ISSN 0819-2642
ISBN 0 7340 2520 3

THE UNIVERSITY OF MELBOURNE

DEPARTMENT OF ECONOMICS

RESEARCH PAPER NUMBER 865

DECEMBER 2002

MODELLING SOCIAL CAPITAL AND GROWTH

by

Yuan K. Chou

Department of Economics
The University of Melbourne
Melbourne Victoria 3010
Australia.

Modelling Social Capital and Growth

Yuan K. Chou
The University of Melbourne

December 12, 2002

Abstract

This paper proposes three theoretical growth models incorporating social capital, based on varied expositions on the concept of social capital and the empirical evidence gathered to date. In these models, social capital impacts growth by assisting in the accumulation of human capital, by affecting financial development through its effects on collective trust and social norms, and by facilitating networking between firms that result in the creation and diffusion of business and technological innovations. We solve for the optimum allocation of human capital or labor towards social capital formation in each model, and examine their comparative statics and transitional dynamics.

KEYWORDS: Economic Growth Social Capital Financial Development Technological Change Human Capital
JEL CODES:

1 Introduction

The concept of social capital which refers to features of social organizations such as networks norms and trust that facilitate coordination and cooperation for mutual benefit has found increasing acceptance among economists in the last five years. Like other sociological concepts its amorphous nature elicited initial skepticism among mainstream economists who questioned the validity of classifying social interactions as a form of capital. Many economists now acknowledge that social capital shares similarities with physical and human capital in its intertemporal dimension and its ability to generate a stream of future benefits. The number of papers on social capital being published in top-ranked economic journals is perhaps the strongest indication of its rising respectability among economists.

More importantly the different facets of social capital have been demonstrated to have a profound impact on economic development and growth. Indicators of social capital has been shown to affect local financial development as well as general economic growth in Italy. Many cross-country studies have shown the importance of trust in determining an economy's growth prospects. Social capital has been shown to be correlated with superior outcomes in watershed conservation in Rajasthan

India [Krishna and Uphoff (2002)] in agricultural trading in Madagascar [Fafchamps and Minten (2002)] in community-based water projects in Central Java Indonesia [Isham and Kahkonen (2002)] and in voluntary solid waste management in Dhaka Bangladesh [Pargal Gilligan and Huq (2002)].

Despite the burgeoning number of empirical studies on the economic impact of social capital there have been few attempts at building theoretical models of social capital and growth. Zak and Knack (2001) construct a model where social constraints and formal institutions ameliorate the principal-agent problem between investors and investment brokers by raising trust thereby reducing the amount of unproductive time spent on inspecting investments. Glaeser Laibson and Sacerdote (2002) model an individual's decision on the optimal amount of social capital to invest in where the opportunity cost of time and occupational returns to social skills are exogenously given.

In this paper we propose three growth models where social capital impacts growth by assisting in the accumulation of human capital by affecting financial development through its effects on collective trust and social norms and by facilitating networking between firms that result in the creation and diffusion of business and technological innovations. We solve for the optimum allocations of human capital or labor towards the building of social capital in each model and examine their comparative statics and transitional dynamics.

The paper is organized as follows: Section 2 examines the concept of capital - its definition(s) attributes and classifications. Section 3 reviews the extensive literature on the empirical relationship between social capital and growth. Sections 4 5 and 6 are devoted to expositions of three theoretical models in which social capital impacts growth through the channels of human capital accumulation financial development and business innovations. Section 7 concludes.

2 The Concept of Social Capital

2.1 Defining Social Capital

What is social capital? Like many sociological concepts it is a broad one encompassing myriad definitions. While some researchers define social capital in terms of trust and norms of civic cooperation others define it in terms of cultural values such as compassion altruism and tolerance while still others emphasize institutions and the quality and quantity of "associational" life. To give the reader a flavor of this diversity we will examine three specific definitions before examining the key attributes that are common to all social capital as well as the different ways in which social capital may be classified.

According to Coleman (1990) "What I mean by social capital in the raising of children is the norms the social networks and the relationships between adults and children that are of value for the child growing up. Social capital exists within the family but also outside the family in the community ... in the interest even the intrusiveness of one adult in the activities of someone else's child." Elaborating

Coleman (1994) argues that "social capital is the set of resources that inhere in family relations and in community social organization and that are useful for the cognitive or social development of a child or young person." (p.300) Education, for Coleman, is the strongest expression of the resources generated by the relationships, values, and trust that constitute social capital. [Field, Schuller and Baron (2000)].

Putnam (1996) focuses on defining a different aspect of social capital: "By social capital I mean features of social life – networks, norms, and trust – that enable participants to act together more effectively to pursue shared objectives." (p.56) In his search for empirical evidence about changes in the stock of social capital, Putnam (2000) identifies a general secular decline in levels of social capital, despite a contemporary rise in educational levels, which is generally positively associated with civic participation.

Maskell (2000) argues that "(s)ocial capital refers to the values and beliefs that citizens share in their everyday dealings and which give meaning and provide design for all sorts of rules. The use of the word 'capital' implies we are dealing with an asset. The word 'social' tells us that it is an asset attained through membership in a community." He believes that the formation of social capital is often not a deliberate action: "Social capital is accumulated within the community through processes of interaction and learning ... Social capital is at the same time in part accumulated as an unintended and even unanticipated consequence of economic activity as people often spend more of their waking hours 'bowling' with their workplace colleagues than with their family and friends." Social capital, then, may arise in the commercial workplace as much as it does in civil society. "Norms, codes, trust, solidarity and other vital elements of social capital are built and reinforced when sharing a common goal or a mutual fate even in the most hierarchical economic structures imaginable, like the globally operating multidivisional corporation, and not just when people mingle, organize and achieve with peers in their spare time." (p.111)

2.2 Key Attributes of Social Capital

Social capital is capital because it is an *accumulated stock* from which a stream of benefits flows. Social capital is therefore more than simply a set of social organizations or social values.[1] Social capital can directly enhance output or lead to higher productivity of other resources, such as human and physical capital.

However, as Grootaert and van Bastelaer (2002) point out, social capital exhibits several characteristics which distinguish it from other forms of physical capital. For example, like human capital but unlike physical capital, social capital may accumulate as a result of its use. That is, social capital is both an input into and an output of collective action. To the extent that social interactions are drawn upon to produce mutually beneficial output, the quality or quantity of these interactions is likely to rise. In addition, although every other form of capital has a potential productive impact in a typical Robinson Crusoe economy, social capital does not

[1] Arrow (2000) and Solow (2000) are, however, skeptical about the "capital" aspect of social capital. Solow argues that "behavior patterns" is a more appropriate term.

- creating and activating social capital requires at least *two* people. Social capital therefore has public good characteristics, so that it is likely to be underproduced because of incomplete collective internalization of the positive externalities inherent in its production.

On the other hand, social capital, like other forms of capital, is not costless to produce and requires a significant amount of time and effort, if not always money. Trusting relationships among members of a sports club, professional organization, or civic association often take a very long time to build. Moreover, since trust is more easily destroyed than rebuilt, there is a maintenance expense to social capital, often in the form of time.

2.3 Classifying Social Capital

2.3.1 The Scope of Social Capital

Social capital may exist on three levels. At the *micro* level, social capital encapsulates features of social organizations, such as networks of individuals or households, and the associated norms and values that create externalities for the community as a whole [Putname (1993)]. It has come to be accepted that these externalities from interpersonal interactions may either be positive or negative.

The analysis of social capital at the *meso* level expands the concept of social capital to include vertical as well as horizontal associations and behavior within and among other entities, such as firms. Vertical associations are characterized by hierarchical relationships and an unequal power distribution among members. While bonding (or integrating) relationships take place within a group and facilitate interaction and collective action within it, bridging (or linking) relationships strengthen linkages between the group and other organizations.

The third and most encompassing view of social capital includes the social and political environment that shapes social structure and enable norms to develop. This *macro* view includes the most formalized institutional relationships and structures, such as the political regime, the rule of law, the court system, and civil and political liberties. Grootaert and van Bastelaer (2002) argue that there is a strong degree of complementarity between horizontal and hierarchical associations and macro institutions, and that their coexistence maximizes the impact of social capital on economic and social outcomes. However, in this paper, we will not attempt to model the relationship between macro level social capital (also known as "government social capital" or "social infrastructure"), as this has been done elsewhere, including Chin and Chou (2002).

2.3.2 The Forms of Social Capital

At each of the three levels explained above, social capital affects economic growth as a result of the interactions between two distinct types of social capital - *structural* social capital and *cognitive* social capital. As noted by Grootaert and van Bastelaer (2002), structural social capital facilitates information sharing and collective action

and decision-making through established roles and social networks supplemented by rules, procedures and precedents. Cognitive social capital, on the other hand, refers to shared norms, values, trust, attitudes and beliefs, and is a more subjective and intangible concept. Krishna (2000) terms the first type of social capital as "institutional capital" and the second as "relational capital".

The two forms of social capital are often complementary. For example, cooperation between parents who are neighbors are based on a cognitive bond, and may also be reflected in a formal structural arrangement if they are both deeply involved in the parents-teachers association of the local school.

2.3.3 The Channels of Social Capital

Like other forms of capital, social capital represents an asset or a class of asset that produces a stream of benefit. The streams of benefits, or channels through which it impacts development, includes elements such as information sharing and mutually beneficial collective action and decision-making. These benefits then lead to higher incomes for households, communities, and nations. Besides serving as forums for information exchange, networks and associations facilitate collective action and decision-making by increasing the costs of non-compliance.

In this paper, social capital will be shown to produce economic growth by facilitating the accumulation of human capital, the creation and diffusion of business innovations, and enabling financial development which increases capital accumulation.

3 Empirical Evidence on Social Capital and Growth

As stated in the introduction, there is now an extensive literature linking the different facets of social capital to economic performance. Some studies have tracked changes in the stock of social capital, some have attempted to identify the determinants of an individual's investment in social capital, while others have examined the importance of civic community, membership in associations, and ethnic homogeneity in promoting economic growth. There have also been many studies on the determinants of trust, and the impact of trust on investment and growth.

