equivalent to writing that

$$\lim_{\gamma \to \overline{\gamma}} \varepsilon(\gamma) > \overline{\gamma}. \tag{28}$$

So (27) and (28) imply that in as $\gamma_t \to \overline{\gamma}$ we have

$$\lim_{\gamma \to \overline{\gamma}} \varepsilon(\gamma) - \lim_{\gamma \to \overline{\gamma}} \sigma(\gamma) > 0.$$

A sufficient condition for the existence of $\widetilde{\gamma} \in [1, \overline{\gamma}]$ is

$$\frac{1}{\beta} < \mathcal{F}_1^2(\varphi(\delta, 1), 1) + 1 - \delta.$$

Proof of Lemma 3

The question of uniqueness of the balanced growth path can be addressed by looking at equation (25). If we differentiate (26) with respect to γ, we find that

$$\acute{\varepsilon}(\gamma) = \frac{(1-\alpha)\gamma^{-\alpha}}{\beta} > 0.$$

We have shown above that $\lim_{\gamma \to \overline{\gamma}} \varepsilon(\gamma) > \lim_{\gamma \to \overline{\gamma}} \sigma(\gamma)$. The sufficient condition for existence guarantees that $\varepsilon(1) < \sigma(1)$. So, the uniqueness of the balanced growth path depends on whether $\sigma(\gamma)$ is strictly decreasing or not. If we differentiate $\sigma(\gamma) = \mathcal{F}_1^2(\varphi(\gamma - 1 + \delta), 1) + 1 - \delta$ with respect to γ, we obtain

$$\acute{\sigma}(\gamma) = \mathcal{F}_{11}^2(\varphi(\gamma - 1 + \delta), 1)\varphi_1(\gamma - 1 + \delta). \tag{29}$$

We know that

$$\varphi_1(\gamma - 1 + \delta) = \frac{1}{\mathcal{F}_1^2}.$$

So (29) reduces to

$$\acute{\sigma}(\gamma) \equiv \frac{\mathcal{F}_{11}^2}{\mathcal{F}_1^2} < 0,$$

where the last inequality is obtained from Assumption 1. The uniqueness result follows.

Proof of Lemma 4

Let us first show that for all $\gamma_t \in (1, \overline{\gamma})$ the sign of V_{21} is strictly positive. Let us recall that we have defined

$$V(k_t, k_{t+1}, X_t) = \frac{\left[\mathcal{F}^1(k_t - \varphi(k_{t+1} - (1-\delta)k_t, X_t), X_t)\right]^\alpha}{\alpha}. \tag{30}$$

We can compute

$$
\begin{aligned}
V_2 &= -\left(\mathcal{F}^1\right)^{\alpha-1}\mathcal{F}_1^1\varphi_1 \\
&= -\frac{(\mathcal{F}^1)^{\alpha-1}\mathcal{F}_1^1}{\mathcal{F}_1^2} < 0.
\end{aligned} \tag{31}
$$

We can now using (31), compute V_{21} as

$$
\frac{(1-\alpha)\left(\mathcal{F}^1\right)^{\alpha-2}\left(\mathcal{F}_1^1\right)^2(\mathcal{F}_1^2+1-\delta)}{(\mathcal{F}_1^2)^2} - \frac{\left(\mathcal{F}^1\right)^{\alpha-1}\mathcal{F}_{11}^1(\mathcal{F}_1^2+1-\delta)}{(\mathcal{F}_1^2)^2}
$$
$$
-\frac{\left(\mathcal{F}^1\right)^{\alpha-1}\mathcal{F}_{11}^2\mathcal{F}_1^1(1-\delta)}{(\mathcal{F}_1^2)^3} \tag{32}
$$

Under Assumptions 1 and 2, the sign of (32) is strictly positive. Using the definition of $V(k_t, k_{t+1}, X_t)$ given in (30), we can also compute $V_1(k_t, k_{t+1}, X_t)$ as

$$
\begin{aligned}
V_1 &= (\mathcal{F}^1)^{\alpha-1}\mathcal{F}_1^1\left[1+(1-\delta)\varphi_1\right] \qquad (33)\\
&= \frac{(\mathcal{F}^1)^{\alpha-1}\mathcal{F}_1^1(\mathcal{F}_1^2+1-\delta)}{\mathcal{F}_1^2} > 0.
\end{aligned}
$$

