Social ties and economic development

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Abstract

We develop a parsimonious general equilibrium model where agents allocate time across three activities: production, trade, and leisure. Leisure includes time spent socializing, which economizes transaction costs. Our framework yields multiple equilibria in terms of the number of social ties and predicts that the number of social ties is positively associated with development, a relationship we observe in cross-country data. The model captures additional dimensions of data, namely: (i) increasing income inequality, but converging growth rates; (ii) an association between weak social ties and development; and (iii) an association between number of social ties and size of the transaction sector.

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1 Introduction

The average per capita number of social ties—e.g., friendships or acquaintances—varies significantly from country to country. More importantly, this variation is positively associated with variation in income per capita, as shown in figure 1.

[Figure 1 about here.]

This paper asks whether and how the heterogeneity in social ties can account for differences in economic development. In order to address this question, we construct a general equilibrium model where the set of goods includes ties between economic agents, where a tie between any two agents is produced according to a technology that uses scarce time from both parties. The model further assumes that time spent socializing economizes transaction costs, i.e. there exists a form of *social capital*. Our theoretical approach yields the existence of multiple equilibria, each one of them associated with a specific number of social ties and an equilibrium level of social capital. These multiple equilibria can be interpreted as rational outcomes in societies with different cultural beliefs, an approach in the spirit of Krugman (1991), Cole, Mailath, and Postlewaite (1992), and Greif (1994).

Traditionally social capital has been understood to be a driver of economic performance, with several authors finding a positive association between the two: Putnam (1993), Knack and Keefer (1997), and LaPorta et al. (1997), amongst others. What drives this association? To begin with, we need to define the concept of social capital. Putnam (2000) (pg. 19) does so in the following way.[1]

> Whereas physical capital refers to physical objects and human capital refers to properties of individuals, social capital refers to connections among individuals—social networks and the norms of reciprocity and trustworthiness that arise from them.

This concept of social capital is also similar to Coleman (1988), who argues that closure (or degree of connectedness) is the key structural property of a social network in increasing the efficiency of

[1] For a review and discussion of several perspectives on social capital, see Sobel (2002).

economic interactions. However, this does not imply that social capital should always be maximized. For example, Durlauf and Fafchamps (2005) and Routledge and von Amsberg (2003) have pointed out that social capital is not without costs. On one hand social capital is sometimes associated with unlawful activity; on the other, it may be efficient to incur high transaction costs if it allows a higher productivity. Moreover, not all types of social capital may benefit the development of institutions that underpin market economies, as shown by Kumar and Matsusaka (2009). In our model social capital requires time investment in social interactions; but since time is scarce and has other uses (e.g. production), it is certainly not the case that the maximum level of social capital is desirable.

In addition to the ambiguous effect of social capital to economic outcomes, some literature has pointed out that the term itself is ambiguous; see e.g. Solow (2000) or Arrow (2000). In particular, it is not clear whether social capital results from a deliberate process of accumulation by economic agents, or whether it is simply a positive externality from social interactions. We adopt the latter perspective: in the model social capital is equated to aggregate time spent socializing, which economizes transaction costs but cannot be materially influenced by any individual agent. Some economists have explored the connection between social capital as a product of agent-level investment (i.e. not an externality) and economic performance, namely Glaeser, Laibson, and Sacerdote (2002), and we view our approach as complementary to this strand of research. Nevertheless, we discuss explicitly in the paper why we believe that disregarding agent-level social capital is reasonable within the context of our model.[2] It is worth mentioning that we do not assume *a priori* that a higher level of social ties equates directly to a higher level of social capital. Social capital corresponds to time spent socializing, which is given by the product of "number of social ties" (exogenous) times "average time devoted to each tie" (endogenous). In that sense, our model is contributing towards understanding the sources of social capital, in particular with relation to the observed cross-country heterogeneity in terms of number of relationships.

The theory predicts a strong association between the number of social ties and economic development. The mechanism underlying this result is that in economies with a large number of ties,

[2]See section 4.

agents choose high levels of *transformational effort*, which is required to produce standard commodities and can be interpreted as a combination of labor and investment in human capital. In the model, productivity growth comes from the accumulation of transformational effort over time (may be interpreted as learning by doing), which implies that higher levels of transformational effort translate into higher rates of economic development. The reason why high-social-ties economies choose higher transformational effort can be attributed to two factors. First, it turns out that a higher number of social ties implies a higher level of equilibrium time spent socializing (for reasons detailed in the theoretical analysis), which increases trade efficiency and thus creates a higher incentive for production. Second, even in the absence of social capital effects, under conditions we view as reasonable it is still the case that a larger number of ties induces a higher level of transformational effort, due to an interplay in preferences between social ties and the consumption of standard goods. For example, if we shut down transaction costs we find that high-social-ties economies display a lower equilibrium share of leisure, where the extra time is devoted to production.

We calibrate the model using data for the United States and generate predictions of development paths for countries with different levels of social ties. The calibrated model generates a cross section of income per capita in 2000 that correlates strongly with data (at 0.58), and with similar levels of dispersion. The coefficient of variation in cross-country data is 0.43, while its equivalent generated by the model is 0.41. Using the calibrated version of the model we also ask the question: How important are social capital effects in terms of determining the cross-sectional dispersion of development? We address this question by shutting down the productivity of social capital and simulating the development path for each country. The coefficient of variation generated by the model becomes 0.20, which allows us to conclude that social capital effects and preference effects are equally important. Finally, it is worth referring that the model implies a significantly growing level of income inequality between countries, which is in line with historical trends: Lucas (2002) reports a coefficient of variation in income per capita in 1990, for a set of 21 regions, that is approximately 4 times greater than in 1750. This inequality result notwithstanding, the calibrated model predicts convergence in growth rates, a feature we also observe in cross-country data.

We regard the result of a strong association between number of social ties and economic development as a rationalization of the positive association found between measures of social capital and economic development in empirical studies mentioned above. The most important contribution of this paper is to make explicit some possible mechanisms that drive that association.

Social ties and family ties

What exactly is meant by "social ties"? Our cross-country data comes from the International Social Survey Programme 2001, which contains a collection of several sociometric variables.[3] Three types of ties are covered by that study: nuclear family, close friends, and participation in secondary associations, such as political parties, neighborhood organizations, etc.[4] Figure 1 plots the data on close friends, which is also what we use in the quantitative exploration of the model. Close friends' ties correlate strongly with participation in secondary associations (at 0.56) and so we broadly interpret social ties in the context of our model as non-familial relationships.[5]

A related strand of research establishes a connection between family ties and economic development. For example, Alesina and Giuliano (2009) establish a negative relation between family ties and political participation, analyzing within-country patterns of immigrant behavior. Lower political participation, the authors argue, would lead to lower social capital and ultimately impact development negatively. One prediction of our model supports this argument, since high-social-ties economies display increased time spent socializing, in part by sacrificing time spent alone. If agents are interpreted as households, this time could be seen as related to family ties. In our data, family ties are indeed associated with lower income per capita (correlation coefficient of -0.35).

Another characteristic of social ties is their strength (e.g. amount of time devoted to each relationship). Our model predicts that countries with more social ties should display lower strength of ties, which is indeed what we observe in data. Thus there is an indirect relationship between weak social ties and economic development (in the model and in the data).

[3] The International Social Survey Programme is a cross-national collaboration initiative in the field of social science. It evolved from a bilateral cooperation between the ZUMA center in Germany and the University of Chicago.

[4] See `www.issp.org` for details.

[5] An earlier version of the paper also contained a calibration based on the intensity of participation in secondary associations, with very similar quantitative results.

Social capital and its productivity

An important feature of our theoretical approach is the way social capital contributes towards the reduction of transaction costs (trading time in the model). More specifically, per-unit-of-trade trading time is reduced as a function of the following product:

$$B_{sc,t} \times Social\ Capital_t,$$

where B_{sc} is the productivity of social capital. If we conceive of social capital as network connectedness (which in our simple model corresponds to weighted average degree), making information flow easier (or lowering monitoring costs),[6] then B_{sc} may be thought of as the institutional/contractual setting that makes use of such information. It is also clear that we are assuming some form of complementarity between these two dimensions, which we believe is reasonable.[7] While social capital *per se* is important for development, what also matters is how the productivity of social capital (B_{sc}) evolves over time. We adopt a very stark specification for the law of motion of B_{sc}, where we assume that it increases linearly over time, at an exogenously given rate.[8] This increase in productivity notwithstanding, trading time does not necessarily converge to zero in the model, even when social capital remains bounded away from zero. This obtains because with development consumption and trade are also increasing, and social capital is assumed to reduce *per-unit-of-trade* transaction costs. The dependence of total transaction costs on trading volume can be interpreted as an implicit assumption of a positive relation between individual incentives to deceive or expropriate and the total return to such behaviors, which would be a function of total trading volume. This feature of the model allows us to obtain a result that is in line with the empirical findings of Wallis and North (1986): In the calibrated model, the weight of the transaction sector in the

[6] We abstract from complex network structure considerations, since we solve for symmetric equilibria (i.e. every agent displays the same degree).

[7] In general terms, a contract specifies payoffs that are contingent on the verification of a certain state. The finer the distinction agents are able to make regarding states, i.e. the more information is available, the more efficient will contracts become. We abstract from the possibility that a higher level of information may generate additional incentive problems *per se*.

[8] Some authors have modeled the dynamics of "social productivity" more explicitly, namely Berg, Dickhaut, and McCabe (1995), Francois and Zabojnik (2005), Tabellini (2008), and Guiso, Sapienza, and Zingales (2008). This is not the objective of our paper.

US rises significantly across time (with the caveat that the model does not match the timing and magnitude of the increase). The model also predicts, for the steady-growth stage, that there should always exist a positive relationship between the number of social ties and the relative weight of the transaction sector. We observe this relationship in our cross-country data in 2000, but we do not fully capture this dimension with our calibration (where not all of the countries are close to the steady-growth stage in the year 2000).

The paper is organized as follows. Section 2 develops the model setup and derives the theoretical results regarding short- and long-run impact of social ties to economic growth. Section 3 proposes a calibration of the model and explores the quantitative implications for a cross section of 27 countries. Section 4 explores the implications of considering agent-level social capital. Section 5 discusses and concludes. The Appendix contains details on the derivation of the setup, some proofs, and a section describing the elaboration of the data plus a table with the explicit numbers.

2 Model

2.1 Static setup

The economy is composed of N agents. Each agent $i \in \{1, ..., N\}$ maximizes the following utility function

$$\mathcal{U}(c_i, s_i) := \left\{\phi c_i^{\rho_{c,s}} + (1-\phi)\left[u(s_i)\right]^{\rho_{c,s}}\right\}^{\frac{1}{\rho_{c,s}}}, \tag{1}$$

subject to time and budget constraints, to be defined shortly. The first component of utility c_i refers to the level of consumption of a standard composite good. The second term in (1) is the utility that the agent derives from social ties (s_i is the vector of ties). The parameter $\rho_{c,s} \in (-\infty, 1)$ controls for the elasticity of substitution between tie utility and standard-commodities utility, given by the ratio $1/(1-\rho_{c,s})$. We also use a constant-elasticity-of-substitution (CES) utility function for social ties:

$$u(s_i) := \left(\sum_j s_{ij}^{\rho_s}\right)^{\frac{1}{\rho_s}}, \tag{2}$$

with $\rho_s \in (0,1)$, such that it is admissible for non-existent ties ($s_{ij} = 0$).[9] The tie of the individual with herself ($j = i$) is part of the utility function too, and we interpret this as *non-social leisure*. An important characteristic of this utility function is a preference for variety, and this will bear significantly in our results.