3.1 Trends in Social Capital

Costa and Kahn (2001) evaluate trends in social capital since 1952 and assess explanations for observed declines. They find that: (1) declines in social capital have been somewhat overstated, with small declines in probability of volunteering, larger declines in group membership, and still larger declines in probability of entertaining since 1970s; (2) there is no decline in the probability of spending frequent evenings with friends and relatives, but decreases in daily visits with friends and relatives; (3) rising community heterogeneity (especially income inequality) explains the fall

in social capital produced outside the home; and (4) the rise in women's labor force participation rates explains the decline in social capital produced within the home.

3.2 Determinants of Investment in Social Capital

In Gleaser, Laibson and Sacerdote (2000), social capital is defined as a person's social characteristics, including social skills and charisma, which enables him to reap market and non-market returns from interaction with others. Individual social capital may thus be seen as the social component of human capital. Using responses to organization membership questions from the General Social Survey (1972-98) with repeated cross sections of 1200-2500 respondents, the authors find evidence supporting the individual-based model of social capital formation. Their findings include: (1) the relationship between social capital and age is increasing and then decreasing; (2) social capital declines with expected mobility; (3) social capital investment is higher in occupations with greater returns to social skills (low social skills occupations include textile operatives, and billing clerks, while high social skills occupations include physicians and clergymen); (4) people who invest in human capital also invest in social capital; and (5) social capital appears to have interpersonal complementaries: people who belong to groups with more social capital tend to invest more in social capital themselves.

3.3 Civic Community and Government Performance

Helliwell and Putnam (1995) provide a rigorous test of Putnam's (1993) hypothesis on the role of social capital in accounting for variations in economic performance in different parts of Italy. Three alternative regional indicators of social capital (citizen satisfaction with local government, performance, and an index of "civic community" based on four components: newspaper reading, number of sports and cultural organizations, turnout in referendums, and the incidence of preference voting) are positively and significantly related to growth over the 1950-90 period, controlling for 1950 *per capita* income.

3.4 Group Membership

Knack and Keefer (1997) attempt to test the conflicting theories of Putnam (1993) and Olson (1982) on the desirability of high membership in horizontal, non-hierarchical associations. Putnam believes that these associations are a source of trust and of social ties conducive to economic performance while Olson emphasizes their growth-impeding, rent-seeking functions. In Barro-type regressions, Knack and Keefer find that group memberships are unrelated to growth and negatively related to investment rates, thus offering little support to either Putnam or Olson. Disaggregating groups into those that seem to have primarily social goals ("Putnam groups") and those that are more likely to engage in lobbying ("Olson groups") proves not to offer Olson additional support, while Putnam groups actually show a strong but *negative* association with investment.

3.5 Social Polarization

Several studies focus on ethnic divisions and inequality as sources of slower growth through their effects on trust, social cohesion, economic policymaking, and violent conflict. Easterly and Levine (1997) show that more ethnically heterogeneous societies grow more slowly than others, controlling for the usual growth regressors. Ethnic heterogeneity is correlated with a range of indicators of inefficient policies, including a high black market premium, high levels of corruption, low schooling rates, a lack of financial development, and poor infrastructure. In Zak and Knack (2001), the strength of informal sanctions against cheating weakens with social distance, increasing monitoring costs of contractual agreements between investor-broker pairs.

3.6 Trust

Knack and Keefer (1997), using indicators of trust and civic norms from the World Values Survey, finds that a one-standard deviation increase in a survey-based measure of country-level trust increases economic growth by more than half a standard deviation. However, they find that memberships in formal groups is not associated with trust or improved economic performance. In addition, trust and civic norms are stronger in countries with higher (and more equal) incomes, and with better-educated and more ethnically homogeneous populations. La Porta, Lopez-de-Silanes, Schleifer, and Vishny (1997) obtain similar results to Knack and Keefer (1997).

Zak and Knack (2001) present a general equilibrium growth model in which investors of varying types (defined by ethnicity, class, age, or other differences) are randomly matched each period with brokers of varying types in order to access credit markets. Only brokers know actual investment returns, creating a moral hazard problem. Before investments are closed out in the second period, brokers' types are revealed and consumers decide on how much time to spend investigating the broker. In the model, trust declines with differences in type between those of an investor and a broker. In empirical tests, Zak and Knack report that trust is higher in countries with stronger formal institutions for enforcing contracts and reducing corruption and in countries with less-polarized populations (as measured by income or land inequality, ethnic homogeneity, and intensity of economic discrimination). They also show that formal institutions and polarization appear to affect growth rates partly through their effect on trust.

3.7 Related Research

Temple and Johnson (1998) find a correlation between the Adelman-Morris index of social development (incorporating factors such as extent of urbanization, kinship, social mobility, literacy, and extent of mass communications) and economic growth. Their results are robust to exclusion of some factors from the index and to the

inclusion of human capital and fertility variables. Temple and Johnson characterize their index of social development as a proxy for "social capability".

4 Social Capital and Human Capital

The impact of civil society, the way individuals in a society work together for common purposes, on the education and raising of children has long been recognized by social scientists. More recently in the US, Sen. Hillary Clinton has greatly increased public awareness of this issue in releasing a book based on the old African proverb, "It takes a village to raise a child". In the introduction to her book, Clinton reminds that us that raising a child well involves activities that draw time away from market activities, such as talking to a baby while changing a diaper, playing airplane to entice a toddler to accept a spoonful of food, and tossing a ball back and forth with a teenager. She acknowledges that social capital that comes from participation in community groups and activities has diminished in contemporary society - membership in civic associations, churches, union, political parties, and even bowling leagues have all experienced significant decline in America. In today's digital age, the 'village' defies geographical boundaries - it is the network of values and relationships that support and affect our lives. Becker (1993) also acknowledges that "(n)o discussion of human capital can omit the influence of families on the knowledge, skills, values, and habits of children ...Therefore, even small differences among children in the preparation provided by their families are frequently multiplied over time into large differences ..." (p.21).

4.1 Background

Among social scientists, James S. Coleman was a pioneer in making explicit reference to the concept of social capital in evaluating society's impact on human capital accumulation. According to Coleman (1988), social capital comes about through changes in the relations among persons that facilitate action. Less tangible than physical or even human capital, it exists in the relations among persons. However, like the first two forms of capital, it facilitates productive activity. For example, a group within which there is extensive trustworthiness and extensive trust is able to accomplish much more than a comparable group without these attributes.

Coleman argues that social relations constitute useful capital resources for individuals in several ways. Firstly, social relations may be characterized by obligations and expectations that rely on and enhance trustworthiness. For example, if A does something for B and trusts B to reciprocate in the future, this establishes an expectation in A and an obligation on the part of B. This obligation may be conceived as a credit slip held by A for performance by B. These credit slips constitute a large body of credit that A can call in if required, unless the placement of trust was betrayed and the debt repudiated. Secondly, social relations serve as information channels for individuals. In the context of childraising and human capital accumulation, two parents who see each other as neighbors may exchange information about

their teenagers' activities.

4.1.1 The Importance of Closure in Social Networks

Social relations may lead to the establishment of norms and provide effective sanctions if they are violated. Effective norms, in turn, requires the 'closure' of social networks. In the case of social capital assisting in the accumulation of human capital, the imposing of norms by parents on children requires intergenerational closure. Colloquially, in a community with substantial social capital, the parents' friends are the parents of their children's friends. This is distinct from the high degree of closure among children as peers (who see each other daily, have expectations toward each other, and develop norms about each other's behavior), which exists even in communities with little social capital. The consequence of intergenerational closure is a set of effective sanctions that can monitor and guide behavior. Parents can discuss their children's activities and come to some consensus about standards and about sanctions. Parents of students from the same school who are willing to sacrifice time away from market activities reinforce one another in sanctioning their children's actions. Each parent constitutes a monitor not only for his or her own child but also for those of another. Intergenerational closure therefore provides a quantity of social capital available to each parent in raising his or her children, not only in matters related to school but also in other matters.

4.1.2 Family Background and Human Capital Accumulation

In Coleman's view, the family background of a student affects his or her accumulation of skills and knowledge in three ways. Financial capital, approximated by the family's wealth or income, provides physical resources that can aid achievement: a fixed place in the home for studying, materials to aid learning, and financial resources that smooth family problems. Human capital, approximately measured by parents' education, provides the potential for a cognitive environment for the child that aids learning, thus validating the inclusion of spillover effects from the existing stock of human capital in the Lucas (1988) specification of the human capital accumulation equation. However, this human capital may be irrelevant to outcomes for children if parents are not an important part of their children's lives, if their human capital is employed exclusively at work or elsewhere outside the home. That is, human capital possessed by parents that is not complemented by social capital embodied in family relations is irrelevant to their child's educational growth.

4.1.3 Empirical Evidence

Coleman (1988) provides empirical evidence that the presence of social capital within the family is especially important in determining whether a child drops out of school. He uses the number of siblings, which measures the dilution of adult attention to a child, as a proxy for social capital. In addition, Coleman (1988) also find that social capital outside the family has a significant impact on the dropping out decision.

Students who have changed schools because their parents moved are more likely to drop out than their peers. For families that have moved often, the social relations that constitute social capital are broken at each move. Whatever the degree of intergenerational closure available to others in the community, Coleman argues, is not available to parents in mobile families. More significantly from our point of view, Coleman finds that dropout rates are lower in religiously based private schools than in public or secular private schools. Whether parents devote time to pursue religion-related activities (which may include social functions), it appears, affects human capital accumulation in their offspring.

