Inside the black box of social capital: micro-models of the value of contacts.

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Abstract

This paper attempts to look inside the black box of social capital by developing micro-models of the value of contacts, and then re-assess the empirical literature as to which sources of productive value are relevant in different stages of development. We identify 4 sources of the value of contacts: depreciation of indivisible intermediaries, economies of scale in information gathering, comparative advantage, and discount rates in the presence of indivisible intermediaries. We argue that economies of scale in information and the presence of discount rates are more relevant to the value of social contacts in developed economies while comparative advantage and depreciation are more likely to be important components of the value of contacts in developing economies.

1 Introduction

The literature on social capital is emerging as one of the new fields of economics. Two different things have been meant by social capital. One is a measure of contacts, termed the 'size of the rolodex' by Putnam (2000) and Glaeser et al. (2002). Another is the set of community ties and expectations that make contact-making itself easier and cheaper. This includes notions of trust, informal networks, and adherence to community norms (Bowles and gintis 2002; also Sobel 2002). The underpinning of both notions of social capital is that contacts have positive production effects. The main empirical 'fact' in this literature has indeed been that the number of contacts of an individual, firm, household, or village, has a strong positive effect on measures of output such as wages and an ability to absorb shocks (Grootaert et al. 2002; Maluccio et al. 2000; Westlund and Bolton 2003; Wilson 2000; Winn 2002). This 'prima facie' evidence is then used to advocate policies that strengthen social capital.

The purpose of this paper is to help connect the social capital development literature to micro-economics by looking at what underlies the usefulness of contacts in terms of basic production processes. By contacts I will invariably mean the coordination of output decisions: having K contacts will mean that K persons can instantaneously and costlessly coordinate what they produce. This means contacts incorporate the notion of input-output relations and worker-job matches. I start from a benchmark representative agent growth model (the Swan-Solow model and its modern counterparts) in which contacts play no role at all to see what deviations one can think of that lead to a value of contacts.

This leads to four basic production reasons for contacts to have productive value, including increasing returns to scale due to depreciating intermediaries (Section 2), economies of scale in information gathering (Section 3), comparative advantages (Section 4), and positive, but not extremely high, discount rates in the presence of indivisibilities (Section 5). Whilst economies of scale in information and comparative advantage have been well-recognised hitherto as reasons for individuals to coordinate output, we're not aware that the literature has so far recognised low positive discount rates and depreciation externalities as important reasons for output coordination. In these sections, I set up simple models of the value of contacts, and make some preliminary observations on their relevance for different countries and phases of development.

The recent empirical literature that has estimated the 'effect' of social capital is re-examined in Section 6. I take all the articles estimating the value of contacts or 'social capital' that appeared in the last 5 years in the Journal of Development Economics; ..., From each article we distill the reasons given for why contacts should causally lead to higher output (as measured in wage, wage growth, and consumption). As best as possible, the stated reasons are categorised into the found 4 basic production reasons for contacts to matter. The main result from that is that there does seem to be a basic difference between the productive value of contacts in various regions. By and large, in poor developing countries, contacts are associated with comparative advantages and depreciating intermediaries. In developed countries, the main benefit of contacts appears to be economies of scale in information gathering, and discount rates in the presence of indivisibilities (which subsume complementarities accross specialisations). The conclusions discuss how these found differences may lead to differentiated approach to social capital promotion.

1.1 Preamble

There are many different things meant by the term social capital in the current state of the social capital literature. This makes it hard to evaluate the supposed production benefit of social capital. Even in the papers using formal models, the benefits of social capital usually appears in reduced form. Glaeser et al. (2002) simply postulate an individual production function with contacts in it without going into the deeper reasons for why contacts may be useful. There are also endogenous growth models of development where social capital enters an economy-wide production function in a reduced-form way (see for example the working papers by Grafton et al (2004) or Frijters et al. (2003)). One thus gets to see a reduced-form production function

$$y = f(L, SC)$$

where L would be labour and SC would be contacts, and where $f'_{SC}(.) > 0$.