If we look at the expression of $V_2(k_t, k_{t+1}, X_t)$ obtained in (31) and compare it to (33) we see that

$$
V_2(k_t, k_{t+1}, X_t) = -\frac{V_1(k_t, k_{t+1}, X_t)}{\mathcal{F}_1^2(\varphi(k_{t+1}-(1-\delta)k_t, X_t), X)+1-\delta}.
$$

So, if we define a function $v(\gamma_t) = V_1(1, \gamma_t, 1)$, we can rewrite the Euler Equation (25) as

$$
\frac{\gamma_t^{1-\alpha}v(\gamma_t)}{\beta\left[\mathcal{F}_1^2(\varphi(\gamma_t-1+\delta,1),1)+1-\delta\right]} = v(\gamma_{t+1}).
$$

We have seen above that, for all $\gamma_t \in (1, \overline{\gamma})$ we have $V_{21}(1, \gamma_t, 1) > 0$. This implies that for all $\gamma_t \in (1, \overline{\gamma})$, $\acute{v}(\gamma_t) > 0$. $v(\gamma_t)$ is invertible. For all $\gamma_t \in (1, \bar{\gamma})$ the implicit function theorem tells us that locally there exists a C^1 function $\theta(\gamma_t)$ such that

$$
\frac{\gamma_t^{1-\alpha}v(\gamma_t)}{\beta\left[\mathcal{F}_1^2(\varphi(\gamma_t-1+\delta,1),1)+1-\delta\right]} = v(\theta(\gamma_t)). \tag{34}
$$

Hence we can rewrite (34) as

$$
\theta(\gamma_t) \equiv v^{-1}\left\{\frac{\gamma_t^{1-\alpha}v(\gamma_t)}{\beta\left[\mathcal{F}_1^2(\varphi(\gamma_t-1+\delta,1),1)+1-\delta\right]}\right\}. \tag{35}
$$

We can rewrite the Euler Equation as $\psi(\gamma_t, \theta(\gamma_t)) = 0$. Applying the implicit function theorem, we can derive $\theta^{'}(\gamma_t)$ as

$$\theta^{'}(\gamma_t) = \frac{(\alpha - 1)V_2(1, \gamma_t, 1) - \gamma_t V_{22}(1, \gamma_t, 1)}{\beta \gamma_t^{\alpha} V_{21}(1, \theta(\gamma_t), 1)}. \tag{36}$$

Under Assumption 1 and 2, we know that $V(k_t, k_{t+1}, k_t)$ is homogenous of degree $0 < \alpha \leq 1$. This implies that $V_2(k_t, k_{t+1}, X_t)$ is homogenous of degree $\alpha - 1$. So, applying the Euler theorem on homogenous functions, we get

$$(\alpha - 1)V_2(1, \gamma_t, 1) = V_{12}(1, \gamma_t, 1) + V_{22}(1, \gamma_t, 1)\gamma_t + V_{23}(1, \gamma_t, 1).$$

Thus, we finally obtain the following expression for the derivative of $\theta(\gamma_t)$

$$\theta^{'}(\gamma_t) = \frac{V_{12}(1, \gamma_t, 1) + V_{23}(1, \gamma_t, 1)}{\beta \gamma_t^{\alpha} V_{12}(1, \gamma_{t+1}, 1)}.$$

Q.E.D.