Finally, Coleman (1988) clearly recognizes the public good aspect of social capital. The kinds of social structures that enable social norms and the sanctions that enforce them do not benefit primarily the person or persons whose efforts would be necessary to bring them about, but benefit all those who are part of such a structure. Coleman gives the example of a dense set of associations among some parents in certain schools. These are the result of a small number of persons, ordinarily mothers who do not hold full-time jobs outside the home. However, these mothers themselves experience only a subset of the benefits of this social capital surrounding the school. Should one of them choose to abandon these activities to take a full time job, the withdrawal of these activities constitutes a loss to all those other parents whose associations and contacts are dependent on them. Because of these externalities, there will generally be underinvestment in social capital. Coleman pessimistically notes that as the social structural conditions that overcome the problems of supplying these public goods - strong families and strong communities - promises to be even less present in the future than now, social capital will become ever more deficient in the absence of concerted policy changes and actions.

4.2 The Formal Model

In our growth model with human and social capital, there are many identical infinitely-lived agents. Each agent faces a trade-off between devoting resources (human capital, specifically) to final goods production (which enables current consumption), to human capital accumulation (real world translation: "teaching in a school" or being spending time acquiring new skills and knowledge), and to building social capital (being involved in parent-teacher associations, or spending time with his/her "kids" - notwithstanding the stilted analogy that afflicts representative agent models!) The last activity produces no income by itself but increases the effectiveness of human capital accumulation.

The formal model that we propose therefore incorporates the following key elements: (1) the building or accumulation of social capital requires resources to be diverted from other productive uses; (2) social capital may decay over time without new "investment" in social capital; (3) the existing stock of social capital has spillover effects on the building of new social capital; (4) social capital has a positive impact of human capital accumulation; (5) human capital has positive intertemporal spillovers in its accumulation; and (6) human capital is an important input in final

goods production.

Mathematically, the model may be summarized as follows:

$$\begin{aligned}
\dot{K} &= Y - C - \delta_K K, && (1)\\
\dot{H} &= E\left(u_H H\right)^{1-\psi} S^{\psi} - \delta_H H, && (2)\\
\dot{S} &= P\left(u_S H\right)^{1-\sigma} S^{\sigma} - \delta_S S, && (3)\\
Y &= AK^{\alpha}\left(u_Y H\right)^{1-\alpha}, && (4)
\end{aligned}$$

where K is the aggregate physical capital stock, Y is aggregate output, C is aggregate consumption, H is the stock of human capital, S is the stock of social capital, δ_K is the physical capital depreciation rate, δ_H is the human capital depreciation rate, δ_S is the social capital depreciation rate, A, E and P are productivity constants, and α, σ and ψ are elasticity parameters constrained to lie on the (0,1) interval.

The above equations describe the evolution of the physical, human, and social capital stocks respectively.

4.2.1 The Decentralized, Competitive Model

Firms seek to maximize profits, π_Y, by choosing the optimal allocation of labor, u_Y, and the optimal amount of physical capital, K :

$$\max\ AK^{\alpha}\left(u_Y H\right)^{1-\alpha} - w_Y u_Y H - r_K K,$$

where w_Y is the wage rate in the final goods sector and r_K is the rental price of capital.

Optimizing firms equate the marginal products of labor and capital to the wage rate and the rental price of capital respectively:

$$\begin{aligned}
w_Y &= (1-\alpha) A k^{\alpha} u_Y^{-\alpha},\\
r_K &= \alpha A k^{\alpha-1} u_Y^{1-\alpha}.
\end{aligned}$$

Individuals seek to maximize lifetime utility subject to constraints, that is:

$$\max \int_0^{\infty} e^{-\rho t} \frac{C^{1-\theta} - 1}{1-\theta} dt$$

subject to

$$\begin{aligned}
\dot{K} &= r_K K + w_Y u_Y H + w_H u_H H - P_H \dot{H} - C,\\
\dot{H} &= E\left(u_H H\right)^{1-\psi} S^{\psi} - \delta_H H,\\
\dot{S} &= \widetilde{P}\left(u_S H\right)^{1-\sigma} - \delta_S S,\\
1 &= u_Y + u_H + u_S,
\end{aligned}$$

where w_H is the prevailing wage in the human capital sector, P_H is the price of each unit of new human capital (think of this as school fees in the real world),

and $\widetilde{P} \equiv PS^s$. That is, individuals do not internalize the externalities that their formation of social capital confer on the accumulation of social capital by others. This is the public good aspect of social capital that we discussed earlier. Note, however, that individuals fully recognize the impact of social capital accumulation on human capital accumulation. (Indeed, this may be their sole motive for building social capital!)

We impose constant returns to scale on the production functions for $\dot{H}$ and $\dot{S}$, so that the ratio of these two forms of capital is constant in the steady state (that is, on the balanced growth path). In addition, we assume that educational services are priced so that they exactly cover the labor costs of providing such services, that is $P_H\dot{H} = w_H u_H H$. Lastly, for simplicity's sake, we assume that social capital itself does not give pleasure to the individual and is thus excluded from the utility function.

4.2.2 Solutions

We define the following variables that are constant in the steady state or the balanced growth path: $k \equiv K/H$ (the physical capital-human capital ratio), $s \equiv S/H$ (the social capital-human capital ratio), $c \equiv C/H$ (the consumption-human capital ratio), and $y \equiv Y/H$ (the output-human capital ratio).

As shown in the Appendix, the solution to the model is:

$$\begin{aligned} u_H^* &= \frac{(1-\psi)(\gamma_H^* + \delta_H)}{\rho + \theta\gamma_H^* + \delta_H}, \\ u_S^* &= \frac{\psi(1-\sigma)(\gamma_H^* + \delta_S)}{(1-\psi)(\rho + \theta\gamma_H^* + \delta_S)} u_H^*, \\ s^* &= \left(\frac{\rho}{\gamma_H^* + \delta_S}\right)^{\frac{1}{1-\sigma}} u_S^*. \end{aligned}$$

Define the implicit function $f(\gamma_H^*) = 0$, where $f(\gamma_H^*) \equiv \gamma_H^* + \delta_H - Eu_H^{*1-\psi} s^{*\psi}$. We solve numerically for γ_H^* after substituting the above expressions for u_H^*, u_S^*, and s^*. Once γ_H^* is found, it can be substituted back into these same expressions to obtain u_H^*, u_S^*, and s^*. Furthermore,

$$\begin{aligned} k^* &= \left(\frac{A\alpha}{\rho + \theta\gamma_H^*}\right)^{\frac{1}{1-\alpha}} (1 - u_H^* - u_S^*), \\ c^* &= \frac{\rho + \theta\gamma_H^* - \alpha\gamma_H^*}{\alpha} \cdot k^*, \\ y^* &= Ak^{*\alpha}(1 - u_H^* - u_S^*)^{1-\alpha}. \end{aligned}$$

We can show that the competitive solution results in an under-allocation of human capital to the accumulation of social capital. In particular, we can show that in the social planner's solution,

$$u_S^{*SP} = \frac{\psi(1-\sigma)(\gamma_H^* + \delta_S)}{(1-\psi)\left[\rho + \theta\gamma_H^* + \delta_S - \sigma(\gamma_H^* + \delta_S)\right]} u_H^*.$$

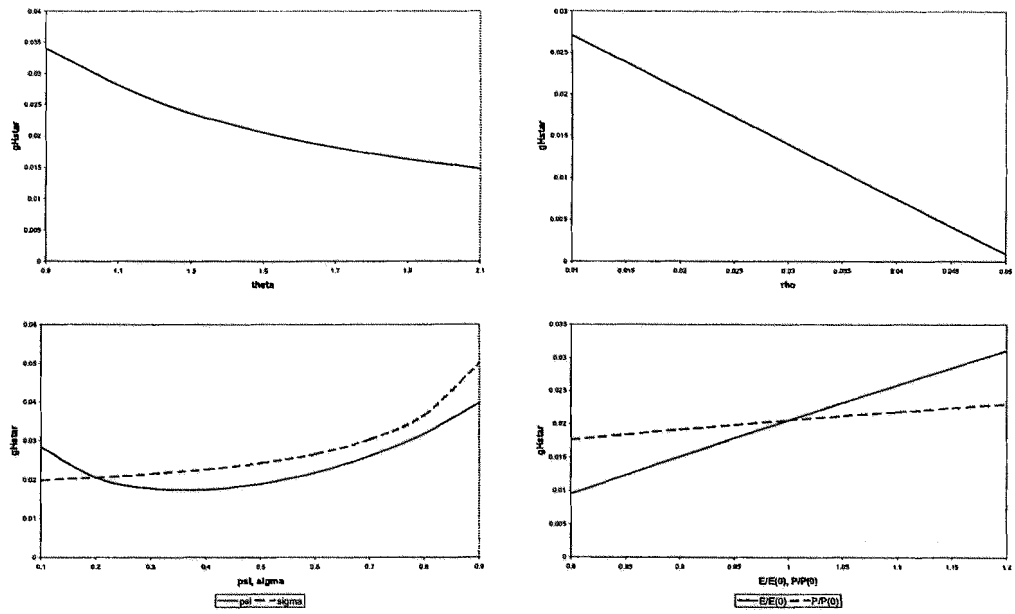


Table 1: Effect of Parameters on the Steady-State Growth Rate

Clearly u_S^*/u_H^* is larger in the social planner's solution since $\sigma\left(\gamma_H^* + \delta_S\right) > 0$. We can also show that a subsidy towards social capital formation financed by a lump sum tax will increase an individual's allocation of human capital towards social capital accumulation.

4.2.3 Comparative Statics

In this section, we examine the impact of changes in the various parameters of the model on the steady state growth rate as the well as the steady state allocations of human capital to the three sectors of the model. Figure 1 shows that the steady state growth rate is increasing in θ, the risk aversion parameter, and ρ, the rate of time preference. Since social capital and human capital accumulation create long run growth but requires a short run sacrifice of consumption, a higher discount rate results in lower investment in social and human capital, and therefore lower long run growth. The steady state growth rate is increasing in the productivity parameters of the human capital and social capital accumulation equations, E and P, as well as the social capital spillover parameter in the social capital accumulation equation, σ. More interestingly, there is a U-shaped relationship between the steady state growth rate and the social capital elasticity parameter in the human capital accumulation equation, ψ. Because of the constant returns to scale production functions for $\dot{H}$ and $\dot{S}$, the steady-state growth rate of the economy is higher at very low and very high values of ψ than at intermediate values.