These models are essentially reduced-form because they suppress the interaction between agents that is supposed to lead to a value of contacts. From the perspective of representative agent macro-theory, such a role of contacts needs more micro-underpinning, if only to get a feel for whether there may be different policy issues arising in different circumstances. To get some handle on the problem, I start from the extreme opposite position of the Swan Solow model:

$$y = f(AL, K)$$

where K would be capital and A would be technology. Under the old Swan-Solow assumptions, A changes exogenously. In more modern versions, A is endogenous to prior investments in K (e.g. Acemoglu 2002 JEl on endogenous skill-biased change); moves stochastically (as in the Augmented Solow Model); is subject to shocks whose arrival rate is endogenous (as in the Neo-Shumpeterian models); or is a reduced-form function of macro variables (like in the growth regressions where things like R&D expenditure are plugged in). In each of these additions though, the strict self-consistent interpretation of this is a representative agent model in which the only real interaction between agents is via externalities on A or intertemporal trade in K.

In the stylised Swan-Solow world technology is diffused costlessly, and individual representative production units make a representative good combining labour and physical capital. There is no need for any interaction between agents in such an economy. Indeed, each productive unit simply is a separate economy moving on the optimal production frontier. Investment arises from own savings, which perfectly overlap with average savings and average investments. The notion of contacts and social capital is meaningless in such a model. No output coordination takes place between these representative agents. This model is an appropriate starting place to think about what underlying production phenomena would lead to a value of output coordination.

The first observation we make is that in order to have a value of output coordination we need to think about production of more than one good, where we include ‘knowledge’ as a good. What assumptions do we need to believe in if we’d want to have the same Swan-Solow model appear valid in a world with many different intermediate goods that are combined into a final good. In order for intermediaries to be unimportant to the representative agent abstraction of the Swan-Solow model, every production unit would have to be able to produce each intermediary good and without any inefficiencies occuring in doing so. In the case that one needs, say, N intermediary goods Z_N to make one unit of final output, then the representative agent model effectively presumes each production unit could efficiently make a small portion of each intermediary Z_n and combine those small portions into final output production in a constant-returns-to-scale manner. Each unit producing all intermediaries independently in small portions is then just as productive as units specialising in one intermediary and trading them with others. We can make a preliminary taxonomy of what the potential value could be of having contacts by simply thinking of the possible deviations of this benchmark:

1. Some indivisible intermediaries may be subject to constant depreciation, making it impossible to simultaneously produce many intermediaries as an individual unit, making output coordination profitable and thus contacts valuable. This partially underlies the productive aspect of public goods, whose production needs output coordination and thus contacts.

2. Having more contacts makes it possible to have faster technological progress when contacts allow one to avoid duplication of information gathering. Coordinating production, including the production of knowledge, then makes those with more contacts more likely to know more efficient way to produce from given inputs. This is the positive externality (public goods) aspect of knowledge.

3. There is heterogeneity in basic talents for making intermediaries, implying the existence of comparative advantages and a gains for trade leading to a value of having trading partners (contacts).

4. Some indivisible intermediaries may take an individual unit a long time to make, which leads to a long period of investment in intermediary production before an individual unit could combine all necessary intermediaries in final good production. The presence of discounting then gives rise to a benefit of output coordination and a value of contacts.

I attempt to show at various stages that these 4 simple basic production mechanisms subsume all the usually stated reasons for why contacts may have productive value at the level of an individual production unit. These include 'market access', 'insurance', 'network economies of scale', and cognitive limitations of individuals. I will introduce each of these 4 basic reasons in stylised examples so as to make these reasons as concrete as possible, after which the general principle embedded in the example is brought out.

1.2 Remark: network economies

A lot of recent attention has gone to the economies of scale inherent in networks (see Melecki 2000). The basic idea is that when K persons are connected, there are $K * (K - 1)$ possible combinations of bilateral trade. The opportunities for bilateral trade thus go up faster than linearly, leading to economies of scale in the network as a whole when the costs of a new contact are linear. Note though that this basic reasoning hides the reasons for why it is relevant that opportunities for bilateral trade would increase non-linearly. Simply stating the non-linear increase in opportunities is not sufficiently precise about the basic production processes giving rise to the advatange of having a network. It would for instance make no difference to have all these opportunities if there were no reasons to trade, i.e. if each person would be at the production frontier on his or her own (Robinson Crusoe economies). It is thus in the implicit background assumptions that the real network economies come in. A story often told is that when people are randomly allocated complementary goods, say nuts and bolts, then being able to trade with many others would more bring the nuts and bolts together than if trade was with only a few people. These are effectively thick-market externalities, such as introduced in Diamon (1982). They still presume some advantage of specialisation for otherwise individuals would simply make nuts and bolts themselves. In a standard competitive model, like the Swan-Solow model and its successors, none of these elements leading to network advantage arise. It's quite a leap from the standard competitive model in which units produce representative goods to have a world in which some allocator 'randomly' throws nuts and bolts around in the population. Hence network economies of scale arguments needs more basic mechanisms to connect them to basic micro.