Each agent produces the composite good. The budget constraint faced by i is

$$c_i \leq y_{c,i}, \tag{3}$$

where the price level is normalized to 1. The variable $y_{c,i}$ stands for the supply of the composite good by i. We do not allow agents to consume from own production; consumed goods need to be acquired in the marketplace.

There are two agent-level technologies: (i) production of the standard good; and (ii) production of social ties:

$$y_{c,i}(r_i) := B_r r_i \tag{4}$$

$$y_{s,ij}(a_{ij}, a_{ji}) := a_{ij}^{\beta} a_{ji}^{1-\beta} = s_{ij}. \tag{5}$$

The variable r_i stands for the time spent by i in the production of the standard good, with productivity B_r. We refer to r as *transformational effort*, and it is intended to capture a combination of labor and investment in human capital. Physical capital is omitted from the production function. The variable a_{ij} represents the amount of time invested by i in the tie with j and is controlled by i. We refer to a_{ij} as *attention*. Social ties are thus produced using two inputs, namely the amount of time invested by each of the two agents in the tie.

The technology for building social ties in (5) implies that no agent can be forced into a re-

[9]Here we follow Dixit and Stiglitz (1977), where instead of multiple standard commodities we have multiple relationships.

lationship, since she can always set $a_{ij} = 0$. This mechanism of building ties is in the spirit of game-theoretic literature on network formation, e.g. Jackson and Wolinski (1996) and Bala and Goyal (2000). If $\beta < 0.5$, relationships—from the perspective of the consumer i—rely more heavily on attention being given by j, the other side of the tie. If $\beta > 0.5$, relationships depend mainly on the attention that the focal agent gives to the other agent. One can thus interpret the level of the inverse of β as the usual level of egotism displayed by an individual in building relationships with others. Also note that the individual's tie with herself is given by a_{ii}, independently of β. Thus a_{ii} can be interpreted as leisure associated with spending time alone. This feature is a direct consequence of assuming a constant-returns-to-scale technology in the production of ties. We will see that $\beta < 1$ leads to a *coordination failure* in relationship building, a discussion we detail a few paragraphs below.

In this economy, trading implies transaction costs (TC), which are fully borne by the buyer; we term this as *transactional effort*. Transaction costs correspond to time spent trading, and they depend on the aggregate level of social capital (SC) and the amount of goods acquired:

$$TC_i := \left(\frac{\alpha}{1 + B_{sc}SC}\right) c_i, \tag{6}$$

where α is a scaling constant and B_{sc} the productivity of social capital. The amount of social capital corresponds to weighted average degree,[10] and it may also be interpreted as the average amount of time spent socializing:

$$SC = y_{sc}\left(\{s_{ij}\}\right) := \frac{\sum_i \sum_{j \neq i} s_{ij}}{N} \tag{7}$$

We assume that the number of agents is large enough that each agent disregards the consequences of her own actions in terms of aggregate social capital. In this model social capital is a positive externality from social relationships.

Time is the only scarce natural resource and the following time constraint must be verified for

[10] Our concept of social capital is close to Coleman (1988).

any agent i:

$$r_i + TC_i + \sum_j a_{ij} \leq 1, \tag{8}$$

where the total amount of time is normalized to 1. Time is thus put into three different uses: transformational effort, transactional effort, and producing ties.

An equilibrium is characterized by solving all agents' (constrained) maximization problem, which immediately implies market clearing, from Walras' law. We solve for a symmetric equilibrium and details are presented in the Appendix. A key feature of the model is that *any number of ties is sustainable in equilibrium.* The intuition is that i will not pay attention to someone from whom she does not receive attention, and this is an equilibrium. It is important to emphasize that if agent j sets $a_{ji} = 0$, $a_{ij} = 0$ is *strictly* a better response than $a_{ij} > 0$ for agent i. This is so because time is valuable and $a_{ij} > 0$ *per se* translates into a zero increase to the utility of agent i.

The existence and uniqueness results are contained in the following proposition, proved in the Appendix. The proposition also contains some mathematical relations that will be used in subsequent sections.

Proposition 1 *Considering a fixed number of social ties F for all agents, then there exists a unique symmetric equilibrium, for any such F, where a positive amount of time is devoted to each tie, as long as $\phi < 1$ and $\beta > 0$. The optimal level of attention paid to each tie, a_1, is not given in closed-form in the general case. The remaining equilibrium magnitudes, as a function of a_1, are given below:*

$$r = \frac{(1 + B_{sc}Fa_1)\left\{1 - a_1\left[\left(\frac{1}{\beta}\right)^{\frac{1}{1-\rho s}} + F\right]\right\}}{1 + B_{sc}Fa_1 + \alpha B_r} \tag{9}$$

$$c = B_r r = \frac{B_r(1 + B_{sc}Fa_1)\left\{1 - a_1\left[\left(\frac{1}{\beta}\right)^{\frac{1}{1-\rho s}} + F\right]\right\}}{1 + B_{sc}Fa_1 + \alpha B_r} \tag{10}$$

$$a_0 = a_1\left(\frac{1}{\beta}\right)^{\frac{1}{1-\rho s}}, \tag{11}$$

where a_0 is the equilibrium time spent alone.

An immediate consequence of our approach to modeling ties/leisure is that time spent alone is always higher than time devoted to any other tie, as long as $\beta < 1$ (see equation (11)). This gap is driven by a coordination failure (or under-investment problem) in relationship building, which obtains because individual agents are only able to partially influence the level of bilateral relationships (recall: time from both sides of a tie is required to produce a relationship). The gap between time spent alone and social ties is smaller if the agent has a strong preference for variety, i.e. if ρ_s is low, which is intuitive. When $\beta \to 1$, coordination failure in relationship building disappears and $a_0 \to a_1$. This obtains because agents fully control the level of any "relationship", where this concept degenerates to unilaterally paying attention to others.[11]

It is useful to derive the solution to two particular cases of the model, which will be used in subsequent sections. The proof may be found in the Appendix.

Proposition 2 *Two particular cases yield a closed-form solution for a_1:*

1. *If there are no transaction costs, i.e. $\alpha = 0$, then*

$$a_1 = \left[\left\{ \frac{\phi B_r^{\rho_{c,s}}}{(1-\phi)\beta \left[\left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}} + F \right]^{\frac{\rho_{c,s}}{\rho_s}-1}} \right\}^{\frac{1}{1-\rho_{c,s}}} + \left[\left(\frac{1}{\beta}\right)^{\frac{1}{1-\rho_s}} + F \right] \right]^{-1}. \tag{12}$$

2. *If the elasticity of substitution between standard commodities and ties is unitary, i.e. $\rho_{c,s} = 0$, then*

$$a_1 = \frac{(1-\phi)\beta}{F\left[\phi + (1-\phi)\beta\right] + \left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}}}. \tag{13}$$

2.2 Dynamics

Each agent lives one period and maximizes a combination of her own lifetime utility plus the discounted utility of her progeny. Agent i's total indirect utility at t is denoted by $\mathcal{J}_i$ (we assume

[11] In rigor, $\beta = 1$ implies that equilibria with $F < N$ no longer exist, since with preference for variety and full control of social ties, every agent would optimally pay some attention to every other agent in the economy.

all decisions are made at t):

$$\mathcal{J}_i(B_{r,t}, B_{sc,t}) = \max\left\{\mathcal{U}_i(c_i, s_i; B_{r,t}, B_{sc,t}) + \gamma \mathcal{J}_{i'}(B_{r,t+1}, B_{sc,t+1})\right\}, \tag{14}$$

where for notational economy we omitted dependence of utility on other parameters besides productivities B_r and B_{sc} (the state variables). We assume these other parameters are fixed across time. The label i' denotes agent i's progeny; γ is the discount factor. We specify the laws of motion for productivities in the following way.

$$B_{r,t+1} = B_{r,t}\left(1 + \psi_r \sum_i \frac{r_{i,t}}{N}\right) \tag{15}$$

$$B_{sc,t+1} = B_{sc,t}\left(1 + \psi_s\right), \tag{16}$$

where the $\psi \geq 0$ parameters measure the speed at which each productivity increases. An interpretation for the law of motion for transformational productivity is that agents learn by doing (hence the dependence on transformational effort), and cannot be excluded from knowledge (hence transformational productivity not being agent-specific). Naturally this implies that for large N, agents cannot materially influence the utility of their progeny (note that the upper bound for r is 1), and our dynamic model reduces to a repetition of the static optimization and equilibrium problem, only with an endogenous evolution of productivity B_r. In particular, we still solve for a symmetric equilibrium at each stage, so the law of motion for B_r reduces to

$$B_{r,t+1} = B_{r,t}\left(1 + \psi_r r_t\right). \tag{17}$$

The evolution of B_{sc} is fully exogenous given the low *a priori* guidance we have regarding the changes in social capital productivity. Nonetheless, ψ_s will be shown to be an important determinant of growth and other characteristics of the economy (e.g. the size of the transaction sector). An illustration of the increase in the productivity of social capital would be the efficiency of the judicial system. The judicial system makes use of information provided via social contacts (e.g. a witness X of contract breach between Z and Y), and it seems reasonable to consider that the efficiency of the judicial system has increased over time. But, what exactly drove the increase in this efficiency? Perhaps in part it is the intensity of information flow that allows some form of learning, as we assume happens with transformational productivity; in which case the law of motion for B_{sc} would depend on the level of contemporaneous social capital. However, a similar argument could be made for the intensity of trading activity. Finally, improvements in transformational productivity (e.g. information technology) certainly also contribute towards efficiency gains in the judicial system. The point we wish to make with this illustration is that it is not clear whether different allocations of time in terms of trading, socializing, and producing—arising from different F's in our model—should be assumed to lead to different outcomes in terms of the dynamics of the overall return to the information provided by social contacts. Therefore, we feel somewhat justified in our assumption of an exogenously specified law of motion for B_{sc}.

2.3 Mechanisms in the static economy

This section shows the two main broad implications of the model in terms of the short-run association between social ties and development. First, if transaction costs are absent ($\alpha = 0$), thus making social capital irrelevant for development, transformational effort for high-social-ties economies is generally larger, *ceteris paribus* (sections 2.3.1 and 2.3.2). This translates into a higher increase in next-period transformational productivity, as specified by the law of motion (17). Second, if transaction costs are positive ($\alpha > 0$) and the elasticity of substitution between leisure and consumption is unitary, then an increase in the number of social ties F corresponds to an increase in equilibrium social capital (or time spent socializing) Fa_1. The higher equilibrium trade efficiency will in turn create a higher incentive for transformational effort r, *ceteris paribus* (section 2.3.3).

The arguments above notwithstanding, dynamics will introduce endogenous heterogeneity in economies with different F, since B_r and B_{sc} are changing. Whether and how variation in F impacts long-run output growth is postponed until section 2.4.

2.3.1 Elasticity of substitution between leisure and consumption

We first set $\alpha = 0$ (no trading costs) and $\beta = 1$, and we show that the sign of $\rho_{c,s}$ determines the equilibrium relationship between the number of social ties F and transformational effort r. Note that if a relation does arise, it will be strictly related to preference motives. Considering $\beta < 1$ introduces a different source through which F affects r, but we postpone this until section 2.3.2. The following proposition contains the main result of this section.