Table 2 shows the response of the steady-state allocation of human capital across

sectors of the model to changes in various parameters. An increase in the discount rate or the risk aversion parameter in the utility function results in more human capital being allocated in the steady state to final goods production, and less being allocated to human capital and social capital accumulation. This is because final goods production brings instant gratification (through consumption) while human capital and social capital accumulation only increases future consumption.

An increase in the spillover parameter in the social capital accumulation equation, σ, which measures the positive externalities of current social capital production on future social capital accumulation, causes more human capital to be allocated to final goods production and less to either human capital or social capital accumulation. This is to ensure that physical capital (whose accumulation depends on the production of the final good) grows at the same rate as human capital and social capital in the steady state. An increase in the social capital elasticity parameter in the human capital accumulation equation, ψ, increases the steady state allocation of human capital to final goods production and social capital accumulation, and decreases the allocation to human capital accumulation.

Finally, an increase in the productivity parameters in the human capital and social capital accumulation equations (E and P respectively) results in a greater steady state allocation of human capital to final goods production and a reduced allocation to both social capital and human capital formation. An increase in E and P enables more new human capital to be produced for any given allocation of human capital across the three sectors, directly in the case of E, and indirectly through social capital in the case of P. However, the constancy of the physical capital-human capital ratio, k, in the steady state then requires more human capital to be channeled into final goods production, which in turn raises capital accumulation.

4.2.4 Transitional Dynamics

In this section, we examine the impact of increases in the productivity parameters governing the production of human and social capital. In order to present the transitional dynamics of the model graphically in the form of phase diagrams, it is necessary to reduce the complexity and dimensionality of the model by assuming a constant saving rate and an exogenous allocation of human capital across the three sectors. (That is, we assume u_S and u_H to be exogenously given.) The dynamics of the model then reduces to equations characterizing the $\dot{s} = 0$ and $\dot{k} = 0$ conditions respectively:

$$s = \left(\frac{P}{E} \cdot \frac{u_S^{1-\sigma}}{u_H^{1-\psi}} \right)^{\frac{1}{1+\psi-\sigma}}, \tag{5}$$

$$k = \left[\frac{A}{E} \left(\frac{s}{u_H} \right)^{1-\psi} \phi \right]^{\frac{1}{1-\alpha}} u_Y. \tag{6}$$

The phase diagram of the simplified model in k, s space is depicted in the top panel of Figure 3. The lower left panel in Figure 3 shows the impact of an increase

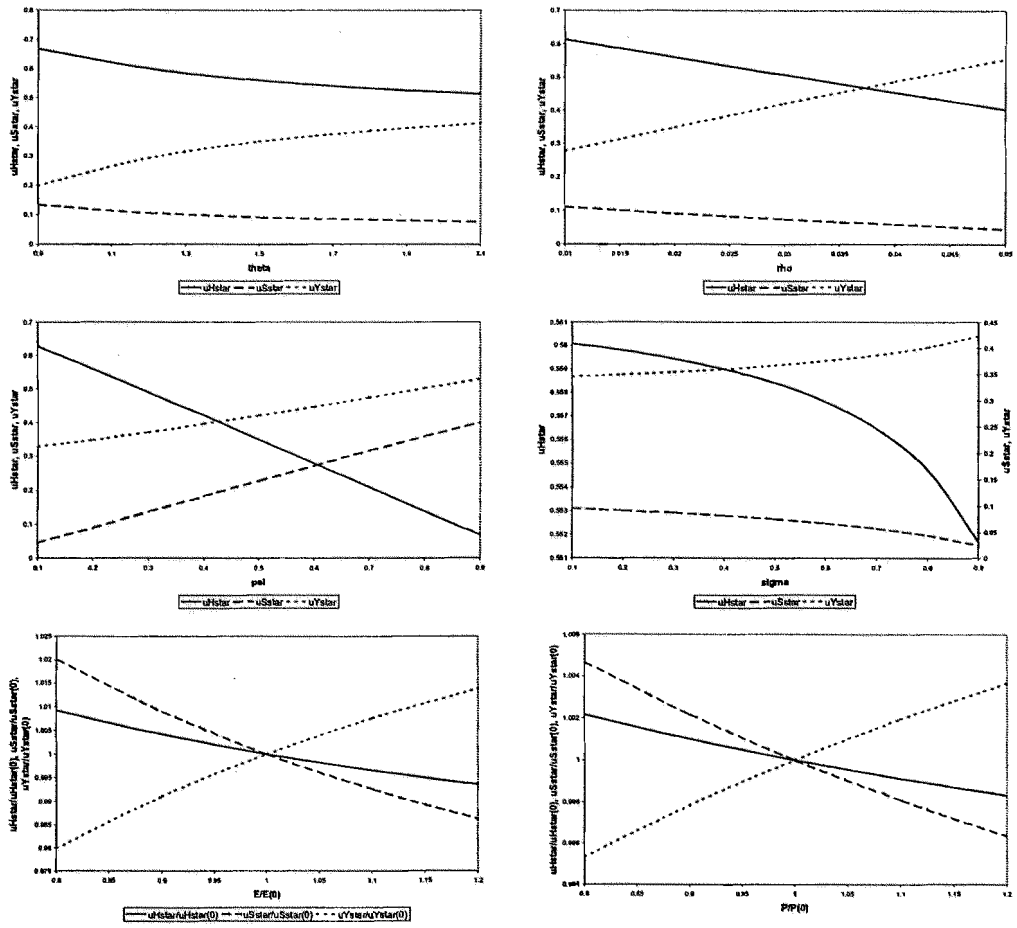
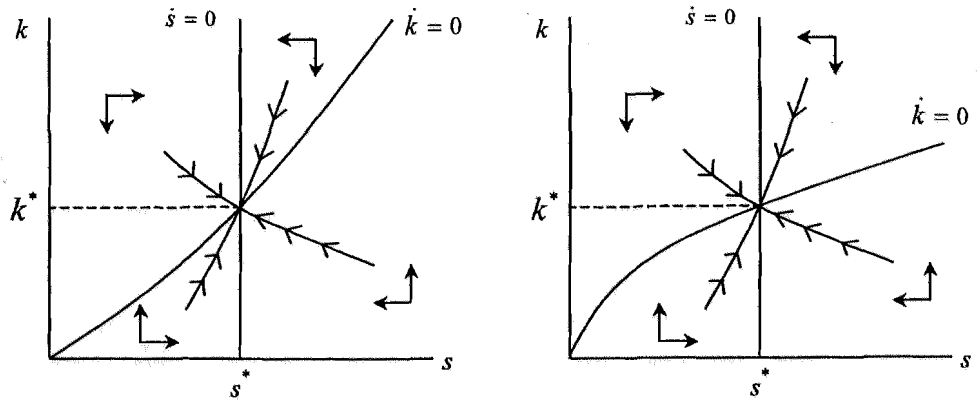
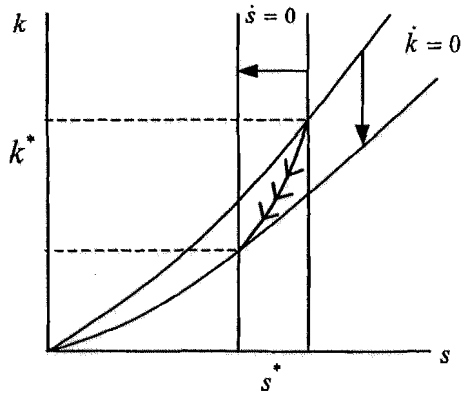


Table 2: Effect of Parameters on Steady-State Human Capital Allocation

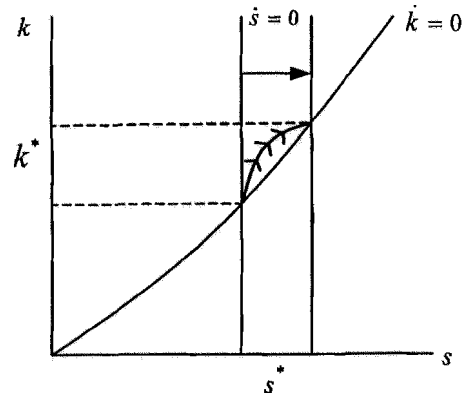


Phase Diagram ($\alpha > \psi$)

Phase Diagram ($\alpha < \psi$)



Effect of an Increase in E ($\alpha > \psi$)



Effect of an Increase in P ($\alpha > \psi$)

Table 3: Transitional Dynamics

in the productivity parameter of the human capital accumulation equation, E, while the lower right panel shows the impact of an increase in the productivity parameter of the social capital accumulation equation, P.

An increase in E causes both the physical capital-human capital ratio, k,and the social capital-human capital ratio, s, to decrease. On the other hand, an increase in P causes both k and s to increase.

5 Social Capital and Financial Development

A second channel through which social capital may impact economic growth is financial development. Guiso, Sapienza and Zingales (2000) provide evidence of this channel by exploiting well known differences in social capital and trust across different parts of Italy and using micro data on households and firms. Controlling for a large set of household characteristics and other environmental variables such as the quality of legal enforcement and GDP per capita, they find that in areas of country

with high social trust, people invest less in cash and more in stock, use more checks, have greater access to institutional credit, and make less use of informal credit. In these areas, firms also have more access to credit and are more likely to have multiple shareholders. In addition, the effect of trust is stronger where legal enforcement is weaker and among less-educated people.

5.1 The Model

In our proposed model, social capital affects growth by increasing the efficiency of the financial sector in transforming household or individual savings into productive investments by firms in the final goods sector. The accumulation process for social capital is similar to that in our first model except for replacing human capital with raw labor. Individuals may devote time to non-market activities such as participating in clubs and associations which raises the level of generalized trust in the community. This in turn spurs the development of financial institutions which provide better intermediation between the needs of savers and those of borrowers, as documented in Guiso et al (2000).