2 Model 1: you dig, I pump

Consider for the sake of concreteness a deep mine that is troubled by an constant inflow of groundwater. It basically takes one person to mind the pump to keep the mine dry. The production in this mine should it have one labourer would thus be zero because the first labourer would have to be spent on minding the pump. The subsequent labourers however can then all dig in the mine, meaning that the average productivity of labour at the mine would be $\frac{(N-1)w}{N}$ where N is the number of labourers, and w the production of one digger per day.

Now, the essential component in this story is the fact that there is an indivisible intermediary good in this mine, called dryness, which is subject to depreciation. The actual production function of the mine would thus read

$$\begin{aligned} y_t &= z_t * (N_t - P_t) \\ z_t &= \min\{1, P_t\} \end{aligned}$$

where z_t is the intermediary good 'dryness' and P_t is the allocation of pumpers per period. More deeply, this example points to depreciation in intermediary production factors as a source of economies of scale. There are many more examples than just the case of a mine subject to flooding. Think of fitting new hoofs on a horse or lifting something heavy with more than 1 person. There too intermediate goods subject to depreciation are involved: the horse whose hoofs need cleaning walks away if not held; the thing that needs lifting would fall if it is not held at each of its corners by others. Arguably the most relevant examples of depreciating intermediaries are in agriculture: irrigation works and river damming need to be almost completely maintained if they are to be effective. This too is because an intermediary (dams and canals) depreciate. There are thus a myriad of cases where intermediate production goods (a docile horse; a thing lifted at all other corners, a dam, anything subject to outside forces) subject to depreciation cause increasing returns to scale which in turn leads to a value of contacts that allow production coordination. Many public goods have such an aspect to them, though we have not seen the importance of indivisible intermediaries subject to depreciation recognised as an important component of the value of output coordination in that literature..

3 Model 2: Information externalities

If one can gain information from contacts about optimal production methods, then this almost immediately implies a value of contacts in the situation that knowledge heterogeneity exist. A simple micro-model to illustrate this is the following:

blabla

4 Model 3: Comparative advantage

Suppose that there are M skills and individuals in the economy, and that person i has a comparative advantage in the production of skill i. These comparative advantages may come from the existence of heterogeneous innate abilities or some other initial endownment. This will mean that the productivity per time unit of i in skill i is 1 whereas the productivity per unit of time is only $0 < c < 1$ in all other skills. Let p_{ij} denote the level of consumption of person i of good j. Utility is presumed to be CES (later we also look at Cobb-Douglas):

$$\begin{aligned} U_i &= \sum_j p_{ij}^{\gamma} \\ with\ 0 &< \gamma < 1 \end{aligned}$$

Comparative advantage is for simplicity taken to be uniformly distributed over the whole population. Hence the 'prices' of each good in the case that everyone could trade with each other would all be the same.

Having contacts in this example would literally mean being able to trade the results of labour time.

Let us first consider the time allocation an individual i would choose in the absence of any contacts. It then holds that the time allocated to production (denoted as t_j) of goods j will be the same for all $j \neq i$. Taking good j=M$\neq i$

as the reference, Utility can then be written as

$$
\begin{aligned}
U_i &= (M-1)(ct_M)^\gamma + t_i^\gamma \\
T &= (M-1)t_M + t_i
\end{aligned}
$$

where T is the total time allocation each period. Solving the first-order condition and simplifying begets

$$
\begin{aligned}
t_M &= \frac{T}{(M-1+c^{\frac{\gamma}{\gamma-1}})} \\
t_i &= \frac{Tc^{\frac{\gamma}{\gamma-1}}}{(M-1+c^{\frac{\gamma}{\gamma-1}})} \\
U_i &= (M-1)\{\frac{cT}{(M-1+c^{\frac{\gamma}{\gamma-1}})}\}^\gamma + \{\frac{Tc^{\frac{\gamma}{\gamma-1}}}{(M-1+c^{\frac{\gamma}{\gamma-1}})}\}^\gamma
\end{aligned}
$$

If we use the prices that would arise in perfect competition as weights, then aggregate production in autarky (thus with only one contact) would be

$$
\pi(1) = (M-1)ct_M + t_i = T - \frac{(M-1)T(1-c)}{(M-1+c^{\frac{\gamma}{\gamma-1}})}
$$

If everyone is connected in this economy, then everyone would specialise completely in their field of comparative advantage and aggregate production would be T. Hence $\pi(M) = T$.