Proof of Proposition 17. Looking at (35) we also derive $\theta^{'}(\gamma_t)$ as

$$\frac{\gamma_t{}^{-\alpha}}{v^{'}(\gamma_{t+1})} \left[\frac{\gamma_t v^{'}(\gamma_t) + (1-\alpha)v(\gamma_t)}{\beta(\mathcal{F}_1^2 + 1 - \delta)} - \frac{\gamma_t v(\gamma_t)\mathcal{F}_{11}^2}{\beta(\mathcal{F}_1^2 + 1 - \delta)^2 \mathcal{F}_1^2} \right].$$

We know from (32) that $V_{21}(1, \gamma_t, 1) > 0$ for all $\gamma_t \in (1, \bar{\gamma})$. Under Assumptions 1 and 2 we see that $\theta^{'}(\gamma_t)$ is strictly positive for all $\gamma_t \in (1, \bar{\gamma})$. We know that a sufficient condition for the existence of a balanced growth path is that at $\gamma_t = 1$ we have

$$\mathcal{F}_1^2(1, \varphi(\delta, 1)) + 1 - \delta > \frac{1}{\beta}. \tag{37}$$

This implies that at $\gamma_t = 1$ we have

$$\frac{v(1)}{v(\theta(1))} = \beta \left[\mathcal{F}_1^2(1, \varphi(\delta, 1)) + 1 - \delta \right] > 1.$$

So under condition (37), we have $v(1) > v(\theta(1))$. We have shown in Proposition **??** that $v^{'}(\gamma_t) > 0$. So, at $\gamma_t = 1$ we have

$$1 > \theta(1). \tag{38}$$

We also know from our existence results that as $\gamma \to \overline{\gamma}$ we have $\lim_{\gamma \to \overline{\gamma}} \varepsilon(\gamma) > \lim_{\gamma \to \overline{\gamma}} \sigma(\gamma)$. This implies that as $\gamma \to \overline{\gamma}$ we have

$$\lim_{\gamma \to \overline{\gamma}} \frac{v(\gamma_t)}{v(\theta(\gamma_t))} = \frac{\beta \left[\mathcal{F}_1^2(1, 1) + 1 - \delta \right]}{\overline{\gamma}^{1-\alpha}} < 1.$$

Hence

$$\lim_{\gamma \to \overline{\gamma}} v(\gamma_t) < \lim_{\gamma \to \overline{\gamma}} v(\theta(\gamma_t)). \quad (39)$$

Since $v'(\gamma_t) > 0$, (39) implies that

$$\lim_{\gamma \to \overline{\gamma}} \gamma_t < \lim_{\gamma \to \overline{\gamma}} \theta(\gamma_t). \quad (40)$$

We know that γ is a unique equilibrium that solves the representative agent's problem. We know that $\theta'(\gamma_t) > 0$ for all $\gamma_t \in (1, \bar{\gamma})$. So, (38) and (40) imply that $\theta(\gamma_t)$ cuts the 45 degree line from below at $\widetilde{\gamma}$. It then follows that

$$\theta'(\widetilde{\gamma}) > 1.$$

The balanced growth path is globally determinate.

Proof of Corollary 13.
From Proposition we have three equilibria if

$$\frac{\mathcal{F}_{11}^1 \mathcal{F}_{12}^1 \mathcal{F}^1}{q \Delta k^1} \left(\frac{k^2}{l^2} - \frac{k^1}{l^1} \right) \Big|_{(1, \widetilde{\gamma} - 1 + \delta, 1)} > \frac{1 - \alpha}{\beta \widetilde{\gamma}^{\alpha}}. \quad (41)$$

If we define the following two functions

$$\begin{aligned} \eta(\widetilde{\gamma}) &= \frac{\gamma^{1-\alpha}}{\beta}, \\ \kappa(\widetilde{\gamma}) &= \mathcal{F}_1^2 + 1 - \delta \Big|_{(1, \widetilde{\gamma} - 1 + \delta, 1)}, \end{aligned}$$

then we see that (41) is equivalent to

$$\kappa'(\widetilde{\gamma}) > \eta'(\widetilde{\gamma}).$$

It follows that a necessary condition for $\widetilde{\gamma}$ to be stable is

$$\widetilde{\gamma} > \left(\frac{1 - \alpha}{\beta} \right)^{1/\alpha}.$$

For endogenous growth we need $\widetilde{\gamma} > 1$.

8 References

Arrow, K.J., (1962): "The Economic Implications of Learning by Doing", *Review of Economic Studies,* 29: 155-173.

Becker, G. (1996), Accounting for Tastes, Cambridge, MA: Harvward University Press and New York: Cambridge University Press.