Specifically, the quantity of social capital per worker, S/L, determines the fraction of savings that is transformed into new productive capital. The relationship is allowed to be a non-linear one through the inclusion of the parameter ι:

$$\begin{aligned} \dot{K} &= \left(\frac{S}{L}\right)^{\iota}(Y-C)-\delta_K K, && (7)\\ \dot{S} &= P\left(u_S L\right)^{1-\sigma} S^{\sigma}-\delta_S S, && (8)\\ Y &= AK^{\alpha}\left(u_Y L\right)^{1-\alpha}, && (9)\\ 1 &= u_Y+u_S && (10) \end{aligned}$$

where L denotes the stock of labor (or number of workers), u_Y and u_S denote the allocation of labor to final goods production and social capital accumulation respectively, A and P are productivity parameters, and σ is parameter constrained to lie on the (0,1) interval. In addition, $\iota > 0$.

5.1.1 Solutions

We define the following variables which are constant in the steady state: $k \equiv K/L$ (physical capital per worker), $s \equiv S/L$ (social capital per worker), $c \equiv C/L$ (consumption per worker), and $y \equiv Y/L$ (output per worker).

The steady-state solutions are shown in the Appendix to be:

$$\begin{aligned} u_S^* &= \frac{\Gamma}{\Gamma+\Phi}, && (11)\\ \Gamma &= \alpha\iota\left(1-\sigma\right)\left(n+\delta_S\right)\left(n+\delta_K\right), \\ \Phi &= \left(1-\alpha\right)\left(\rho+\delta_K\right)\left[\rho+\delta_S-\sigma\left(n+\delta_S\right)\right]. \end{aligned}$$

$$u_Y^* = 1 - u_S^* = \frac{\Phi}{\Gamma + \Phi}, \tag{12}$$

$$s^* = \left(\frac{P}{n+\delta_S}\right)^{\frac{1}{1-\sigma}} u_S^*, \tag{13}$$

$$k^* = \left(\frac{s^{*\iota} A\alpha}{\rho+\delta_K}\right)^{\frac{1}{1-\alpha}} u_Y^*, \tag{14}$$

$$c^* = \frac{\rho + \delta_K - \alpha(n+\delta_K)}{\alpha} \cdot \frac{k^*}{s^{*\iota}}. \tag{15}$$

Proposition 1 *We can show that* $\partial u_S^*/\partial\rho < 0$, $\partial u_S^*/\partial\iota > 0$, *and* $\partial u_S^*/\partial P = 0$. *That is, the steady state allocation of labor to social capital accumulation is decreasing in the discount rate but increasing in the scale returns parameter in the transformation of savings into investment, and is independent of the productivity parameter in the social capital accumulation equation.*

Proof. Using equation (11),

$$\partial u_S^*/\partial\rho = \frac{(\Gamma+\Phi)\,\partial\Gamma/\partial\rho - \Gamma\partial\Phi/\partial\rho}{(\Gamma+\Phi)^2} < 0,$$

since $\partial\Gamma/\partial\rho = 0$, $\partial\Phi/\partial\rho > 0$ and $\Gamma > 0$. In addition,

$$\partial u_S^*/\partial\rho = \frac{(\Gamma+\Phi)\,\partial\Gamma/\partial\iota - \Gamma\partial\Phi/\partial\iota}{(\Gamma+\Phi)^2} < 0,$$

since $\partial\Gamma/\partial\iota > 0$, $\partial\Phi/\partial\iota = 0$, and $\Phi > 0$. Finally,

$$\partial u_S^*/\partial P = \frac{(\Gamma+\Phi)\,\partial\Gamma/\partial P - \Gamma\partial\Phi/\partial P}{(\Gamma+\Phi)^2} = 0.$$

since $\partial\Gamma/\partial P = 0$ and $\partial\Phi/\partial P = 0$. ■

Proposition 2 *In the steady state, social capital per worker,* s, *is decreasing in the discount rate,* ρ, *and increasing in the productivity parameter in the social capital accumulation equation,* P.

Proof. From equation (13) and using Proposition 1,

$$\frac{\partial s^*}{\partial\rho} = \left(\frac{P}{n+\delta_S}\right)^{\frac{1}{1-\sigma}} \cdot \frac{\partial u_S^*}{\partial\rho} < 0,$$

Similarly,

$$\frac{\partial s^*}{\partial P} = \frac{1}{1-\sigma} \cdot \left(\frac{P}{n+\delta_S}\right)^{\frac{\sigma}{1-\sigma}} > 0$$

■

Proposition 3 *Physical capital per worker, k, and output per worker, y, are increasing in the productivity parameter in the social capital accumulation equation, P, in the steady state.*

Proof. From equation (14), k^* is increasing in s^*. Since we showed previously that $\partial s^*/\partial P > 0$, it follows that $\partial k^*/\partial P > 0$. Note that u_Y^* is independent of P since $u_Y^* = 1 - u_S^*$ and $\partial u_S^*/\partial P = 0$. From the production function, $y^* = Ak^{*\alpha}u_Y^{1-\alpha}$. Therefore, $\partial y^*/\partial P > 0$. ■

5.1.2 Transitional Dynamics

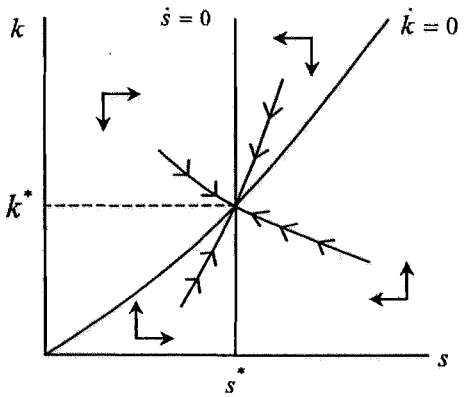
As in our previous model, we assume a fixed saving rate and an exogenous allocation of labor in order to present a phase diagram of this model in k, s space. The top left and top right panels in Figure 4 depict the two possible phase diagrams, depending on the relative magnitudes of the parameters ι and α. The lower panel in the same figure show the paths of k and s following a positive shock to the productivity parameter in the social capital accumulation equation, P. Both k and s rise smoothly to their higher levels in the steady state, confirming Propositions 2-3.

6 Social Capital and Innovation

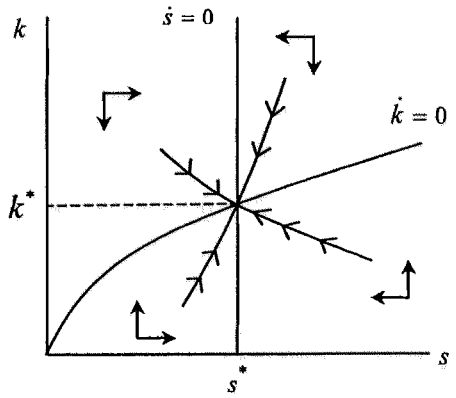
6.1 Social Capital and High-Technology Firms

In developed economies, the "new economy" of the 1990s and the new millennia has seen a distinct trend towards inter-organizational linkages in the form of partnerships and consortia. Many firms and industries have formed productive collaborative relationships with other firms, laboratories, universities, and local and national governments to leverage the benefits of cooperation (which include shared resources, group problem-solving, multiple sources of learning, collaborative development, and diffusion of innovation). The reason for this is that the investments required to sustain technology development and deployment have increased so much that single firms are often unable to undertake the level of risk necessary for innovation. Moreover, large, centralized bureaucracies emphasizing division of labor and functional specialization have devolved into smaller, leaner organizations where team-based structures cross functional lines, disrupt traditional hierarchical chains of command, and focus on core functions while contracting with outside firms for other tasks.

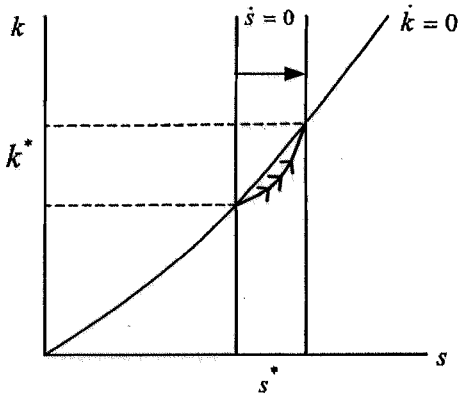
Fountain (1998) argues that gains in economic performance and innovative capacity depend on the institutional effectiveness of these relationships as measured by the stock of social capital available. Social capital is created when a group of organizations develops the ability to work together for mutually productive gain. The relationships between the organizations may be horizontal among similar firms in associations, vertical in supply chains, and multidirectional in their linkages to sources of technical knowledge, human resources, and public agencies.



Phase Diagram ($\iota > 1-\alpha$)



Phase Diagram ($\iota < 1-\alpha$)



Effect of an Increase in P ($\iota > 1-\alpha$)

Table 4: Transitional Dynamics

Fountain emphasizes that social capital is derived from perspectives in which co-operation paradoxically enhances competitiveness, information sharing leads to joint gains, and the importance of reputation and trust ensure reciprocity and fair play within a given network. Social capital encompasses well-functioning partnerships, consortia and networks. Capital is located both in the sharable resources held by individual institutions in a network as well as the overall structure among the institutions in the network. Social capital is preserved by careful selection of network players and strict sanctioning of inappropriate (network-destroying) behaviors.