Consider now the case where $1 < m < M$ persons in this economy are connected and these m persons would agree to the social planner allocation of time and consumption. For notational convenience, suppose these m persons cover the first m out of M skills. It would firstly clearly be suboptimal if anyone would produce something in which one of the other (m-1) has a comparative advantage. Thus the optimal time allocation would be for each to spend the same amount of time t_i on their individual skill of comparative advantage, and to each spend t_M on all of the $(M - m)$ fields not covered by the group of m connected people. The utility of the representative person would thus be $U_i = m(\frac{t_i}{m})^\gamma + (M - m)\,(ct_M)^\gamma$. Solving for a maximum leads to

$$
\begin{aligned}
t_M &= \frac{T}{M - m + (M - m)^{\frac{1}{\gamma-1}} c^{\frac{\gamma}{\gamma-1}}} \\
t_i &= \frac{(M - m)^{\frac{1}{\gamma-1}} c^{\frac{\gamma}{\gamma-1}} T}{M - m + (M - m)^{\frac{1}{\gamma-1}} c^{\frac{\gamma}{\gamma-1}}} \\
\pi(m) &= (M - m)ct_M + t_i = T - \frac{(M - m)T(1 - c)}{M - m + (M - m)^{\frac{1}{\gamma-1}} c^{\frac{\gamma}{\gamma-1}}}
\end{aligned}
$$

The resulting function $\pi(m)$ is thus a micro-founded production function of the value of contacts arising due to comparative advantages. Although it looks a little cumbersome, it is quite well-behaved: it is convex and differentiable. This means that if the costs of making contacts is linear (which is the dominant presumption in the literature on contacts making: see Petrongolo and Pissarides 2001), there is going to be a unique optimum level of contacts persons would make in this economy.

4.1 Submodel 3.1 Cobb-douglas utility

Take a slight variation of the model above where $U_i = \prod_{j=1}^{M} p_{ij}^{\frac{1}{M}} = (\frac{T-(M-m)t_M}{m})^{\frac{m}{M}} (ct_M)^{\frac{M-m}{M}}$ i.e. utility is cobb-Douglas. Following the same train of argumentation as above, the resulting production function reads

$$
\begin{aligned}
t_M &= \frac{T}{M} \\
t_i &= \frac{mT}{M} \\
\pi(m) &= (M-m)ct_M + t_i = \frac{(M-m)cT}{M} + \frac{mT}{M} = T - \frac{(M-m)(1-c)T}{M}
\end{aligned}
$$

which is linearly increasing in m and would thus lead to knife-edge cases for the choice of the number of contacts with linear contact making costs.

4.2 Alternative interpretations of complementarities

It is important to realise that complementarities in production captures many different possibilities. Complementarities reflect different initial endowments in things people can profitable combine. This fits the notions of people having complementary skills, as modelled above. It also fits the possibility of individuals being uninformed in some sense: when individuals are for instance only capable of memorising a limited number of things then having contacts expands the total number of things that can be remembered for a connected group, with exactly the same property as skill complementarities.

We can go one step deeper and wonder what leads to skill complementarities in a world where everyone is born equal but where individuals can specialise in different fields. The key question in the back of ones mind is then why individuals don't learn every specialisation to a limited degree and then produce or why they don't learn every specialisation and then produce. One can venture that one must know almost everything about a field before one is truly capable of producing a specific intermediary (which itself reflects a complementarity in sub-sub knowledge) which would be a reason why individuals don't learn everything to a limited degree but learn specialisations. Without discount rates however, individuals would even then simply first learn everything there is to know and then produce. The presence of discount rates breaks this argument. It is the combination of an indivisibility of knowledge and discount rates that leads to endogenous specialisation and thus ultimately leads to skill complementarities. This argument is formalised in the next subsection. Note though that complementarities may exist even without initial differential education investments: individuals can be differently endowed with talents and production factors because of genetics, geography, history, and many other reasons unconnected to own time investments.