Proposition 3 *Considering $\alpha = 0$ and $\beta = 1$, equilibrium transformational effort is given by*

$$r = \frac{\left[\left(\frac{\phi}{1-\phi}\right) B_r^{\rho_{c,s}}\right]^{\frac{1}{1-\rho_{c,s}}}}{\left[\left(\frac{\phi}{1-\phi}\right) B_r^{\rho_{c,s}}\right]^{\frac{1}{1-\rho_{c,s}}} + (1+F)^{\frac{\rho_{c,s}(1-\rho_s)}{\rho_s(1-\rho_{c,s})}}}, \tag{18}$$

which implies

$$\frac{\partial r}{\partial F} > 0 \Leftrightarrow \rho_{c,s} < 0. \tag{19}$$

The proposition follows directly from setting $\beta = 1$ and $\alpha = 0$ in equations (9) and (12), so a detailed proof is omitted. When $\rho_{c,s} < 0$, this means that consumption of standard commodities and (utility from) social ties (or "total leisure") are complementary. Also, given the agent's taste for variety (recall, $\rho_s < 1$), an increase in F must leave the agent better off. Even if the relative share of time devoted to leisure was not revised after an increase in F, a simple proportional redistribution of total leisure time would increase total utility. Given the complementarity of leisure utility and consumption, the agent would however prefer to slightly adjust the level of the latter upwards. In order to achieve this, she sacrifices part of the leisure time and increases transformational effort, which ultimately is required to acquire standard commodities.

Whether or not leisure and consumption are complementary is an empirical question. We present some arguments in section 2.4.3 for why excluding $\rho_{c,s} > 0$ is reasonable, at least within the strict context of this model.

2.3.2 Coordination failure in relationship building

It turns out that less-than-perfect coordination creates a channel through which the number of social ties influences equilibrium transformational effort. We shut down the channels related to complementarity between leisure and consumption (setting $\rho_{c,s} = 0$) and social capital (setting $\alpha = 0$), in order to isolate the effect of β.

Proposition 4 *Considering $\alpha = 0$ and $\rho_{c,s} = 0$, equilibrium transformational effort is given by*

$$r = \left[1 + \frac{(1-\phi)\left(1 + F\beta^{\frac{1}{1-\rho_s}}\right)}{\phi\left(1 + F\beta^{\frac{\rho_s}{1-\rho_s}}\right)} \right]^{-1}, \tag{20}$$

which implies

$$\frac{\partial r}{\partial F} > 0,$$

as long as $\beta < 1$.

The proposition follows directly from setting $\alpha = 0$ in equations (9) and (13), so a detailed proof is omitted. To understand the intuition behind the result, assume for a moment that non-social leisure is not allowed. In this case the utility function for social ties becomes

$$u(s_i) = \left(\sum_{j \neq i} s_{ij}^{\rho_s} \right)^{\frac{1}{\rho_s}}. \tag{21}$$

Let us assume that agent i already anticipates a symmetric attention from all her ties (denoted by $\bar{a}$); and also a non-discriminant response from herself, such that $a_{ij} = a^*$. Using (5), (21) becomes

$$\begin{aligned} u(s_i) &= \left[\sum_{j \neq i} \left((a^*)^{\beta} (\bar{a})^{1-\beta} \right)^{\rho_s} \right]^{\frac{1}{\rho_s}} \\ &= \left[\sum_{j \neq i} (a^*)^{\rho_s \beta} (\bar{a})^{\rho_s (1-\beta)} \right]^{\frac{1}{\rho_s}} \\ &= \left[(a^*)^{\rho_s \beta} F (\bar{a})^{\rho_s (1-\beta)} \right]^{\frac{1}{\rho_s}} \\ &= (a^*)^{\beta} F^{\frac{1}{\rho_s}} (\bar{a})^{(1-\beta)}. \end{aligned} \tag{22}$$

We can then write the total utility function, which in this case is Cobb-Douglas (recall that $\rho_{c,s} = 0$), as

$$\begin{aligned} \mathcal{U}(c_i, s_i) &= c_i^{\phi} (u(s_i))^{1-\phi} \\ &= c_i^{\phi} (a^*)^{\beta(1-\phi)} \times F^{\frac{(1-\phi)}{\rho_s}} (\bar{a})^{(1-\beta)(1-\phi)}. \end{aligned} \tag{23}$$

The terms after the multiplication sign in equation (23) do not influence the marginal rate of substitution between leisure and consumption. It is then straightforward to show that the share of leisure is

$$\frac{\beta(1-\phi)}{\phi + \beta(1-\phi)}, \tag{24}$$

and not $(1-\phi)$, as it would be in the standard neoclassical model. In short, in a setting where all leisure comes from social ties, *as β decreases so does the equilibrium share of leisure.* This takes place because of the weak control that agents have over the level of consumed relationships s_{ij}, whenever β is small. Since time is devoted either to leisure or transformational effort (recall: $\alpha = 0$, i.e. there are no transaction costs), a reduction in leisure increases r.

If instead we were to not allow ties with other agents (by setting $F = 0$), then leisure would simply correspond to a_0, and it would have a share of $(1-\phi)$. In the general version of the model, the equilibrium share of leisure is indeed a combination of these two cases (since there is both social and non-social leisure), as a function of whether leisure comes mostly from social ties or not. The weights in this combination are determined by F, where a high F brings us closer to the case where there is only social leisure, and thus its share is relatively small. In fact, the share of leisure when $F \to \infty$ converges to (24):

$$\begin{aligned} \lim_{F\to\infty} a_0 + F a_1 &= \lim_{F\to\infty} 1 - r \\ &= 1 - \lim_{F\to\infty} \left[1 + \frac{(1-\phi)\left(1 + F\beta^{\frac{1}{1-\rho_s}}\right)}{\phi\left(1 + F\beta^{\frac{\rho_s}{1-\rho_s}}\right)} \right]^{-1} \\ &= \frac{\beta(1-\phi)}{\phi + \beta(1-\phi)}. \end{aligned} \tag{25}$$

2.3.3 Social capital

In order to acquire standard commodities, agents incur transaction costs; which in turn are a function of social capital. Equilibrium social capital (Fa_1) is a function of both the number of social ties (F) and the time devoted to each tie (a_1). It turns out that equilibrium social capital increases with F, at least if the elasticity of substitution between consumption and leisure is unitary. The higher level of trade efficiency increases equilibrium transformational effort r, which implies a higher growth of transformational productivity B_r. The proposition below makes these arguments formally precise. The channel related to coordination failure in relationship building is shut down; as well as the channel related to the elasticity of substitution between leisure and consumption.

Proposition 5 *Considering $\rho_{c,s} = 0$ and $\beta = 1$,*

$$r = \frac{\phi}{1 + \left(\frac{\alpha B_r}{1+B_{sc}Fa_1}\right)} \tag{26}$$

$$Fa_1 = \frac{1-\phi}{1+\frac{1}{F}}, \tag{27}$$

therefore

$$\frac{\partial(Fa_1)}{\partial F} > 0 \text{ and } \frac{\partial r}{\partial F} > 0,$$

whenever $\alpha > 0$.

The proposition follows directly from setting $\beta = 1$ in equations (9) and (13), so a detailed proof is omitted. The mechanism underlying the result above is that with higher F agents now spend more time socializing, *relative* to time spent alone. In fact, since $\rho_{c,s} = 0$ (Cobb-Douglas case) and $(a_0 + Fa_1)$ is total leisure, with $\beta = 1$ it will have a constant share of $(1-\phi)$. Given that $\beta = 1$, then as F increases so too does Fa_1 (note that $a_0 = a_1$ with $\beta = 1$). This increase in Fa_1—i.e. time spent socializing—takes place at the expense of time spent alone, a_0.

If we relax the assumption of $\beta = 1$, then the effect described above and the one described in section 2.3.2 reinforce each other. To see this note that with $\beta < 1$ and $\rho_{c,s} = 0$ we can write

$$
\begin{aligned}
r &= \left[\frac{1}{1 + \left(\frac{\alpha B_r}{1 + B_{sc} F a_1} \right)} \right] \left[1 - (a_0 + F a_1) \right] && (28) \\
F a_1 &= \frac{(1-\phi)\beta}{[\phi + (1-\phi)\beta] + \frac{1}{F} \left(\frac{1}{\beta} \right)^{\frac{\rho_s}{1-\rho_s}}}, && (29)
\end{aligned}
$$

where $(a_0 + F a_1)$ does not depend on α, given the unitary elasticity of substitution between standard commodities and total leisure. In proposition 4 (where α was set to zero), we proved that $\partial r / \partial F > 0$, but in this special case, r is equal to $1 - (a_0 + F a_1)$. Thus, we have indirectly shown that $\partial (a_0 + F a_1) / \partial F < 0$ for any α. Also, equation (29) shows that it is still the case that $\partial (F a_1) / \partial F > 0$, as in proposition 5. Thus, as F increases, the incentive to exert more transformational effort because of higher trade efficiency compounds with the incentive to spend less time in total leisure (or total ties).

2.4 Analysis of steady growth

In this section we will restrict ourselves to studying a subclass of the economies generated by the model. In particular, we are interested in economies with the following two characteristics in terms of the steady-growth stage, which *a priori* seem reasonable to us, especially in light of empirical evidence:[12]

1. Non-vanishing leisure;

2. Non-vanishing output growth.

In the model, output per capita is given by

$$
GDP = B_r \left(r + TC \right). \tag{30}
$$

[12]See section 3 for details.

The expression for GDP can be interpreted in the following intuitive way. Total output is the outcome of agents spending $(r + TC)$ time in raw production, obtaining the quantity in expression (30), which follows from our assumption about the production technology of the standard good given in equation (5). The quantity $B_r TC$ is lost as iceberg (trading) costs and agents end up with consumption $c = B_r r$. The relative share of the transformational sector with respect to the transactions' sector is thus given by r/TC. In a steady-growth stage of development, r and TC become constant, hence GDP growth is given by variation in B_r. According to our specification (17), this implies that steady-growth rates are simply

$$\left.\frac{\Delta GDP}{GDP}\right|_{steady-growth} = \psi_r r. \tag{31}$$

The following proposition, proved in the Appendix, establishes that the Cobb-Douglas case is the only one consistent with the *a priori* assumptions.

Proposition 6 *If $\rho_{c,s} \neq 0$, then it is not possible to simultaneously obtain non-vanishing leisure and non-vanishing GDP growth in the steady-growth stage, i.e. when $t \to \infty$.*

To understand the intuition behind this result, consider first that $\rho_{c,s} < 0$. As time goes by, B_r and B_{sc} increase, which lowers the (total) relative price of standard commodities. This obtains because the complementarity between consumption and leisure keeps a_1 always positive, which in turn implies that $B_{sc} F a_1$ is growing unboundedly. In fact, if B_r and B_{sc} are increasing, a_1 will also necessarily increase (income effect more than offsets substitution effect). This is however inconsistent with transformational effort r (and thus GDP growth) not converging to zero. Assume otherwise. Then consumption $B_r r$ would go to infinity as B_r increases. But since leisure has an upper bound by construction, an infinite quantity of consumption is not optimal when these two goods are complementary. It follows that consumption will be finite and thus r needs to converge to zero. If complementarity is present, it does not compensate for agents to increase consumption beyond a certain level, and so at some point (almost) all time is devoted to leisure.[13]

[13]However, r still needs to be slightly positive to obtain strictly positive consumption. But note that r converging to zero is not inconsistent with $B_r r$ growing.

Consider now that $\rho_{c,s} > 0$. If there were no transaction costs and as B_r increases, agents would start substituting away from leisure; until they converge to a scenario where they only work and consume (and so we would end up with vanishing leisure). This obtains because an increase in B_r lowers, *ceteris paribus*, the price of standard commodities and the substitution effect more than offsets the income effect, since $\rho_{c,s} > 0$. When transaction costs are present, as agents start substituting away from leisure, they inadvertently increase transaction costs, because social capital is declining. Nevertheless, it turns out that as time passes, B_{sc} is growing at a fast enough rate and so at some point transaction costs do become endogenously irrelevant;[14] and it must be the case that leisure converges to zero.