Benhabib, J., and K. Nishimura, (1985): "Competitive Equilibrium Cycles", *Journal of Economic Theory*, 35: 284-306.

Boldrin, M and A. Rustichini, (1994): "Growth and Indeterminacy in Dynamic Models with Externalities", *Econometrica*, 62: 323-42.9

Boldrin, M, Nishimura K., Shigoka, T. and M. Yano, (2001): "Chaotic Equilibrium Dynamics in Endogenous Growth Models", *Journal of Economic Theory,* 96: 9-132.

Coleman, J.S. (1988), 'Social capital in the creation of human capital', American Journal of Sociology, 94, 95–121.

Drugeon, J.P. and A. Venditti, (1998): "Intersectoral External Effects, Multiplicities and Indeterminacies II: The Long -Run Growth Case", Working Paper 98A20, GREQAM.

Drugeon, J.P., Poulsen O., and A. Venditti, (2003): "On Intersectoral Allocations, Factor Substitutability and Multiple Long-Run Growth Paths", *Economic Theory*, 21: 175-183.

Fukuyama, F (1995): *Trust, Social Virtues and the Creation of Propserity.* New York: Free Press

Green, D.P. and I. Shapiro (1994), Pathologies of Rational Choice. Theory. A Critique of Applications in Political Science, New Haven, CT: Yale University Press.

Harrod, R, (1937): "Review of Joan Robinson's *Essays in the Theory of Unemployment*", *Economic Journal*, 47: 326-330.

Goenka, A., O., Poulsen (2004): "Indeterminacy and Labor Augmenting Externalities", forthcoming, *Journal of Economics.*

Knack,S. and Keefer P. (1997): "Does Social Capital have an Economic Payoff? A Cross-Country Investigation." *Quaterly Journal of Economics,* 112:1252-88.

North, D.C. (1990), Institutions, Institutional Change and Economic Performance, Cambridge, UK: Cambridge University Press.

Ostrom, E. and T.K. Ahn (eds.) (2003), Foundations of Social Capital. Critical Studies in Economic Institutions, Cheltenham, UK and Northampton, MA, USA: Edward Elgar Publishing.

Paldam, M. (2000), 'Social capital: one or many? Definition and measurement', Journal of Economic Surveys, Special Issue on Political Economy, 14 (5), 629–53.

Poulsen, A. and Svendsen, G.T. (2005): 'Social capital and endogenous preferences.' Public Choice. In Press.

Poulsen, O. (2001) "Indeterminacy in a Two-Sector Discrete Time Model with Labor augmenting External Effects", Unpublished Ph.D. Thesis, University of Essex.

Putnam, R.D. (1993), Making Democracy Work. Civic Traditions in Modern Italy, Princeton, NJ: Princeton University Press.

Putnam, R. (2000), Bowling Alone. The Collapse and Revival of American Community. New York, London, Toronto, Singapore: Simon & Schuster.

Romer, P., (1983): "Dynamic Competitive Equilibria with Externalities, Increasing Returns and Unbounded Growth", Unpublished Ph.D. Thesis, University of Chicago.

Solow, R. M. (2000), “Notes on Social Capital and Economic Performance” in P. Dasgupta and I. Serageldin (eds), Social Capital, A Multifaceted Perspective, Washington, DC: World Bank, p 6-10.

Srinivasan, T.N., (1964): “Optimum Savings in a Two-Sector Model of economic Growth”, *Econometrica*, 32: 358-373.

Svendsen, G.L.H. and G.T. Svendsen (2003), ‘The wealth of nations: Bourdieuconomics and social capital’, Theory and Society, 32 (5/6) (special double issue in memory of Pierre Bourdieu), 607-631.

Uzawa, H., (1961): “Neutral Inventions and the Stability of Growth Equilibrium”, *Review of Economic Studies,* 28: 117-124.

Uzawa, H., (1961): “On a Two-Sector Model of Economic Growth, II”, *Review of Economic Studies,* 30: 105-118.

Zack, P.J. and S. Knack “Trsut and Growth”, *Economic Journal*, 111: 295-321.

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