5 Model 4: discount rates and indivisible intermediaries.

This examples explores the pin factory example in Adam Smith's 1778 book the Wealth of Nations. Adam Smith observed that a pin factory using a sophisticated machine could produce far more pins per worker than any individual worker could achieve. He argued there were thus economies of scale in mechanisation. We're going to delve into that example somewhat deeper because the existence of machinery per se (an intermediary complementary to labour) does not give rise to economies of scale. An individual could namely simply first make a machine and then produce with that machine. One could postulate that a worker does not have the knowledge to make a pin-making machine, which would imply the economies of scale in machinery are related to comparative advantage or the economies of scale in information discussed above. We will explore whether there is another economies of scale argument associated with the pin factory example, in the absence of comparative advantages, information economies of scale, or even depreciation.

Suppose the production of a good, say pins, has two possible technologies. Technology A is without intermediary goods, where a labourer spends his whole day making pins using simple technologies. Suppose a labourer can then make A pins per unit time.

Pin-making technology B requires the construction of a machine, which takes T units of labour time to make. This means that a machine can be made by a single labourer in T periods of time, or by T labourers in 1 unit of time: the making of the machine is a constant-return to scale exercise and no-one has a comparative advantage in making machines. That machine then instantaneously produces P pins after which it is a write-off and a new machine has to be made. In order to avoid uninteresting cases, we assume that $TA < P$ which means one can make more pins using the second technology with the same amount of total inputs (which is T units of labour time) than with the first technology.

Now, suppose there are K>1 infinitely lived homogeneous labourers in this world and that the discount rate is $\rho > 0$.

We look at three possible ways of organising this economy, which will cover all the efficient combinations in all states of this world.

Case 1: if technology A is followed by all workers, then the total discounted value of this pin economy equals $W_1(\rho) = \frac{KA}{\rho}$.

Case 2: if technology B is followed by all workers individually (without coordination), then the total discounted value of this pin economy equals

$$W_2(\rho) = K \sum_{t=1}^{\infty} \frac{p_t}{(1+\rho)^t}$$

where p_t is the production of pins in period t. Now, the optimal way for an individual to allocate time is an optimal control problem with a very simple solution: first the labourer will spend T periods on making the machine, then spend one period on making pins with the machine, then another T periods making the new machine, etc. Hence, $p_t = P$ if $\frac{t}{T}$ is an integer and $p_t = 0$ otherwise. The worth of the economy is then

$$W_2(\rho) = K \sum_{j=1}^{\infty} \frac{P}{(1+\rho)^{jT}} = \frac{KP}{(1+\rho)^T} * \frac{(1+\rho)^T}{(1+\rho)^T - 1}$$

Case 3: if technology B is followed by all workers under coordination, then the optimal plan would be to have all K workers work on making one machine simultaneously. After that one machine is made, they work on another one. The worth of the economy is then

$$W_3(\rho) = \sum_{j=1}^{\infty} \frac{P}{(1+\rho)^{j\frac{T}{K}}} = \frac{P}{(1+\rho)^{\frac{T}{K}}} * \frac{(1+\rho)^{\frac{T}{K}}}{(1+\rho)^{\frac{T}{K}}-1}$$

$$K\frac{(1+\rho)^{\frac{T}{K}}}{(1+\rho)^T}\left(\frac{\frac{(1+\rho)^T}{(1+\rho)^T-1}}{\frac{(1+\rho)^{\frac{T}{K}}}{(1+\rho)^{\frac{T}{K}}-1}}\right) = \frac{1-\frac{1}{(1+\rho)^{\frac{T}{K}}}}{1-\frac{1}{(1+\rho)^T}}$$

Now, the following proposition follows fairly directly:

Proposition 1: (i) When $\rho \downarrow 0$, then $\frac{W_2}{W_3}$ goes to 1. (ii) With $\rho > 0$, $\frac{W_2}{W_3} < 1$. (iii) When $\rho > \bar{\rho}$ then $\frac{W_2}{W_1} < 1$ and else $\frac{W_2}{W_1} > 1$ where $\bar{\rho}$ solves $\frac{\rho}{(1+\rho)^T}\left(\frac{1}{1-(1+\rho)^T}\right) = \frac{A}{P}$. (iv) When $\rho > \breve{\rho} > \bar{\rho}$ then $\frac{W_3}{W_1} < 1$ and else $\frac{W_3}{W_1} > 1$ where $\breve{\rho}$ solves $\frac{\rho}{(1+\rho)^{\frac{T}{K}}} * \frac{(1+\rho)^{\frac{T}{K}}}{(1+\rho)^{\frac{T}{K}}-1} = \frac{KA}{P}$.