Given the discussion above, we assume $\rho_{c,s} = 0$ for the remainder of the paper. Next we consider three distinct cases:

1. **Fast accumulation of transformational productivity**, i.e. B_r grows faster than B_{sc}, such that
$$\lim_{t\to\infty} \frac{B_{sc,t}}{B_{r,t}} = 0;$$
2. **Fast accumulation of social productivity**, i.e. B_{sc} grows faster than B_r, such that
$$\lim_{t\to\infty} \frac{B_{r,t}}{B_{sc,t}} = 0;$$
3. **Balanced accumulation**, i.e. B_r and B_{sc} keep the same order of magnitude, such that
$$\lim_{t\to\infty} \frac{B_{sc,t}}{B_{r,t}} \in (0,\infty).$$

In all three cases we conjecture that the following holds:

$$\lim_{t\to\infty} B_{r,t} = \lim_{t\to\infty} B_{sc,t} = \infty,$$

since this directly follows from the *a priori* restrictions and the laws of motion (16) and (17).

[14] Note that it is possible to have a_1 converging to zero and $B_{sc}Fa_1$ growing.

2.4.1 Fast accumulation of transformational productivity

Dividing the numerator and denominator of equation (9) by B_r, one immediately obtains that r converges to zero under the assumption of fast accumulation of transformational productivity. If B_r is accumulating relatively fast, then it is trade that becomes the main obstacle to increasing consumption. Accordingly, agents devote all non-leisure time to trade. However, this implies that this scenario is not compatible with the *a priori* restriction of non-vanishing GDP growth and we will thus not investigate this case further.

2.4.2 Fast accumulation of social productivity

Dividing the numerator and denominator of equation (9) by B_{sc}, and under the assumption of fast accumulation of social productivity, transformational effort converges to

$$r = 1 - a_1 \left[\left(\frac{1}{\beta} \right)^{\frac{1}{1-\rho_S}} + F \right] = 1 - a_0 - F a_1, \tag{32}$$

which implies that now transaction costs (or time spent trading) converge to zero. The main obstacle to growth is now transformation, not trade efficiency. Steady-growth levels of transformational effort (and thus steady-growth levels of GDP growth) vary positively with the number of social ties F. This result mirrors what we had already obtained in the static analysis of section 2.3.2.

2.4.3 Balanced accumulation

Considering the result of vanishing transaction costs makes the last scenario perhaps not very reasonable; especially considering empirical trends.[15] In this section we explore the implications of assuming that the relative level of B_r and B_{sc} converges to a finite, strictly positive constant, a case which we term as *balanced accumulation*. Let us denote the finite, non-zero limit of B_{sc}/B_r by μ, i.e.

$$\mu := \lim_{t \to \infty} \frac{B_{sc,t}}{B_{r,t}}. \tag{33}$$

[15] See section 3.

It follows that the following is true as well:

$$
\begin{aligned}
&\lim_{t\to\infty}\left[\frac{B_{sc,t+1}}{B_{r,t+1}}-\frac{B_{sc,t}}{B_{r,t}}\right]=0 \Leftrightarrow \\
&\lim_{t\to\infty}\left[\frac{B_{sc,t}\,(1+\psi_s)}{B_{r,t}\,(1+\psi_r r_t)}-\frac{B_{sc,t}}{B_{r,t}}\right]=0 \Leftrightarrow \\
&\mu\lim_{t\to\infty}\left[\frac{(1+\psi_s)}{(1+\psi_r r_t)}-1\right]=0 \Leftrightarrow \\
&\lim_{t\to\infty} r_t=\frac{\psi_s}{\psi_r}
\end{aligned}
\tag{34}
$$

The following proposition (proved in the Appendix) and corollary 1 contain the key results of this section.

Proposition 7 *The following statements are true under the balanced accumulation assumption, in the steady-growth stage:*

1. *Long-run transformational effort converges to*

$$r=\frac{\psi_s}{\psi_r}. \tag{35}$$

2. *For the balanced accumulation regime to hold, ψ_r needs to verify the lower bound defined below:*

$$\psi_r>\psi_s\frac{F\left[\phi+(1-\phi)\beta\right]+\left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}}}{\phi\left[F+\left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}}\right]}=:\underline{\psi_r}, \tag{36}$$

otherwise the scenario of fast accumulation of social productivity obtains.

Corollary 1 *Under balanced accumulation, long-run GDP growth is independent of F.*

The result in corollary 1 contrasts with the short-run effects of social ties, where a higher F was associated with higher transformational effort r. Moreover, this also implies that even if countries initially diverge in terms of growth rates, they must necessarily converge.

The following corollary, illustrated in figure 2, emphasizes that long-run GDP growth is a non-trivial function of the speed at which transformational productivity grows.

Corollary 2 *Under balanced accumulation, long-run GDP growth $\psi_r r$ corresponds to ψ_s, and so does not depend (locally) on ψ_r. If one gradually decreases ψ_r, then long-run growth is constant until the threshold $\underline{\psi_r}$; and afterwards the balanced accumulation regime collapses and long-run GDP growth varies with ψ_r, as in the scenario with fast accumulation of social productivity.*

[Figure 2 about here.]

When ψ_r is low, consumption is growing slowly (relative to social productivity). This implies that total transaction costs cease to matter in the limit, since social productivity B_{sc} is increasing and lowering the per-unit-of-trade transaction cost at a (relatively) fast rate. All non-leisure time is thus devoted to transformational effort, and this share is a function of the relative preference of consumption over leisure. The right panel of figure 2 shows that as ψ_r increases from 0, so does long-run GDP growth. The proportionality obtains because r is constant. As ψ_r becomes large enough, transaction costs start to matter and a different long-run equilibrium obtains. In this equilibrium, non-leisure time is allocated between time spent trading and time spent transforming, and long-run GDP growth is constant. This barrier to growth obtains because very strong increases in consumption necessarily create high total transaction costs. Long-run growth thus becomes a trivial function of ψ_s (the rate at which trade efficiency increases), which obtains by simply multiplying expression (35) by ψ_r.

Another implication of the model that is shown in the right panel of figure 2 is that the long-run difference in growth rates between low-social-ties countries and high-social-ties countries only obtains for low ψ_r. When both countries are in an equilibrium with fast accumulation of social productivity (low ψ_r), the difference in growth rates is simply the outcome that agents in high-social-ties countries choose lower leisure shares, as discussed in section 2.3.2.

Finally we wish to analyze what the model predicts in terms of the relative weight of the transaction sector in the economy. Empirically we find a strong association between social ties and the size of the transaction sector, in the cross section of countries (detailed in section 3). Proposition 8 shows that this is predicted by the model for the steady-growth stage.

Proposition 8 *Under the balanced accumulation assumption, the weight of the transaction sector in the economy is given by*

$$\frac{TC}{r+TC} = 1 - \frac{\psi_s}{\psi_r}\left\{\frac{F\left[\phi+(1-\phi)\beta\right]+\left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}}}{\phi\left[F+\left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}}\right]}\right\} = \frac{\psi_s}{\psi_r}\underline{\psi_r}. \tag{37}$$

Expression (37) varies positively with F.

This result is perhaps counter-intuitive, in that high-social-ties economies trade more efficiently. But these economies also grow at a faster rate and accordingly exhibit larger trading volumes. This effect is predicted by the model to dominate in the long-run.

3 Quantitative implications

In this section we first calibrate the model using data for the United States and then simulate development paths for other countries with respect to which we have social ties' data. We make the strong assumption that the only difference in primitives between countries at $t = 0$ (the year 1700 in data) is the number of social ties F and that this number remains constant across time (culture). One period of time in the model corresponds to 20 years in data, and we interpret each period's decisions as the decisions of individuals in a generation.

Before getting into the numerical exploration, we would like to offer three reasons why we consider it useful. First, we are interested in the transition towards the steady state of countries with different number of ties, and it is not clear *a priori* how that works. Second, we are interested in fleshing out the most relevant *quantitative* predictions of the model, and recognizing which dimensions of the data are and which are not being accounted by the model. Third, by focusing in the quantitative aspects of the model, we can discern where we need more and better data.

3.1 Calibration

There are a total of 9 parameters to calibrate: F, $B_{r,0}$, $B_{sc,0}$, ψ_r, ψ_s, α, β, ρ_s, and ϕ. First note that α and $B_{r,0}$ are not separately identified, since it is the term αB_r that determines r, as shown in equation (9). Given our multiplicative law of motion for B_r given by (17), we are indeed specifying a law of motion for αB_r. Thus we set $\alpha = 1$. Also, given our data it is not possible to separately identify β and ρ_s, so we set $\rho_s = 0.5$. To identify all parameters except $B_{r,0}$ and $B_{sc,0}$, we use the data in table 1. We also assume that the United States is close to the steady-growth stage in the year 2000.

[Table 1 about here.]

Our estimate for the number of social ties comes directly from data and we set $F = 8$. The equilibrium relationship between a_0 (time spent alone) and a_1 (average time per social tie) is given by equation (11), being determined by ρ_s and β. We already specified a value for ρ_s and so the relative levels of a_0 and a_1 in data immediately imply $\beta = 0.16$. Next, using the equilibrium level of a_1, given by equation (13), we are able to determine that $\phi = 0.18$. According to our assumption that the United States is close to the steady-growth stage, we can equate expression (35) multiplied by ψ_r to our estimate of long-run growth. This yields $\psi_s = 0.35$. Next, equating expression (35) to the value of r in data implies $\psi_r = 1.96$. The only two parameters left to determine are the initial values for productivities. We require two conditions regarding the calibration of these parameters. First, that the observed growth rate between 1750 and 1990 matches data; Lucas (2002) estimates the ratio of real per capita GDP in 1990 relative to 1750 at 21.6. Second, we require that our choice for initial productivities is consistent with the assumption that the US is close to the steady-growth stage. Our final choice was to set $B_{r,0} = 0.7$ and $B_{sc,0} = 4.2$. A summary of the calibration is contained in table 2.

[Table 2 about here.]

[Table 3 about here.]

Table 3 shows a sensitivity analysis for different pairs of $(B_{r,0}, B_{sc,0})$. The most important magnitude we want to match is the variation in output between 1750 and 1990, especially given the nature of our simulation exercise. Thus we only consider calibrations that generate this result. The assumption that the US is close to the steady-growth stage would require that the transformational effort in the year 2000 generated by the model is close to 0.18. Note that for lower levels of initial productivities this becomes less the case. Another important feature of the data is that the weight of the transaction sector increased significantly from 1900 to 2000. The model is not able to capture this, but if we interpret this pattern as a generalized increase of the weight of the transaction sector over time, then for low levels of initial productivities this qualitative aspect does obtain, if instead we compare the year 1700 with later years (1900 or 2000). In that sense we would say that the model does not match the *rate* at which the weight of the transaction sector increased. This argument notwithstanding, low levels of initial productivity are not consistent with the US being close to a steady-growth stage and so we face a trade-off. We compromised by setting $B_{r,0} = 0.7$ and $B_{sc,0} = 4.2$ (bold-faced in table 3).

Although not the main focus of the paper, the fact that the model predicts an increase in the weight of the transaction sector speaks directly to the questions raised in Wallis and North (1986) (pg. 125): "The growing size of the transaction sector poses a major explanatory challenge to economists and economic historians. What is the relationship of those inputs to their outputs? How have transaction and transformation costs interacted in the transformation of the economy?" What our model says is that the initial levels of social and transformational productivities play a major role in the observed subsequent pattern of the relative shares of transaction and transformation sectors (see table 3).