Fountain gives two examples of high-performance network structures that have developed significant levels of trust. The first describes the ways in which firms in the biotechnology industry partner to remain at the forefront of research and development. The second examines the dynamics that undergird regional industrial systems, as exemplified by the semiconductor industry in Silicon Valley. She writes: "One of the best-known examples of a high-performing industry network is the computer industry in Silicon Valley, California. The professional culture is highly collaborative. Non-proprietary professional and technical information is regularly shared among employees and companies. Professionals regularly telephone and e-mail one another for assistance concerning specific technical problems. Professionals meet socially and discuss technical issues. Employment mobility of professional employees is unusually high relative to other industries. Nevertheless, among competing firms and professionals, the level of competition is fierce." (p.99)

6.2 Social Capital and Traditional Firms

According to Maskell (2000), social capital facilitates the 'low-tech' learning and innovation that takes place when firms in traditional industries are innovative in how they handle and develop resource management, logistics, production, organization, marketing, sales, distribution, industrial relations, and other tasks and activities. He argues that much of this is due to inter-firm learning. Pure market interactions by themselves are often incapable of facilitating this due to the problem of asymmetric information. For example, potential buyers of information want to ascertain the merit of knowledge offered for sale. But when fully informed of the content of the knowledge offered, it has in effect acquired it for free.[2]

Maskell argues that these market failures for the exchange of knowledge between firms can only be overcome when open market relations are superseded by stable and reciprocal exchange arrangements based on trust. Trust will characterize a relation between firms when each is confident that the other's present value of all foreseeable future exchanges exceeds the possible benefits of breaking the relation. The key argument here is that the time and resources needed to build a relationship varies with the stock of social capital that the firms in question might attain through membership in a community. However, "(w)e still know very little about the actual process by which social capital is produced and accumulated, beyond suspecting

[2] This problem was recognized in Arrow (1970).

that it might be a mainly unanticipated consequences of doing something else - just like, for instance, learning by doing." (p.114)

6.3 The Formal Model

In this model, innovation or the creation of new technology follows a process similar to Romer (1990) and Jones (1995). The rate of innovation depends on the allocation of labor to the R&D sector as well as the effect of spillovers from past innovation activities. (We can therefore write down a similar decentralized, competitive model with rigorous microeconomic underpinnings, where R&D firms produce new blueprints that are sold to intermediate goods producers, which in turn supply intermediate goods to firms producing the final, consumption good.) However, here the rate of innovation also depends on the stock of social capital in the economy. In turn, social capital (unlike our first two models) is created partly through learning-by-doing as an unintended consequence of firms simply engaging in productive activities. However, in order to leverage the social capital that is embodied in the types of networks described previously, firms do have to invest at least some labor resources towards seeking suitable network partners and identifying productive collaborative activities. The equations of motion for physical capital, technology and social capital are:

$$\dot{K} = Y - C - \delta_K K, \tag{16}$$

$$\dot{A} = B\left(u_A L\right)^{\eta} S^{\beta} A^{\psi}, \tag{17}$$

$$\dot{S} = P\left(u_S L\right)^{\sigma} S^{\phi} \widehat{K}^{\lambda} - \delta_S S, \tag{18}$$

$$Y = K^{\alpha}\left(u_Y A L\right)^{1-\alpha}. \tag{19}$$

where A denotes technology, $\widehat{K}$ denotes the aggregate physical capital stock that each firm takes as being exogenously given, B and P are productivity constants, and α, β, η, ψ, σ, ϕ, and λ are elasticity parameters constrained to lie on the (0,1) interval.

6.3.1 The Solution

The growth rates of technology and social capital on the balanced growth path are:

$$\gamma_A^* = \frac{\eta\left(1-\phi\right)+\beta\left(\sigma+\lambda\right)}{\left(1-\psi\right)\left(1-\phi\right)-\beta\lambda} n, \tag{20}$$

$$\gamma_S^* = \frac{\left(\sigma+\lambda\right) n + \lambda\gamma_A^*}{1-\phi} \tag{21}$$

We can show algebraically that both γ_A^* and γ_S^* are increasing in the elasticity parameters of the $\dot{A}$ and $\dot{S}$ equations: β, λ, σ, ψ, and ϕ.

Defining the following variables that are constant in the steady state, $\widehat{k} \equiv K/AL$ (physical capital per effective unit of labor), $s \equiv S/L$ (social capital per worker),$\widehat{c} \equiv$

C/AL (consumption per effective unit of labor), and $\widehat{y} \equiv Y/AL$ (output per effect unit of labor), the solution to the model is shown (in the Appendix) to be:

$$u_S^* = \frac{1}{1+(1+\Gamma)\Phi}, \tag{22}$$

$$u_A^* = \frac{\Phi}{1+(1+\Gamma)\Phi}, \tag{23}$$

$$u_Y^* = \frac{\Gamma\Phi}{1+(1+\Gamma)\Phi}, \tag{24}$$

$$\Gamma \equiv \frac{\rho+(\eta-1)n+\beta}{\eta\gamma_A^*},$$

$$\Phi \equiv \frac{\eta\left[\rho+(1-\phi)\delta_S+(\sigma+\lambda-1)n+(\theta+\lambda-1)\gamma_A^*\right]}{\sigma\beta\left(\gamma_S^*+\delta_S\right)}.$$

$$\widehat{k}^* = \left(\frac{\alpha}{\rho+\theta\gamma_A^*+\delta_K}\right)^{\frac{1}{1-\alpha}} u_Y^*, \tag{25}$$

$$\widehat{c}^* = \frac{\rho+\theta\gamma_A^*+\delta_K-\alpha\left(n+\gamma_A^*+\delta_K\right)}{\alpha}\widehat{k}^*, \tag{26}$$

$$\widehat{y}^* = \widehat{k}^{*\alpha} u_Y^{*1-\alpha}. \tag{27}$$

6.3.2 Comparative Statics

In this section, we examine the impact of changes in the various parameters of the model on the steady state allocations of labor to the production of final goods, the creation of innovations, and the accumulation of social capital. The top panels in Figure 5 shows that a larger risk aversion parameter, θ, and a larger discount rate, ρ, is associated with a greater allocation of labor to the final goods sector, and correspondingly smaller allocations to the other sectors.

The middle left panel in Figure 5 shows that the social capital spillover parameter in the $\dot{A}$ equation has a negative relationship with the allocation of labor to final goods production, u_Y; a positive relationship with the allocation of labor to social capital accumulation, u_S, and hump-shaped relationship with the fraction of the labor force allocated to innovation creation, u_A. The middle right panel in Figure 5 shows that the innovation spillover parameter in the the $\dot{A}$ equation has a negative relationship with the allocation of labor to final goods production, u_Y; a hump-shaped relationship with the allocation of labor to social capital accumulation, u_S, and a positive relationship with the fraction of the labor force allocated to innovation creation, u_A.

The bottom panels in Figure 5 show that a larger social capital spillover parameter (ϕ) or a larger physical capital learning-by-doing effect (λ) in the social

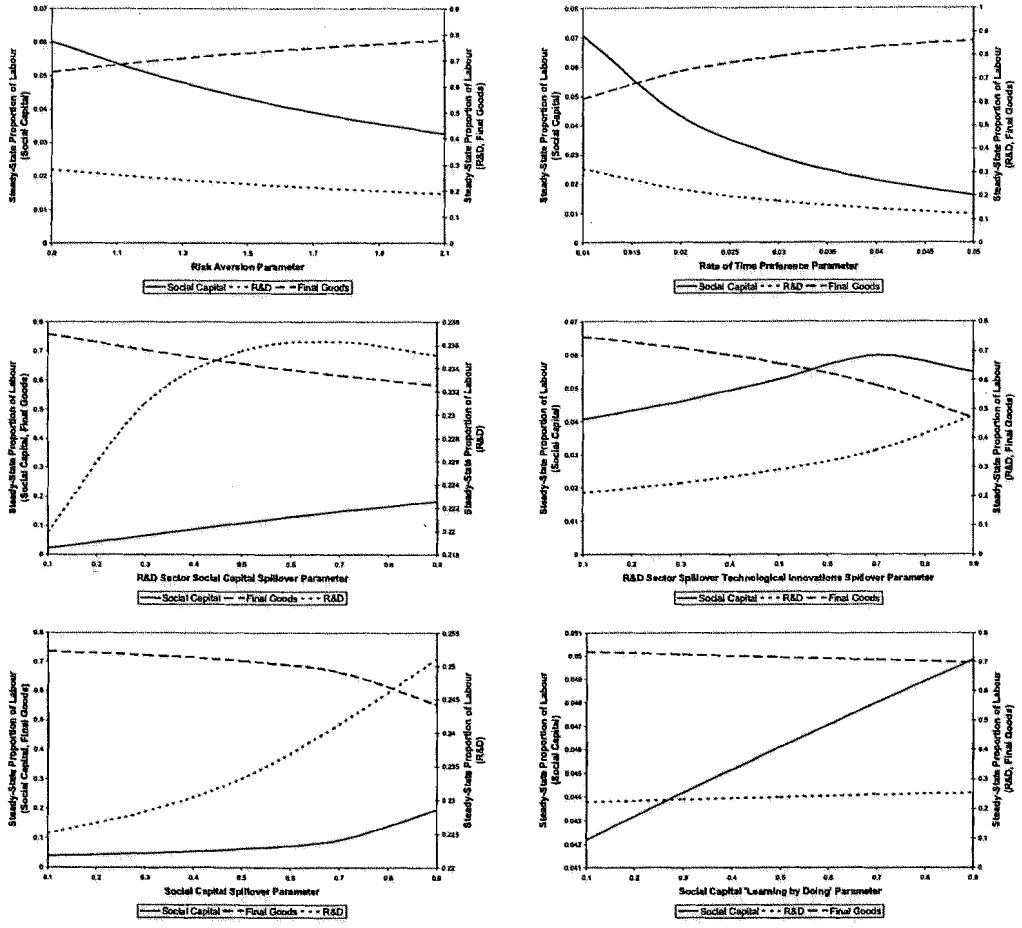


Table 5: Effect of Parameters on Steady State Labor Allocation

capital accumulation equation results in a greater steady state allocation of labor to *both* innovation creation and social capital accumulation, at the expense of labor allocated to final goods production.