Proof: for (i) we can note that $\lim_{\rho\downarrow 0} \frac{W_2}{W_3} = \lim_{\rho\downarrow 0} K\frac{(1+\rho)^{\frac{T}{K}}}{(1+\rho)^T}\left(\frac{\frac{(1+\rho)^T}{(1+\rho)^T-1}}{\frac{(1+\rho)^{\frac{T}{K}}}{(1+\rho)^{\frac{T}{K}}-1}}\right) = \lim_{\rho\downarrow 0}\left(K\frac{1-\frac{1}{(1+\rho)^{\frac{T}{K}}}}{1-\frac{1}{(1+\rho)^T}}\right)$. Using l'Hopitals rule then begets our result. For (ii) we can see that W_2 is more concave than W_3 which together with initial condition proves (ii). What we need to do for (iii) is note that W_2 is more concave than $W_1 : \frac{W_2''}{W_2'} < \frac{W_1''}{W_1'}$ which means they can at most have one intersection. Together with the condition that $W_1(0) < W_2(0)$ and $W_1(\infty) > W_2(\infty)$ this proves (iii). The same argument for W_3 implies that W_3 and W_1 have one intersection, which together with (ii) begets (iv).

The interpretation of this result is that in the presence of a very high discount rate (higher than $\breve{\rho}$), it is inefficient to specialise at all and autarky emerges where all use Technology A. As soon as $\rho < \breve{\rho}$ then full coordination will take place where all will use technology B. The key thing to bear in mind here is that the supposed economies of scale of all coordinating on building a pin machine only materialise if there is a positive low discount rate, and do not require comparative advantages or increasing returns to scale in any basic production technology. An empirical implication of this is that the advantages of output coordination go up with moderate discount rates (because $\frac{W_2}{W_3}$ is decreasing in ρ). If there are no discount rates at all, i.e. when $\rho = 0$, then individuals are just as well off in autarky (first making machines, then producing) as when they fully coordinate with others.

Now, how relevant is the issue raised above going to be? The theory above would seem to have very wide applicability because the situation that an indivisible intermediary good (in this case the pin machine) only becomes productive once it is complete, would seem to hold for virtually any piece of machinery or intermediate production factor. Think of advertising: the add is only productive when it is finished. Think of transport: half-way is not really there. Think of consultancy: half an advice is no advice. Think of trade negotiations: having negotiated half a deal still means no final deal and hence all else is still on hold; etc. In all these cases, the fact that the intermediary is useless until complete means that economies of scale emerge that have nothing to do with comparative advantage or information, but with discount rates. Hence the organisation of all industries that use these intermediaries is affected by discount rates which, paradoxically, should be positive but not extremely high because then technologies which by-pass any intermediary become more attractive. This incidentally also gives a reason for the break-down in specialisation in historical periods with extremely high discount rates, such as periods of hyper-inflation.

The implication for theory for this model is mixed: the above story would be a basic reason for specialisation, but the basic factors underlying them do not as yet seem to provide a handy 'building block' for larger theories: terms with $\frac{P}{(1+\rho)^{\frac{T}{K}}} * \frac{(1+\rho)^{\frac{T}{K}}}{(1+\rho)^{\frac{T}{K}}-1}$ in them hardly make for simple closed-form solutions of the kinds preferred in theories of trade, specialisation, etc.

What we thus advocate as a conclusion is that the argument above be used as a 'background micro-story' for why specialisation and output coordination can be production enhancing. This means they can be used as support for theories of the firm (i.e. its a manager's job to coordinate random labourers into pin-machine makers), the theory of contact formation amongst homogeneous agents (the more contacts any labourer has with any other, the more he can engage in temporary coordination of the production of intermediaries and thus the more productive he is). We can for instance write the average productivity of a person who coordinates with K other labourers as

$$W(\rho, K) \equiv \frac{W_3(\rho)}{K} = \sum_{j=1}^{\infty} \frac{P}{K(1+\rho)^{j\frac{T}{K}}}$$

which is increasing and convex in K, meaning that the above is a micro-founded production function where the number of contacts of a person appears as a positive argument. One can extend this implication by noting that in the limit of high T, we get an aggregate production function that looks like

$$\lim_{T\to\infty} W(\rho, \frac{K}{T}) = \frac{KP}{\rho T(K+\rho T)}$$

which is thus a linear function of K for low K, tending to a constant $\frac{P}{\rho T}$ for high K (when K is of the same order as T). If we relate this productivity to the productivity of a person working alone (when K is 1), then the ratio of production with K (very high) co-workers to no co-workers tends to ρT which is thus the gain from cooperation.