3.2 Results

As explained before, we consider that all countries had the same productivities in the year 1700, although different levels of social ties. We assume the latter were kept constant across time, thus we can use data from the International Social Survey Programme 2001 to calibrate the value of F

for each country. All other parameters are set at the levels presented in table 2. The main result is depicted in figure 3.

[Figure 3 about here.]

Not surprisingly, given the theoretical results, the model predicts a positive association between the number of social ties and income per capita in the year 2000 (or, equivalently, the average growth rate of the economy). The correlation coefficient between the model's prediction and data is 0.58. The coefficients of variation of income per capita are surprisingly similar, 0.43 in the data and 0.41 in the model.

Given that two channels drive our theoretical results (social capital and preferences), we ask which one is more relevant. We analyze this by running the experiment of simulating development paths with $B_{sc} = 0$, i.e. shutting down the productivity of social capital. Computing again the coefficient of variation generated by the model we obtain 0.20, roughly half the benchmark value of 0.41. This means that both channels, preferences and social capital, are *quantitatively* important in terms of explaining cross-sectional development patterns.[16]

The next step is to investigate how the model fares in other dimensions. We consider cross-sectional dimensions first, and follow later with time series dimensions. Two other cross-sectional dimensions are worth inspecting. The first one refers to the *strength* of ties. Respondents in the ISSP survey answered the following question: "How often did you visit or see your closest friend?" There were eight possible ordered answers, from "he/she lives in the same household" to "never". We consider the answer to this question as a proxy for the *time* that respondents dedicate to each close friend. Figure 4 shows that the model does a reasonable job at capturing this aspect: in both model and data, countries with larger *number* of ties tend to have lower *strength* of ties. The correlation coefficient between the model's prediction and data is 0.40 and it may be worth mentioning that, in both model and data, the correlation between strength of ties and income per

[16] Of course, growth with zero productivity of social capital would be much lower; GDP per capita of the US would have grown between 1750 and 1990 at an annual rate of 0.65% instead of a rate of 1.3%. This is due to the fact that a large share of the market resources (by the year 2000, almost 90% instead of near 47% in the benchmark case) could have been allocated to the transactional instead of the transformational sector.

capita is also negative.[17] We do not compare coefficients of variation in model and data, since our empirical proxy is ordinal.

[Figure 4 about here.]

[Figure 5 about here.]

The second additional cross-sectional dimension we are interested in is the share of effort dedicated to transactional services *vis à vis* transformational effort. In figure 5 we observe that the model, above a small threshold, captures the increase in the share of transactional effort associated with large number of ties (and high income per capita), although the slope is flatter in the model (prediction for the year 2000) than in the data. The correlation coefficient between the model's prediction and data is 0.56. In this case, as can be readily observed from the figure, the coefficients of variation in share of transaction sector differ markedly, 0.21 in the data and 0.03 in the model.

The prediction of a positive relationship between number of ties and the share of the transaction sector is not obvious. Indeed, from a superficial inspection of the model, one would conclude that countries with relatively large number of ties would have a *low* share of transaction services, as ties translate into social capital. This is, in fact, the case in the initial periods. But soon enough, countries with large number of ties grow faster (due to higher transformational productivity), and need to allocate a larger share of resources in the *trading* of that additional production. By 2000, the relationship between number of ties and share of transactional effort in total effort is positive. It must be said that, in the limit (dashed line in figure 5), this feature is accentuated with slopes being quite similar in data and model. In fact, while the correlation coefficient between data and model remains similar, in the limit the coefficient of variation is much closer to the data (0.19). In this sense, the calibrated model seems not to be capturing accurately the *timing* of some changes.

With respect to the time series dimensions, we have already showed that the model is not able to capture the steep increase in transaction costs between 1900 and 2000 for the US, if one wants to match the average growth rate between 1750 and 1990. On the other hand, the model is consistent

[17] In data this coefficient is -0.65, statistically significant at 0.1%. See bottom part of table 6 in Appendix for all correlations between variables.

with effort share of time being almost constant at near 0.30. This constancy in shares is, of course, given by the unitary elasticity of substitution between consumption and leisure.

[Table 4 about here.]

Table 4 also shows that growth rates for the US economy were higher in the period 1900-1990 than in the period 1750-1900, unlike what is predicted by the model, with similar growth rates in both periods. This counter-factual dimension would certainly disappear if the model separated between schooling (investment in human capital) and labor, with the former driving a large share of the inter-temporal increase in productivity.[18] However, we do not have reason to believe this would change our cross-sectional results, which are the focus of the paper. Moreover, the model can account for a large share of the "great divergence" in income per capita. Using data from Lucas (2002) we are able to compute the coefficient of variation of income per capita for a set of 21 regions/countries and conclude that this magnitude increased 4.05 times from 1750 to 1990. The calibrated version of the model generates a 2.3-fold increase in the coefficient over the same period, although for our set of 27 countries (which somewhat limits the quantitative comparability). Finally, the last row in table 4 shows that both model (our 27 countries) and data (the 21 regions in Lucas (2002)) exhibit a decrease in the heterogeneity of growth rates (convergence).

4 Extension: agent-level social capital

A strong assumption made in the paper is that agents are not able to influence their social capital. This section will try to make a case for why we believe this assumption is relatively innocuous. We start by alternatively assuming that both agent-level and aggregate decisions matter for the social capital—and thus the transaction costs—faced by agent i, i.e.

$$SC_i = \left(\sum_{j \neq i} s_{ij}\right)^{\tau} \left(\frac{\sum_{k \neq i} \sum_{j \neq i} s_{kj}}{N-1}\right)^{1-\tau}. \tag{38}$$

[18]This is due to the fact that, while total effort seems to have remained rather constant in time, schooling time has increased monotonically.

According to the expression above, an agent's social capital depends on how well-connected she is and how well-connected all other agents are. The relative importance of the former is gaged by τ. The intuition behind this is that an agent can only extract benefits from the global network if she establishes access to the network via her own links; and that the benefits of the network the agent is accessing are a function of how dense the network is. The question becomes: How does this alternative specification of social capital change the incentives to socialize? The first step in answering this is computing the derivative of social capital with respect to a_{ij}, i.e. the time devoted by i in the relationship with j:

$$\frac{\partial SC_i}{\partial a_{ij}} = \tau \left(\sum_{j \neq i} s_{ij} \right)^{\tau - 1} \beta a_{ij}^{\beta - 1} a_{ji}^{1-\beta} \left(\frac{\sum_{k \neq i} \sum_{j \neq i} s_{kj}}{N-1} \right)^{1-\tau} \tag{39}$$

First notice from the expression above that it is still the case that multiple equilibria are allowed, since $a_{ji} = 0$ makes the derivative also zero, which in turn makes $a_{ij} = 0$ still optimal (as under the initial assumption). If we solve for a symmetric equilibrium with F ties and $a_{ij} = a_1$, then equation (39) becomes

$$\tau \left(F a_1 \right)^{\tau - 1} \beta a_1^{\beta - 1} a_1^{1-\beta} \left(F a_1 \right)^{1-\tau} = \tau \beta. \tag{40}$$

The product $\tau\beta$ involves two magnitudes below unity, which makes it naturally a small number. Moreover, in market economies where it is more unlikely that the agents know who they are going to interact with, it is probably more reasonable to assume that τ is relatively low, i.e aggregate connectedness being more important. These arguments notwithstanding, it is still possible that the transaction costs of agent i become so high—since trade volume is increasing significantly—that marginal decisions are importantly affected. Recall that transaction costs are borne by the buyer and amount to

$$TC_i = \frac{\alpha c_i}{1 + B_{sc} SC_i} = \frac{\alpha B_r r_i}{1 + B_{sc} SC_i}.$$

If we divide the numerator and denominator of the expression above by B_r and consider later stages of development (i.e. B_r is large), then transaction costs are approximately

$$TC_i \approx \frac{\alpha r_i}{\mu SC_i}, \tag{41}$$

where μ is the limit for the ratio B_s/B_r. If we assume a balanced accumulation path in order to be consistent with the empirical fact that the transaction sector is not vanishing, then μ belongs to the interval $(0, \infty)$. Since r_i is bounded from above at 1, then the (absolute) marginal influence that an agent can have in her transaction costs via time chosen to be spent in ties is bounded from above at

$$\frac{\alpha}{\mu SC_i^2} \tau \beta, \tag{42}$$

even as consumption grows towards infinity. Moreover, SC_i is bounded away from 0, since the consumption motive for social ties by itself makes a_1—and thus equilibrium social capital Fa_1—strictly positive. In words, in a model like ours where agents are already building social capital as an externality of consuming social relationships, it is not clear that there subsists a strong incentive to further increase time spent socializing in order just to reduce transaction costs. We numerically solved for the steady-growth stage outcomes of an extended model that includes this additional motive, using the calibrated parameters from section 3. The results are shown in table 5.[19]

[Table 5 about here.]

For any τ there is not a change in the order of magnitude of social capital (recall that social capital is proportional to a_1). This is true for both low-social-ties economies ($F = 3$, the smallest in our sample) and high-social-ties societies ($F = 11$, the highest in our sample). Moreover, we do not observe low-social-ties economies being significantly more responsive to increases in τ, which would be necessary to overturn our argument that dispersion in F drives dispersion in growth rates.

[19] We still assume balanced accumulation and unitary elasticity of substitution between consumption and total leisure, otherwise the *a priori* restrictions would not be verified.

5 Discussion and conclusion

We present a general equilibrium model where agents derive utility from relationships and time spent socializing generates a positive externality in terms of transaction costs. While it is a fairly intuitive result that the model predicts a positive association between social capital (i.e. lower transaction costs) and development, it is perhaps unexpected that the relationship building mechanism by itself would produce the same effect. Furthermore, our calibration suggests that this second channel is quantitatively important. In this sense, our paper adds to the literature not only by providing a conceptually clear and quantitatively grounded analysis of social capital and development, but also by highlighting how social and economic dimensions may importantly interact in less obvious ways.

A key assumption of our model is that different countries display different average levels of social ties, which remain constant across time. This can be seen as a product of culture, an interpretation which is consistent with the multiple equilibria predicted by the model. This argument notwithstanding, country cross-sectional variation in the average number of social ties can also be seen as resulting from variation in some fixed cost of establishing a relationship. For the purpose of deriving a connection between social ties and economic development in the context of our model, either of these stories is admissible, as long as time variation in social ties is sufficiently small. Ideally we would empirically inspect variation in social ties across long periods, but such data is not available. There is however some evidence we can present in support of our hypothesis, shown in figure 6.

[Figure 6 about here.]

The figure depicts the median level of social ties for a subset of countries where social ties' data was collected both in 1986 and 2001. If our hypothesis were true, then the plot would correspond to the 45-degree line. However, we observe that for most countries, the median level of social ties in 2001 is greater or equal than the value in 1986. We believe that this may be explained by a difference in the questionnaire.[20] Abstracting from the difference in averages, the ranking among countries did not change dramatically. In fact, with the exception of the US, countries that had

[20]The 1986 survey asked directly how many close friends one had (question 9), while the 2001 survey asked separately how many close friends one had at work, in the neighborhood, and elsewhere (questions 15, 16, and 17).

more or the same close friends than countries in some subset X still maintain that property in 2001. Naturally we are only inspecting 7 countries and over a short period of time, which limits the relevance of the data, but it seems somewhat consistent with our hypothesis that the level of social ties, or at least the cross-sectional difference in levels, is relatively stable.