7 Conclusion

In this paper, we first discussed the concept of social capital – its definitions, attributes and classifications. This was followed by a review of recent empirical studies on the link between social capital and economic growth. We then proposed three theoretical growth models incorporating social capital, based on different perspectives on the concept of social capital and the available empirical evidence.

In the first model, social capital impacts growth by assisting in the accumulation of human capital. Building social capital in this model corresponds to parents taking

time off from work or even staying at home with their children, and involving themselves in parent-teachers associations. In the second model, social capital impacts growth by affecting financial development through its effects on collective trust and social norms. Social capital accumulation in this model corresponds to participation in community clubs or engaging in other forms of associational activities. In our last model, social capital arises from networking and collaborative activities that firms engage in, which result in a more efficient creation and diffusion of business and technological innovations. In each of these models, we solved for the optimum steady-state allocations of human capital or labor towards the creation and maintenance of social capital, and examined their comparative statics as well as their transitional dynamics. The implications for public policy were also discussed.

Future research possibilities include the construction of an overlapping generations model of fertility, human capital, and growth which incorporates social capital.

References

ALESINA, A., AND E. L. FERRARA (2000): "Participation in Heterogenous Communities," *Quarterly Journal of Economics*, 115(3), 847–904.

ARROW, K. (1970): *Essays in the Theory of Risk Bearing*. North-Holland, Amsterdam.

——— (2000): "Observations on Social Capital," in *Social Capital: A Multifaceted Perspective*, ed. by I. S. Partha Dasgupta. The World Bank, Washington D.C.

BECKER, G. S. (1993): *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education, 3rd Edition*. The University of Chicago Press, Chicago and London.

CHIN, M. S., AND Y. K. CHOU (2002): "Modelling Social Infrastructure and Economic Growth," mimeograph.

CLINTON, H. (1996): *It Takes a Village: And Other Lessons Children Teach Us*. Simon and Schuster, New York.

COLEMAN, J. (1990): *Equality and Achievement in Education*. Westview Press, Boulder, CO.

——— (1994): *Foundations of Social Theory*. Belknap Press, Cambridge, MA.

COSTA, D. L., AND M. E. KAHN (2001): "Understanding the Decline in Social Capital, 1952-1998," *NBER Working Paper*.

EASTERLY, W., AND R. LEVINE (1997): "Africa's Growth Tragedy: Policies and Ethnic Divisions," *Quarterly Journal of Economics*, 112(4), 1203–1250.

FAFCHAMPS, M., AND B. MINTEN (2002): "Social Capital and the Firm: Evidence from Agricultural Traders in Madagascar," in *The Role of Social Capital in Development*, ed. by C. Grootaert, and T. V. Bastelaer, pp. 125–154. Cambridge University Press, Cambridge.

FOUNTAIN, J. E. (1998): "Social Capital: A Key Enabler of Innovation," in *Investing in Research and Innovation Policy: Creating a Research and Innovation Policy That Works*, ed. by L. M. Branscomb, and J. H. Keller, pp. 85–111. MIT Press, Cambridge, Massachusetts and London, England.

GLAESER, E. L., D. LAIBSON, AND B. SACERDOTE (2002): "The Economic Approach to Social Capital," *Economic Journal*, 112, F437.

GROOTAERT, C., AND T. VAN-BASTELAER (eds.) (2002): *The Role of Social Capital in Development*. Cambridge University Press, Cambridge.

GUISO, L., P. SAPIENZA, AND L. ZINGALES (2000): "The Role of Social Capital in Financial Development," *NBER Working Paper 7563*.

HELLIWELL, J., AND R. PUTNAM (1995): "Economic Growth and Social Capital in Italy," *Eastern Economic Journal*, 21(3), 295–307.

ISHAM, J., AND S. KAHKONEN (2002): "How Do Participation and Social Capital Affect Community-Based Water Projects? Evidence from Central Java, Indonesia," in *The Role of Social Capital in Development*, ed. by C. Grootaert, and T. V. Bastelaer, pp. 155–187. Cambridge University Press, Cambridge.

JONES, C. I. (1995): "R&D-Based Models of Economic Growth," *Journal of Political Economy*, 103, 759–784.

KNACK, S., AND P. KEEFER (1997): "Does Social Capital Have an Economic Payoff? A Cross-Country Investigation," *Quarterly Journal of Economics*, 112(4), 1251–1288.

KNACK, S., AND P. J. ZAK (2003): "Building Trust: Public Policy, Interpersonal Trust, and Economic Development," *Supreme Court Economic Journal*, forthcoming.

KRISHNA, A. (2000): "Creating and Harnessing Social Capital," in *Social Capital: A Multifaceted Perspective*, ed. by P. Dasgupta, and I. Serageldin, pp. 71–93. The World Bank, Washington D.C.

KRISHNA, A., AND N. UPHOFF (2002): "Mapping and Measuring Social Capital Through Assessment of Collective Action to Conserve and Develop Watersheds in Rajasthan, India," in *The Role of Social Capital in Development*, ed. by C. Grootaert, and T. V. Bastelaer, pp. 85–124. Cambridge University Press, Cambridge.

LA PORTA, R., F. L. DE SILANES, A. SHLEIFER, AND R. W. VISHNY (1997): "Trust in Large Organizations," *American Economic Association Papers and Proceedings*, 87(2), 333–338.

MASKELL, P. (2000): "Social Capital, Innovation, and Competitiveness," in *Social Capital: Critical Perspectives*, ed. by S. Baron, J. Field, and T. Schuller, pp. 111–123. Oxford University Press, New York.

OLSON, M. (1982): *The Rise and Decline of Nations: Economic Growth, Stagflation, and Social Rigidities.* Yale University Press, New Haven.

PARGAL, S., D. O. GILLIGAN, AND M. HUQ (2002): "Does Social Capital Increase Participation in Voluntary Solid Waste Management? Evidence from Dhaka, Bangladesh," in *The Role of Social Capital in Development*, ed. by C. Grootaert, and T. V. Bastelaer, pp. 188–212. Cambridge University Press, Cambridge.

PUTNAM, R. (1993): *Making Democracy Work: Civic Traditions in Modern Italy.* Princeton University Press, Princeton.

——— (1996): "Who Killed Civic America?," *Prospect*, March, 66–72.

——— (2000): *Bowling Alone: The Collapse and Revival of American Community.* Simon Schuster, New York.

ROMER, P. M. (1990): "Endogenous Technological Change," *Journal of Political Economy*, 98, S71–S102.

SOLOW, R. M. (2000): "Notes on Social Capital and Economic Performance," in *Social Capital: A Multifaceted Perspective*, ed. by P. Dasgupta, and I. Serageldin. The World Bank, Washington D.C.

TEMPLE, J., AND P. A. JOHNSON (1998): "Social Capability and Economic Growth," *Quarterly Journal of Economics*, 113(3), 965–990.

ZAK, P. J., AND S. KNACK (2001): "Trust and Growth," *Economic Journal*, 111, 295–321.

A Solving the Models

A.1 Social Capital and Human Capital

The Hamiltonian corresponding to the individual's optimization problem is given by:

$$\begin{aligned} \mathbf{H} &= \frac{C^{1-\theta}-1}{1-\theta}e^{-\rho t} + \upsilon\left(r_K K + w_Y u_Y H - C\right) \\ &\quad +\mu\left[E\left(u_H H\right)^{1-\psi} S^{\psi} - \delta_H H\right] + \pi\left[\widetilde{P}\left(u_S H\right)^{1-\sigma} - \delta_S S\right], \end{aligned} \tag{28}$$

where c, u_Y and u_H are control variables; K, H, and S are state variables; and υ, μ, and π are the corresponding co-state variables.

The first order conditions are obtained from $\partial\mathbf{H}/\partial C = 0$, $\partial\mathbf{H}/\partial u_Y = 0$, $\partial\mathbf{H}/\partial u_H = 0$, $\partial\mathbf{H}/\partial K = -\dot{\upsilon}$, $\partial\mathbf{H}/\partial H = -\dot{\mu}$, and $\partial\mathbf{H}/\partial S = -\dot{\pi}$ respectively:

$$\frac{\dot{C}}{C} = -\frac{1}{\theta}\left(\rho + \frac{\dot{\upsilon}}{\upsilon}\right), \tag{29}$$

$$\frac{\upsilon}{\pi} = \frac{\widetilde{P}\left(u_S H\right)^{1-\sigma}}{w_Y H} \cdot \frac{1-\sigma}{u_S}, \tag{30}$$

$$\frac{\mu}{\pi} = \frac{1-\sigma}{1-\psi} \cdot \frac{\widetilde{P}\left(u_S H\right)^{1-\sigma}}{E\left(u_H H\right)^{1-\psi} S^{\psi}} \cdot \frac{u_H}{u_S} \tag{31}$$

$$-\frac{\dot{\upsilon}}{\upsilon} = r_K, \tag{32}$$

$$-\frac{\dot{\mu}}{\mu} = (1-\psi)\, E u_H^{-\psi} s^{\psi} - \delta_H, \tag{33}$$

$$-\frac{\dot{\pi}}{\pi} = \frac{(1-\sigma)\,\psi}{1-\psi} \cdot P u_S^{1-\sigma} s^{\sigma-1} \cdot \frac{u_H}{u_S} - \delta_S. \tag{34}$$

The transversality conditions are:

$$\lim_{t\to\infty} \upsilon(t)K(t) = 0, \tag{35}$$

$$\lim_{t\to\infty} \mu(t)H(t) = 0, \tag{36}$$

$$\lim_{t\to\infty} \pi(t)S(t) = 0. \tag{37}$$

Defining $k \equiv K/H$, $s \equiv S/H$, $c \equiv C/H$, and $y \equiv Y/H$, the steady state conditions $\dot{c}/c = 0$, $\dot{k}/k = 0$, $\dot{s}/s = 0$, $\dot{u}_Y/u_Y = 0$, and $\dot{u}_H/u_H = 0$ may be simplified to the following:

$$A k^{\alpha-1} u_Y^{1-\alpha} = \gamma_H + c/k, \tag{38}$$

$$\alpha A k^{\alpha-1} u_Y^{1-\alpha} = \rho + \theta\gamma_H, \tag{39}$$

$$P u_S^{1-\sigma} s^{\sigma-1} = \gamma_H + \delta_S, \tag{40}$$

$$\frac{\dot{\pi}}{\pi} = \frac{\dot{\upsilon}}{\upsilon}, \tag{41}$$

$$\frac{\dot{\pi}}{\pi} = \frac{\dot{\mu}}{\mu}. \tag{42}$$

where γ_H denotes the growth rate of H. Combining these five equations and simplifying then yields the solutions shown in the main text.