5.1 Example of several basic reasons combined: complementarities in production due to the arrival of random orders.

Suppose that skills are defined on a continuum [0,1], that individuals only possess one skill in which their productivity is 1 per unit of time, and that the set of skills a representative firm i possesses is denotes by S_i. Suppose further that a firm can search directedly for skills in the population of potential workers, and that it thus can choose S_i subject to its choice of its number of workers K. Suppose now further that each period the firm receives an order to produce, and that the value of production this firm can offer decreases quadratically in the degree to which it can offer the skill required:

$$\pi = \max_{\theta \in S_i}(1 - c(O-\theta)^2)$$

one can see the loss-function $c(O-\theta)^2$ as the number of mistakes that will be made in production if a skill mismatch occurs, or have some similar story about the importance of a correct match.

The problem of optimal spacing of θ in the case of such a cost-function has been addressed previously in the literature (e.g. Van Praag and Kapteyn 1973: the allocation is the same for any concave loss function). If we number the skills in increasing order then a firm will opt to equally space its skill: $\theta_k = \frac{2k-1}{2K}$ with $k = 1, .., K$. Expected production is then equal to

$$\pi(K) = 1 - c2K \int_0^{2K} x^2 dx = 1 - \frac{c}{12} K^{-2}$$

which is again convex in K and would thus, in the presence of constant search costs of extra contacts, lead to a unique level of productive contacts a firm would consist of. If one would interpret this cooperative not as a firm but as a village, a section, or a network of friends, then the production function above gives the aggregate production for that network size.

Note that the idea that individuals only possess one skill rather than have them all needs a more basic productive reason. One such basic reason that an individuals lives a finite life and that learning all specialisations requires more than a life-time. This is at a deeper level an example of the fact that a specialisation is indivisible (a fixed minimum amount of knowledge is needed to be a specialist) but that there is discounting, if only due to death. The value of combining specialists is thus fundamentally due to indivisibilities combined with discounting.

6 Revisiting the empirical literature on the value of contacts and social capital

This section revisits all the empirical papers published since Januari 1st 2000 in four development journals that have tried to empirically estimate the importance of contacts or social capital. The journals consulted are the Journal of Development Economics, the Journal of Comparative Economics, Economic Development and Cultural Change, and World Development. In total, 44 papers were found, of which 31 related to developing countries (Africa, Latin America, and Asia) and 13 to middle-income and developed countries. 22 papers included regression estimates of a reduced-form equation linking some output measure (wages, village production, GDP, consumption) to a set of variables including some measure of contacts or contact-improving 'social capital' (trust, community norm, institutions). Nearly all these papers find both contacts and the factors making the formation and maintainance of contacts easier to be beneficial for the output measure at hand. What is of main interest here is the explicit or implicit production reasons cited in those papers for the found link.

One of the main issues involved in interpreting these previous papers is how to map statements of a particular paper into the 4 basic production mechanisms examined above. Individual papers often give very reduced-form arguments for why contacts should be relevant. The main two ones are 'access to markets and capital', and 'the ability to pool risks'. These arguments are reduced-form and we thus need to unpack them to see how they relate to basic production processes. As a preliminary to re-interpreting the existing literature, we thus first need to examine what underlies the value of 'market access' and 'risk-pooling'.

6.1 How does risk-pooling fit in?

Consider the usual argument for why risk-pooling would be beneficial: risk-aversion supposedly leads to a consumption benefit of being able to pool output accross production units subjects to ideosyncratic shocks. Whilst this is undoubtedly true in very many situations, it does not directly imply there is a link between the average level of output itself and the ability to pool risks. An effect on output needs a behavioural effect of having risks. One can argue that in the absence of risk-pooling mechanisms individual production units would opt for sub-optimal production techniques that have lower expected output but also lower variance. A variant of this argument is that individuals need a minimum amount of calories to be functional, and that a period of particularly low production will lower productive capacity in further periods due to body decay. Note how both these argument relate to the basic mechanisms we already described. The argument that body decay leads to lock-in of a particularly low-productive year hinges on an intermediary (a body) that depreciates and thus leads to a benefit of production coordination. There is thus a link between indivisibilities and risk-pooling when it concerns the production benefits from having contacts.