We wish to emphasize that our model of relationship building is relatively stark. Different specifications for this dimension could generate different results, for instance if we take into account the fact that communication and transportation costs, which have significantly decreased with development, play a role in the ability to maintain a network of connections. Moreover, it is not clear how technological aspects of relationship building interact with culture. Additional research in this area would help better understand the relationship between economic development, social ties, and social capital.

Another limitation of our framework is that in our model there are no "network architecture concerns", since we solve for symmetric equilibria. But in real-world social networks, where there is strong clustering, social capital may be used to promote bad purposes, such as criminal activity or exclusion of potential competitors. It could be argued that our model does not consider the negative effect that may arise in high-social-ties societies, if it is the case that a higher intensity of socialization also creates more incentives for clustering and subsequent bad uses of social capital. Once again, further research will be necessary to better understand these trade-offs.

Finally we mention the potentially interesting implications of our approach for fiscal policy. In our setting, a Pigouvian tax on the consumption of standard goods and/or income from transformational effort could potentially be welfare-enhancing for two reasons: (i) such taxation could minimize the equilibrium underinvestment in relationships, by reducing the value of each individual's outside option for non-social uses of time; and (ii) it could partially internalize the benefits of social relationships associated with the positive externality on transaction costs. One could additionally consider fiscal policies aimed at inter-generational effects. It is also likely that our model would predict specific optimal fiscal policies for each type of society, which could be an additional testable implication of our framework.

A Appendix

A.1 Solution to the static problem

The Lagrangian for any agent i is given by:

$$\mathcal{L}_i = \left[\phi c_i^{\rho_{c,s}} + (1-\phi)\left\{\sum_j \left(a_{ij}^{\beta} a_{ji}^{1-\beta}\right)^{\rho_s}\right\}^{\frac{\rho_{c,s}}{\rho_s}}\right]^{\frac{1}{\rho_{c,s}}} - \tag{A.1}$$

$$\theta_i\left[r_i + \left(\frac{\alpha}{1+B_{sc}SC}\right)c_i + \sum_j a_{ij} - 1\right] - \lambda_i\left[c_i - B_r r_i\right] + \tag{A.2}$$

$$\sum_j \eta_{a,ij} a_{ij} + \eta_{r,i} r_i, \tag{A.3}$$

where θ, λ, and η are Lagrange multipliers for the relevant constraints (η's are associated with non-negativity constraints for a_{ij} and r_i). Assuming a symmetric equilibrium where $a_{ii} = a_0$, $a_{ij} = a_1 > 0$ for j in the set of i's friendships (totaling F), $a_{ij} = 0$ for j not in the set of i's friendships, $r_i = r$, and $c_i = c$, the first-order conditions of the problem may be simplified into the following two equations (agent subscript omitted):

$$\frac{\phi c^{\rho_{c,s}-1}}{(1-\phi)\left[a_0^{\rho_s} + F a_1^{\rho_s}\right]^{\frac{\rho_{c,s}}{\rho_s}-1} a_0^{\rho_s-1}} = \frac{\alpha}{1+B_{sc}Fa_1} + \frac{1}{B_r} \tag{A.4}$$

$$\frac{a_0}{a_1} = \left(\frac{1}{\beta}\right)^{\frac{1}{1-\rho_s}}, \tag{A.5}$$

The budget and time constraints are

$$c = B_r r \tag{A.6}$$

$$r + \left(\frac{\alpha}{1+B_{sc}Fa_1}\right)c + a_0 + Fa_1 = 1. \tag{A.7}$$

Combining (A.4)-(A.7) we obtain an implicit expression for a_1:

$$\frac{\phi\left[B_r r^*(a_1)\right]^{\rho_{c,s}-1}}{(1-\phi)\beta\left[\left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}} + F\right]^{\frac{\rho_{c,s}}{\rho_s}-1} a_1^{\rho_{c,s}-1}} = \frac{\alpha}{1+B_{sc}Fa_1} + \frac{1}{B_r}, \tag{A.8}$$

where $r^*(a_1)$ is given by equation (9).

A.2 Proofs

Proof of proposition 1. Since we are interested in symmetric equilibria, we can derive the solution using the following simpler problem, that is isomorphic to the general one under the assumption of symmetry. Any agent maximizes the following CES utility function

$$\mathcal{U}(r, a_0, a_1) = \left\{ \phi B_r^{\rho_{c,s}} r^{\rho_{c,s}} + (1-\phi) \left[a_0^{\rho_s} + F a_1^{\beta\rho_s} \bar{a}^{(1-\beta)\rho_s} \right]^{\frac{\rho_{c,s}}{\rho_s}} \right\}^{\frac{1}{\rho_{c,s}}}, \tag{A.9}$$

subject to the time constraint

$$r + TC + a_0 + F a_1^{\beta} \bar{a}^{1-\beta} = 1. \tag{A.10}$$

The agent knows that only F other agents will pay her some attention (i.e. $\bar{a} > 0$), and so already optimally decided to not pay attention to any other agent outside her set of friends (note that time is valuable, so this is not just a weak best response). As long as $\phi < 1$ and $\beta > 0$, this is a standard concave programming problem with a unique interior solution (derivatives with respect to r, a_0, and a_1 are all infinity at 0). An equilibrium is defined by requiring

$$a_1^*(\bar{a}, ...) = \bar{a}.$$

Next we need to establish that there exists $\epsilon > 0$ small enough such that

$$a_1^*(\epsilon, ...) > \epsilon.$$

To see that this is true, let us compute the following:

$$\left. \frac{\partial \left[a_1^{\beta\rho_s} \bar{a}^{(1-\beta)\rho_s} \right]}{\partial a_1} \right|_{\bar{a}=a_1=\epsilon} = \beta\rho_s a_1^{(\beta\rho_s - 1)} \bar{a}^{(1-\beta)\rho_s} \Big|_{\bar{a}=a_1=\epsilon} = \frac{\beta\rho_s}{\epsilon^{1-\rho_s}} \tag{A.11}$$

Expression (A.11) goes to infinity as ϵ goes to zero, which implies that marginal utility of a_1 also does. This is not consistent with optimizing behavior, so it must be the case that for small enough $\bar{a}$, $a_1^* > \bar{a}$ will obtain. Thus it follows that for small ϵ,

$$a_1^*(\bar{a}, ...) \in [\epsilon, 1/F], \forall \bar{a} \in [\epsilon, 1/F],$$

where we are also making use of the time constraint when setting the upper bound of a_1^* at $1/F$. By Brouwer's fixed point theorem, there exists a fixed point in $[\epsilon, 1/F]$. This concludes establishing existence of an equilibrium where a positive amount of time is devoted to each of the F friends, for any finite F. To show that this equilibrium is unique, construct the homotopy function $H : [\epsilon, 1/F] \times [0, 1] \to \mathbb{R}$ with

$$H(\bar{a}, t) = a_1^*(\bar{a}, ...; \alpha = t \times \bar{\alpha}) - \bar{a},$$

where $\bar{\alpha}$, set exogenously, denotes the true level of transaction costs. Setting $t = 0$ reduces to the case with no transaction costs, where $H(\bar{a}, t = 0) = 0$ has a unique solution (see proposition 2; and note that all equilibrium magnitudes besides a_1 are uniquely determined by a_1, as shown in proposition 1). Also, we have shown that an equilibrium exists for any level of transaction costs, which implies that there exists a solution to $H(\bar{a}, t) = 0$, for any t. Thus, H is continuously differentiable in $\bar{a}$ and t, which means that the solution to $H(\bar{a}, t) = 0$ is a continuously differentiable function of t. Combining this with the uniqueness of the solution at $t = 0$ implies that the solution for any $t \in (0,1]$ is also unique.[21] It follows that there is a unique solution to $H(\bar{a}, t = 1) = 0$, for any $\bar{\alpha}$; or equivalently, our equilibrium is unique.■

Proof of proposition 2. Setting $\alpha = 0(\rho_{c,s} = 0)$ in the general expression (A.8) yields point 1(2) in the proposition.■

Proof of proposition 6. Using the first-order conditions, the relation between consumption c and per-friend attention a_1 may be written as

$$a_1^{1-\rho_{c,s}} c^{\rho_{c,s}} = (1 - a_0 - Fa_1) \left(\frac{1-\phi}{\phi}\right) \beta \left[\left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}} + F\right]^{\frac{\rho_{c,s}}{\rho_s} - 1}. \tag{A.12}$$

If GDP growth is non-vanishing, then $c \to \infty$. If $\rho_{c,s} < 0$ this implies that the LHS of (A.12) goes to zero, since a_1 has an exogenous upper bound of 1. The only way to make the RHS of (A.12) equal to zero is to set $(a_0 + Fa_1) = 1$. However, this implies that $r = 0$, which is inconsistent with non-vanishing GDP growth. Consider now that $\rho_{c,s} > 0$. Since the RHS of (A.12) is always finite, it would be necessary that $a_1 = 0$, which implies vanishing leisure.■

Proof of proposition 7. Dividing the numerator and denominator of equation (9) by B_r, and under the balanced accumulation assumption, yields the following expression for long-run transformational effort:

$$r = \frac{1 - a_1 Y}{1 + \frac{\alpha}{\mu F a_1}}, \tag{A.13}$$

where

$$Y := \left(\frac{1}{\beta}\right)^{\frac{1}{1-\rho_s}} + F. \tag{A.14}$$

We know that in the long-run, as long as $\mu > 0$ (which holds under balanced accumulation),

$$\frac{\psi_s}{\psi_r} = r = \frac{1 - a_1 Y}{1 + \frac{\alpha}{\mu F a_1}},$$

which yields, after a few steps of algebra,

$$\mu = \frac{\alpha}{Fa_1 \left[(1 - a_1 Y)\frac{\psi_r}{\psi_s} - 1\right]}. \tag{A.15}$$

Requiring $\mu > 0$ (necessary for balanced accumulation) and using equation (A.15) gives the lower bound for ψ_r in expression (36). This implies that we shift to the scenario with fast accumulation of social productivity when ψ_r is low enough. To see that this is the case, first note that for ψ_r small enough, μ becomes negative, which is not consistent with the fact that B_{sc} and B_r are both non-negative (recall: μ is defined as the limit of the ratio B_{sc}/B_r). Then it must be the case that for low ψ_r, either the scenario with fast accumulation of transformational productivity obtains, or the scenario with fast accumulation of social productivity obtains. Assume it is the former, which implies that B_{sc}/B_r converges to zero. Then it cannot be the case that there exists some t^*, such

[21] See Garcia and Zangwill (1982) for a textbook introduction to the use of homotopies in solving equilibrium problems.

that for all $t > t^*$ the following holds:

$$\frac{B_{sc,t+1}}{B_{r,t+1}} > \frac{B_{sc,t}}{B_{r,t}} \Leftrightarrow r_t < \frac{\psi_s}{\psi_r}$$

But such a t^* is guaranteed to exist, since we showed in section 2.4.1 that r_t converges to zero under the assumption of fast accumulation of transformational productivity. This contradiction implies that it is the scenario with fast accumulation of social productivity that obtains for low enough ψ_r.■