A.2 Social Capital and Financial Development

The solution to the social planner's problem is shown below. The Hamiltonian is given by:

$$\begin{aligned}\mathbf{H} &= \frac{C^{1-\theta}-1}{1-\theta}e^{-\rho t}+\upsilon\left\{s^{\iota}\left[AK^{\alpha}\left(u_{Y}L\right)^{1-\alpha}-C\right]-\delta_{K}K\right\} \\ &+\pi\left[P\left(u_{S}L\right)^{1-\sigma}S^{\sigma}-\delta_{S}S\right],\end{aligned} \tag{43}$$

where C and u_Y are control variables, K and S are state variables, and υ and π are the corresponding co-state variables.

The first-order conditions, obtained from $\partial\mathbf{H}/\partial C=0$, $\partial\mathbf{H}/\partial u_{Y}=0$, $\partial\mathbf{H}/\partial K=-\dot{\upsilon}$,:and $\partial\mathbf{H}/\partial S=-\dot{\pi}$, may be expressed as:

$$\frac{\dot{c}}{c} = -\frac{1}{\theta}\left(\rho+\frac{\dot{\upsilon}}{\upsilon}+\iota\frac{\dot{s}}{s}\right), \tag{44}$$

$$\frac{\upsilon}{\pi} = \frac{1-\sigma}{1-\alpha}\cdot\frac{P\left(u_{S}L\right)^{1-\sigma}S^{\sigma}}{s^{\iota}AK^{\alpha}\left(u_{Y}L\right)^{1-\alpha}}\cdot\frac{u_{Y}}{u_{S}}, \tag{45}$$

$$-\frac{\dot{\upsilon}}{\upsilon} = s^{\iota}\alpha Ak^{\alpha-1}u_{Y}^{1-\alpha}-\delta_{K}, \tag{46}$$

$$\begin{aligned}-\frac{\dot{\pi}}{\pi} &= \frac{(1-\sigma)\,\iota}{1-\alpha}\cdot\frac{Pu_{S}^{1-\sigma}s^{\sigma-1}}{Ak^{\alpha-1}u_{Y}^{1-\alpha}}\cdot\frac{u_{Y}}{u_{S}}\left(Ak^{\alpha-1}u_{Y}^{1-\alpha}-\frac{c}{k}\right) \\ &+\sigma Pu_{S}^{1-\sigma}s^{\sigma-1}-\delta_{S},\end{aligned} \tag{47}$$

where $k\equiv K/L$.

Defining $s\equiv S/L$, $c\equiv C/L$, and $y\equiv Y/L$, the steady state conditions $\dot{c}/c$, $\dot{k}/k=0$, $\dot{s}/s=0$, and $\dot{u}_{Y}/u_{Y}=0$ may be simplified to the following:

$$s^{\iota}\left(Ak^{\alpha-1}u_{Y}^{1-\alpha}-\frac{c}{k}\right) = n+\delta_{K}, \tag{48}$$

$$s^{\iota}\alpha Ak^{\alpha-1}u_{Y}^{1-\alpha} = \rho+\delta_{K}, \tag{49}$$

$$Pu_{S}^{1-\sigma}s^{\sigma-1} = n+\delta_{S}, \tag{50}$$

$$\frac{\dot{\pi}}{\pi} = \frac{\dot{\upsilon}}{\upsilon}. \tag{51}$$

Combining these four equations and simplifying then yields the solutions shown in the main text.

A.3 Social Capital and Innovations

The solution to the social planner's problem is shown below. The Hamiltonian is given by:

$$\begin{aligned}\mathbf{H} &= \frac{C^{1-\theta}-1}{1-\theta}e^{-\rho t}+\upsilon\left[K^{\alpha}\left(u_{Y}AL\right)^{1-\alpha}-C-\delta_{K}K\right] \\ &+\mu B\left(u_{A}L\right)^{\eta}S^{\beta}A^{\psi}+\pi\left[P\left(u_{S}L\right)^{\sigma}S^{\phi}\widehat{K}^{\lambda}-\delta_{S}S\right],\end{aligned} \tag{52}$$

where c, u_Y and u_A are control variables; K, A, and S are state variables; and υ, μ, and π are the corresponding co-state variables.

The first order conditions are obtained from $\partial \mathbf{H}/\partial C = 0$, $\partial \mathbf{H}/\partial u_Y = 0$, $\partial \mathbf{H}/\partial u_A = 0$, $\partial \mathbf{H}/\partial K = -\dot{\upsilon}$,:$\partial \mathbf{H}/\partial A = -\dot{\mu}$, and $\partial \mathbf{H}/\partial S = -\dot{\pi}$ respectively:

$$\frac{\dot{c}}{c} = -\frac{1}{\theta}\left(\rho + \frac{\dot{\upsilon}}{\upsilon}\right), \tag{53}$$

$$\frac{\upsilon}{\pi} = \frac{\sigma}{1-\alpha} \cdot \frac{P\left(u_S L\right)^{\sigma} S^{\phi} \widehat{K}^{\lambda}}{K^{\alpha}\left(u_Y A L\right)^{1-\alpha}} \cdot \frac{u_Y}{u_S}, \tag{54}$$

$$\frac{\mu}{\pi} = \frac{\sigma}{\eta} \cdot \frac{P\left(u_S L\right)^{1-\sigma} S^{\sigma}}{B\left(u_A L\right)^{\eta} S^{\beta} A^{\psi}} \cdot \frac{u_A}{u_S}, \tag{55}$$

$$-\frac{\dot{\upsilon}}{\upsilon} = \alpha \widehat{k}^{\alpha-1} u_Y^{1-\alpha} - \delta_K, \tag{56}$$

$$-\frac{\dot{\mu}}{\mu} = \gamma_A\left(\eta \frac{u_Y}{u_A} + \psi\right), \tag{57}$$

$$-\frac{\dot{\pi}}{\pi} = \left(\frac{\sigma\beta}{\eta}\frac{u_A}{u_S} + \phi\right)\left(\gamma_S + \delta_S\right) - \delta_S, \tag{58}$$

where $\gamma_A \equiv B\left(u_A L\right)^{\eta} s^{\beta} A^{\psi-1}$ and $\gamma_S \equiv P\left(u_S L\right)^{\sigma} S^{\phi-1} \widehat{K}^{\lambda} - \delta_S$.

From $\gamma_A \equiv B\left(u_A L\right)^{\eta} s^{\beta} A^{\psi-1}$, we have

$$\frac{\dot{\gamma}_A}{\gamma_A} = \eta\left(\frac{\dot{u}_A}{u_A} + n\right) + \beta\gamma_S - \left(1-\psi\right)\gamma_A. \tag{59}$$

In the steady state, $\dot{\gamma}_A = \dot{u}_A = 0$. Hence,

$$\gamma_A = \frac{\eta n + \beta\gamma_S}{1-\psi}. \tag{60}$$

From $\gamma_S \equiv P\left(u_S L\right)^{\sigma} S^{\phi-1} \widehat{K}^{\lambda} - \delta_S$, taking logs and time derivatives yields

$$\sigma\left(\frac{\dot{u}_S}{u_S} + n\right) - \left(1-\phi\right)\gamma_S + \lambda\left(\gamma_A + n\right) = 0. \tag{61}$$

as $\dot{\gamma}_S = 0$ in the steady state. Moreover, since $\dot{u}_S = 0$ in the steady state,

$$\gamma_S = \frac{\left(\sigma+\lambda\right)n + \lambda\gamma_A}{1-\phi}. \tag{62}$$

Solving for γ_A and γ_S simultaneously yields

$$\gamma_A^* = \frac{\eta\left(1-\phi\right) + \beta\left(\sigma+\lambda\right)}{\left(1-\psi\right)\left(1-\phi\right) - \beta\lambda} n, \tag{63}$$

$$\gamma_S^* = \frac{\left(\sigma+\lambda\right)n + \lambda\gamma_A^*}{1-\phi}. \tag{64}$$

Defining $\widehat{k} \equiv K/AL$, $\widehat{c} \equiv C/AL$, and $\widehat{y} \equiv Y/AL$, the steady state conditions $\dot{\widehat{c}}/\widehat{c} = 0$, $\dot{\widehat{k}}/\widehat{k} = 0$, $\dot{u}_Y/u_Y = 0$, and $\dot{u}_A/u_A = 0$ may be simplified to the following:

$$\widehat{k}^{\alpha-1} u_Y^{1-\alpha} - \frac{\widehat{c}}{\widehat{k}} = n + \gamma_A^* + \delta_K, \tag{65}$$

$$\alpha \widehat{k}^{\alpha-1} u_Y^{1-\alpha} = \rho + \theta \gamma_A^* + \delta_K, \tag{66}$$

$$-\frac{\dot{\pi}}{\pi} = -\frac{\dot{\upsilon}}{\upsilon} + (\sigma + \lambda - 1)\, n + \phi \gamma_S^* + (\lambda - 1)\, \gamma_A^*, \tag{67}$$

$$-\frac{\dot{\pi}}{\pi} = -\frac{\dot{\mu}}{\mu} + (\sigma + \lambda - 1)\, n + (\phi - \beta)\, \gamma_S^* + (\lambda - \psi)\, \gamma_A^*. \tag{68}$$

Combining these four equations and simplifying then yields the solutions shown in the main text.