Proof of proposition 8. The size of the transaction sector in the steady-growth stage is given by

$$TC = \lim_{t\to\infty}\left(\frac{\alpha B_r r}{1 + B_{sc}SC}\right) = \frac{\alpha\psi_s}{\psi_r \mu F a_1}, \tag{A.16}$$

where μ is given by (A.15) and we made use of the fact that $r = \psi_s/\psi_r$. The relative weight of the transaction sector may then be written as

$$\frac{TC}{TC + r} = \frac{\alpha\psi_s}{\psi_r \mu F a_1 (1 - a_1 Y)}, \tag{A.17}$$

where Y is given in (A.14). Simplification of the expression above yields equation (37) in the proposition. To show that the weight of the transaction sector varies positively with F it is sufficient to prove the following:

$$\begin{aligned}
&\frac{\partial}{\partial F}\left\{\frac{F\left[\phi + (1-\phi)\beta\right] + \left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}}}{\phi\left[F + \left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}}\right]}\right\} < 0 \Leftrightarrow \\
&\left[\phi + (1-\phi)\beta\right]\left[F + \left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}}\right] < F\left[\phi + (1-\phi)\beta\right] + \left(\frac{1}{\beta}\right)^{\frac{\rho_s}{1-\rho_s}} \Leftrightarrow \\
&\phi + (1-\phi)\beta < 1,
\end{aligned}$$

which always holds, since β and ϕ belong to the open unit interval.■

A.3 Data

Data on number of social ties, strength of ties, and share of employment in transaction sector have been obtained from the International Social Survey Programme (ISSP). This program includes two chapters on social networks, one for the year 1986 and another for the year 2001. In this paper we have in all cases used the data for the year 2001, with the exception made for the construction of figure 6, in which we used data for both years. In its chapter of the year 2001 (ZA No. 3680), around 37,000 individuals in 27 countries were asked, among other questions, about number and frequency of contacts with different types of agents: family members, friends, and secondary associations.
The *number of friends' ties* for each individual was calculated summing variables v23r, v24r, and v25r (respectively, number of close friends at work, at their neighborhood, and other close friends). Then we took the median value for each country. The *number of nuclear family ties*, for each

individual, was calculated summing variables v4r (number of brothers and sisters), v8r (number of adult sons and daughters), v66r (number of children aged 18 or less), plus 2 for father and mother. Then we took the median value for each country. The *number of secondary associations' ties* was calculated first separating if a person participates or not in a particular association, which is informed for seven types of them (political party (v29), union (v30), religious organization (v31), sports/hobby clubs (v32), charitable organization (v33), neighborhood organization (v34), and other associations (v35)). Then we counted the number of associations in which each individual participates; and then we took the average for each country.
The *strength of friends' ties* was calculated using variable v27, which asks "how often do you visit or see your closest friend?". The answers go from "he/she lives in same household" (1), "daily" (2), "at least several times a week" (3), up to "never" (8). We recoded the answers such that a higher number means a higher frequency of visits, and took the average for each country.
The *share of employment in transaction sector* was calculated following the classification used by Wallis and North (1986), appendix, section 1, by which occupation categories are classified into transaction-related and the rest. The main categories in the former group are sales workers, clerk workers, foremen, some professional workers (accountants, lawyers, etc.) and some protective workers (police, guards, etc.). In the ISSP (2001) the variable of interest is labeled isco88 (as it follows the 4 digit classification of the International Labour Organization). For each country, we counted the number of individuals that indicated that they worked in a transaction-related sector, and divided that number by the total of individuals that informed their occupation. The surveys in Austria, France, Italy, Slovenia, and South Africa did not inform this variable.
The data for *shares of time use* in table 1 was calculated using Ramey and Francis (2009), and are averages for population of age 10 and more. In their study, time use is divided into six categories: market work, home work, schooling, leisure, personal care, and travel. We calculated shares over a total that excludes personal care and travel. We considered *effort* $(r + TC)$ to be the sum of market work and schooling. This total is separated into transactional and transformational effort using the share employment in transaction sector for the United States obtained above (0.392). Leisure time is separated in two categories, social activities and non-social leisure, using data for the year 1985 provided by Robinson and Godbey (1997). They decompose leisure (free time) into its components (see figure 12 in their chapter 8 and table 13 in their chapter 11). We considered social activities (Fa_1) as the sum of (according to their classification) "socializing", "religion", and "other organizations". Out of 37.4 weekly hours (free time informed by the authors minus adult education time), 8.8 hours correspond to social activities. (This number is remarkably similar to a raw average of socializing time in Aguiar and Hurst (2007), 9.04 weekly hours for the year 2003). We calculated then that social activities represent almost 24% of leisure time. Non-social leisure plus home work is considered household time (a_0).

[Table 6 about here.]

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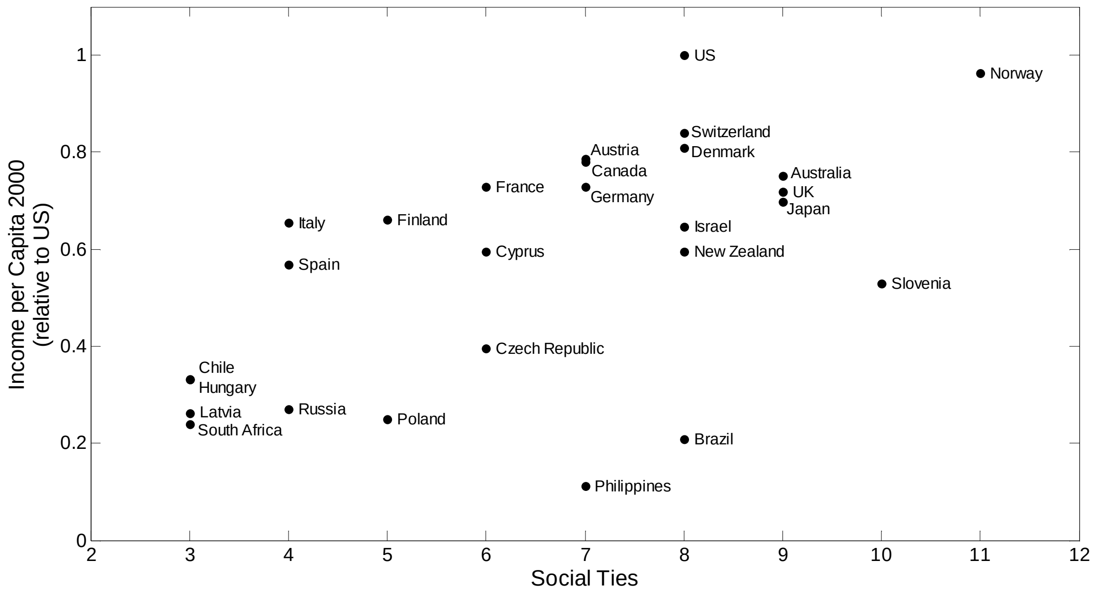

Figure 1: Social Ties and Income per Capita: Cross-Country Comparison. The figure plots, for each country, the median number of "close friends" (source: International Social Survey Programme, 2001) versus the income per capita in the year 2000 (source: Penn World Table), normalized by the income per capita for the United States. The sample correlation between social ties and income per capita is 0.58, statistically significant at 0.1%. Data is provided in the Appendix.

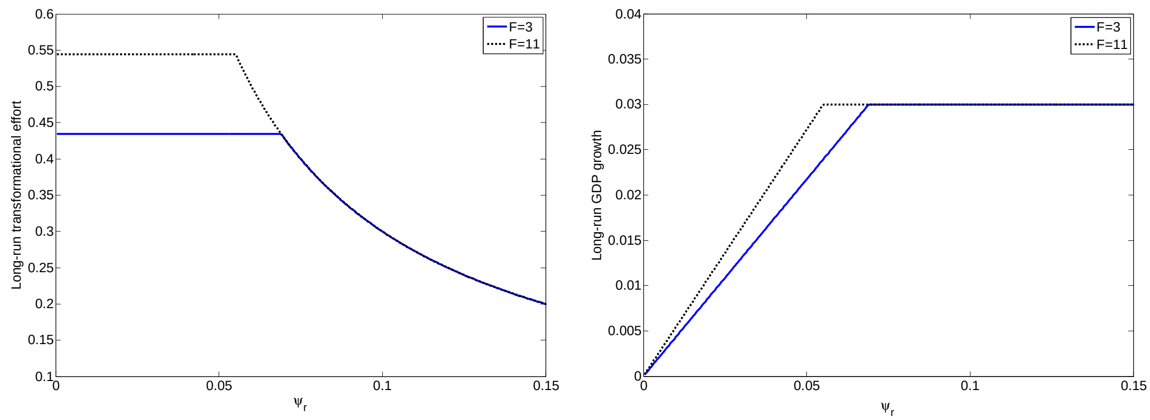

Figure 2: Long-run Outcomes as a Function of Speed of Accumulation of Transformational Productivity. Left panel: shows long-run transformational effort r for low-social-ties countries ($F = 3$) and high-social-ties countries ($F = 11$), for varying ψ_r. Right panel: shows long-run GDP growth $\psi_r r$ for low-social-ties countries ($F = 3$) and high-social-ties countries ($F = 11$), for varying ψ_r. The remaining parameters are set at the following levels: $\beta = 0.2$, $\phi = 0.35$, $\rho_s = 0.5$, $\psi_s = 0.03$.

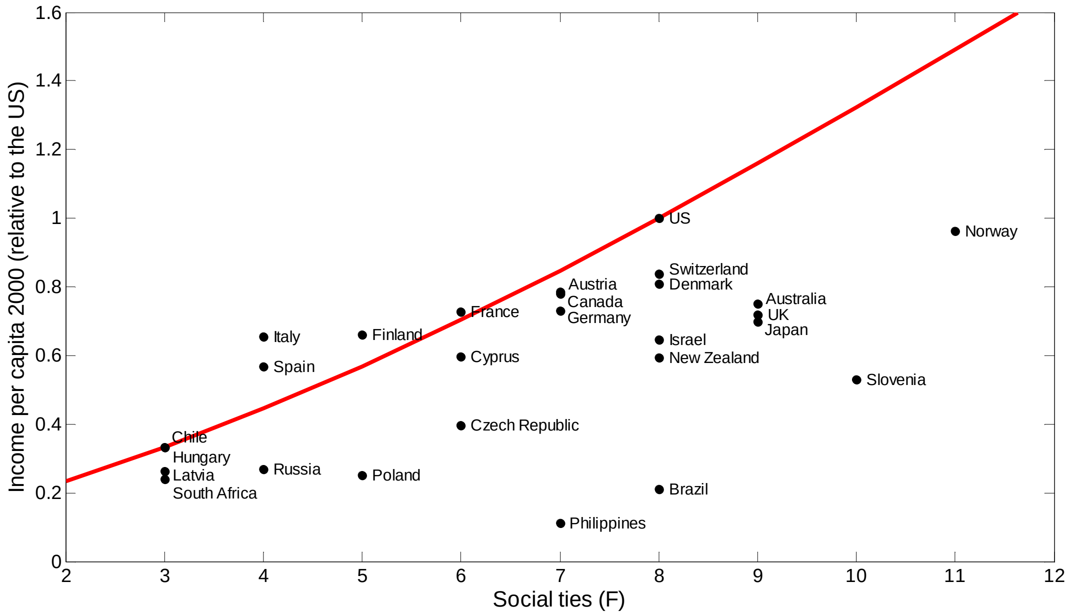

Figure 3: Social Ties and Income per Capita: Data (dots) and Model Prediction (solid line). The figure plots, for each country, the median number of close friends (source: International Social Survey Programme, 2001) versus the income per capita in the year 2000 (source: Penn World Table), normalized by the income per capita for the United States. In data, the correlation coefficient between number of ties and income per capita is 0.58, statistically significant at the 0.1% level. Data is provided in the Appendix.

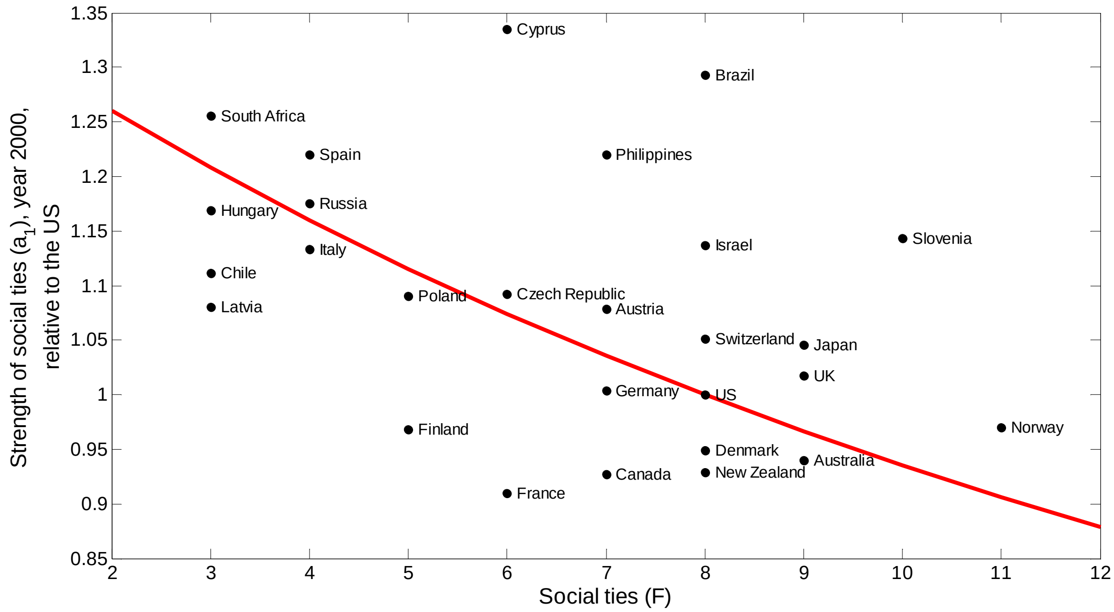

Figure 4: Number of Social Ties and Strength of Ties: Data (dots) and Model Prediction (solid line). The figure plots, for each country, the median number of close friends (source: International Social Survey Programme, 2001) versus the average strength of ties (same source). In data, the correlation coefficient between number and strength of ties is -0.30, statistically significant at the 10% level. Data is provided in the Appendix.

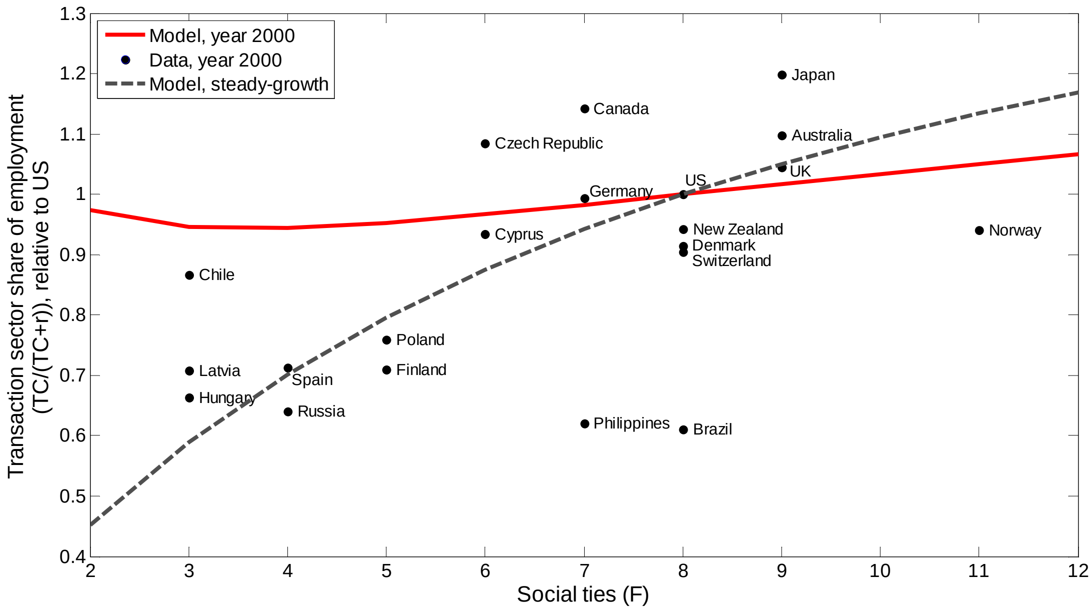

Figure 5: Social Ties and Share of Transaction Sector: Data and Model Prediction. The figure plots, for each country, the median number of close friends (source: International Social Survey Programme, 2001) versus the share of transaction sector employment in total employment (same source, using Wallis and North (1986) methodology). In data, the correlation coefficient between number of ties and share of transaction sector is 0.57, statistically significant at the 0.5% level. Data is provided in the Appendix.

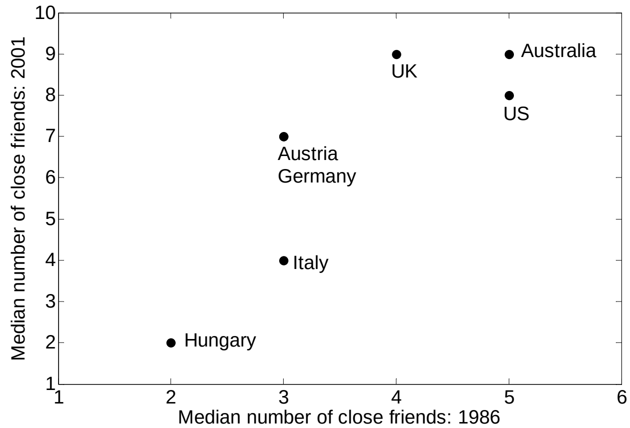

Figure 6: Time Variation in Social Ties. The figure plots, for each country, the median number of social ties in 1986 and 2001(source: International Social Survey Programme, 1986 and 2001).

Table 1: Data Used for Calibration (US, year 2000). The number of social ties comes from the International Social Survey Programme 2001 (ISSP 2001). Shares of time use constructed from Ramey and Francis (2009) and Robinson and Godbey (1997), and excludes time for sleep, personal care, and travel. Share of transformational effort, relative to transactional effort, constructed using employment data in ISSP 2001, using the classification of Wallis and North (1986). See Appendix for details. The estimate for steady-state growth corresponds to the average level of real per capita GDP growth for the US, for the period 2000-2007 (source: Penn World Table).

Description	Value
Number of social ties (F)	8
Share of transformational effort (r)	0.18
Share of transactional effort (TC)	0.11
Share of time in social activities (Fa_1)	0.12
Share of non-social leisure plus home work (a_0)	0.59
Steady-state annual growth rate ($(1+\psi_r r)^{1/20}-1$)	1.5%

Table 2: Calibration Summary. Shows the calibrated parameters using United States data.

Parameter	Value
α	1.00
ρ_s	0.50
β	0.16
ϕ	0.18
ψ_s	0.35
ψ_r	1.96
$B_{r,0}$	0.7
$B_{sc,0}$	4.2

Table 3: Sensitivity Analysis of Initial Productivities. Shows how the choice of initial productivities $B_{r,0}$ and $B_{sc,0}$ impacts several outputs of the model. r corresponds to the share of time dedicated to effort in the transformational sector; TC stands for the share of time dedicated to effort in the transaction sector. N.a. stands for not available. Data sources: Wallis and North (1986), Lucas (2002), Ramey and Francis (2009), and International Social Survey Programme 2001.

$B_{r,0}$	$B_{sc,0}$	GDP_{1990}/GDP_{1750}	r_{2000}	TC_{1700}	TC_{1900}	TC_{2000}
0.1	0.31	21.6	0.11	0.03	0.17	0.18
0.7	**4.2**	**21.6**	**0.15**	**0.09**	**0.15**	**0.14**
3	17.3	21.6	0.16	0.16	0.15	0.13
Data		21.6	0.18	n.a.	0.05	0.11

Table 4: Additional Comparisons of Model and Data. The table compares magnitudes observed in data with predictions of the model. IPC stands for income per capita and G for average annual growth rates in IPC. CV stands for coefficient of variation and captures the dispersion in IPC or G among countries/regions. Sources for data construction: Lucas (2002) and Ramey and Francis (2009).

Magnitude	Model	Data
Effort share of time, US 1900	0.29	0.30
Annual growth rate IPC 1900-1990, US	1.29%	1.70%
Annual growth rate IPC 1750-1900, US	1.28%	1.04%
$CV_{IPC,1990}/CV_{IPC,1750}$	2.30	4.05
$CV_{G,1900-1990}/CV_{G,1750-1900}$	0.79	0.44

Table 5: Steady-Growth Outcomes for Varying Levels of the Private-Good Component of Social Capital. We used the calibrated parameters from section 3 and solved numerically for steady-growth equilibrium outcomes in high- and low-social-ties economies in the extended model where social capital has a private good component (with weight of τ) and a public good component (with weight of $(1-\tau)$).

	$F=3$		$F=11$	
τ	a_1	Δ vs. $\tau=0$ (%)	a_1	Δ vs. $\tau=0$ (%)
0.0	0.0183	–	0.0136	–
0.2	0.0193	+5.5	0.0142	+4.4
0.5	0.0209	+14.2	0.0151	+11.0
0.8	0.0221	+20.8	0.0160	+17.7
1.0	0.0232	+26.8	0.0166	+22.1

Table 6: Data. Close friends and nuclear family correspond to medians, secondary associations corresponds to the average number of participated organizations. Strength of friends' ties corresponds to the frequency of visits to closest friend. Share of transaction sector corresponds to the employment share. See above for explanation of data construction. n.a. stands for not available. Sources: International Social Survey Programme 2001 and Penn World Table.

Country	Type of tie			Income per Capita (2000 US $'000)	Strength of friends' ties	Share of transaction sector
	Nuclear family	Close friends	Secondary associations			
United States	6	8	2.3	34.36	4.7	0.39
Norway	5	11	1.8	33.09	4.6	0.37
Switzerland	5	8	1.6	28.83	4.9	0.36
Denmark	5	8	2.1	27.83	4.5	0.36
Austria	5	7	1.4	27.00	5.1	n.a.
Canada	7	7	2.3	26.82	4.4	0.45
Australia	6	9	2.1	25.83	4.4	0.43
Germany	5	7	1.6	25.06	4.7	0.39
France	6	6	1.2	25.04	4.3	n.a.
United Kingdom	5	9	1.4	24.67	4.8	0.41
Japan	6	9	1.4	23.97	4.9	0.47
Finland	5	5	2.1	22.74	4.5	0.28
Italy	4	4	1.0	22.49	5.3	n.a.
Israel	6	8	1.1	22.24	5.3	n.a.
Cyprus	6	6	0.9	20.46	6.3	0.37
New Zealand	6	8	2.0	20.42	4.4	0.37
Spain	5	4	0.6	19.54	5.7	0.28
Slovenia	5	10	1.4	18.21	5.4	n.a.
Czech Republic	5	6	0.9	13.62	5.1	0.43
Chile	8	3	0.7	11.43	5.2	0.34
Hungary	5	3	0.4	11.38	5.5	0.26
Russia	5	4	0.4	9.26	5.5	0.25
Latvia	4	3	0.5	9.00	5.1	0.28
Poland	6	5	0.4	8.61	5.1	0.30
South Africa	6	3	1.7	8.23	5.9	n.a.
Brazil	7	8	0.7	7.19	6.1	0.24
Philippines	10	7	1.2	3.83	5.7	0.24
Correlations						
Friends	0.07	1	-	-	-	-
Sec. associations	0.06	0.56	1	-	-	-
Income per capita	-0.35	0.58	0.69	1	-	-
Strength of ties	0.19	-0.38	-0.64	-0.65	1	-
Transaction share	-0.11	0.57	0.59	0.68	-0.58	1