We will interpret the risk-pooling advantage of contacts (which arises mainly in rural development settings) as belonging to the depreciating intermediary variety.

When one thinks of what behaviour may be distorted by uninsured risks, one can think of farmers choosing subsistence agriculture versus cash-crop agriculture. Such behavioural responses only seem logical however in a one-period situation. In a longer perspective, one would think the opportunity for self-insurance should arise, allowing an individual to escape the need to have outside contacts for insurance. What prevents this in practise could be the inability of an individual to store output or other reasons for abnormally low returns on savings. It may also be due to the fact that there are other returns of scale in alternative higher-yield production methods preventing an individual from changing production modes. Those reasons are not really innate to risk-aversion or risk-pooling at all though, but relate to returns of scale present in storage devices and financial systems. Those economies of scale in turn may lead to a value of coordination and thus of contacts. Hence the argument on relative risks is often a reduced-form argument that hinge on economies of scale elsewhere.

6.2 How does 'access to markets' fit in?

What basic production processes make access to markets relevant? Here, we can be very direct: access to a market is in essence no different than having contacts. What happens on a market is the trade of time and production of different individuals and is thus an indirect means of production coordination.

Having market access is thus simply equivalent to having a set of contacts. By implications, all the basic production processes visited above are also relevant as reasons for why 'market access' is important. Seen in this light, statements like 'via migrant family members, village X has access to the transport market of the main cities', would be re-interpreted as 'the spacial contacts of the villagers allow them to take advantage of indivisibilities in transport combined with discount rates'. What is of relevance here is that without having access to the transport facilities of others, a village would have to buy or make an indivisible transport devise itself, which in turn would only be used infrequently due to the limited output of the individual village implying that discounting will make this option less favourable than being able to infrequently hire a transport devise. In a like manner, one can recast many statements about the presumed advantages of contacts into our four basic mechanisms.

6.3 Categorising the found advantages of social capital in the literature

blabla

7 Conclusions

This paper had the modest goal of exploring the underlying productive advantage of having contacts, understood as the ability to coordinate production. It was shown that the value of output coordination is made up of some reasons well-known in micro-theory (comparative advantage, and economies of scale in information gathering) but that there are also less obvious reasons (depreciating intermediaries; discount rates when intermediaries are indivisible) that lead to a value of output coordination. In each of these 4 cases, we have shown that one can derive a resulting production function that is (quasi-)convex in the number of contacts, implying unique levels of contacts when the costs of making contacts is linear. We advocate these micro-stories as basic building blocks of more elaborate theories of social capital.

I then re-visited the recent published development literature that has documented production benefits of having contacts in various developing and developed countries. I tried to assign the reasons the authors of 44 recent papers gave for their results into the four different basic production circumstances that give rise to the value of contacts.

One can wonder whether we should see any systematic difference in the production role of contacts in different countries. If we reflect on the importance of the 4 different sources of contact value in differences countries, I'd argue that more developed countries have more specialised productive units (individuals and firms) than less developed countries. More developed countries already have taken up many opportunities for the use of comparative advantage and economies of scale, whereas those factors would still seem to be important sources of growth in less developed countries. The issue of discounting and the existence of many specialised intermediaries that need to be linked seem the more relevant micro-stories of contact value to think of for developed countries.

These latter sources of contact value seem to need different institutions than economies of scale and comparative advantage would seem to call for. Efficiently linking many specialised intermediaries would seem to call for minimising volatility and maximising mass-available specialised information. Taking advantage of economies of scale and comparative advantages would seem to call for streightforward reductions in internal and external trade barriers. Thinking harder about the underlying micro-sources of the value of contacts in different stages of development may thus well lead to a differentiated social capital research agenda.

References.

1. Bowles, S., Gintis, H. (2002), 'Social capital and community governance', *The Economic Journal* 112, F419-36.

2. Diamond, P. (1982), 'Aggregate Demand in Search Equilibrium', *Journal of Political Economy* 90, 881-94.

3. Frijters, P., D Bezemer, U Dulleck (2003) 'Contacts, Social Capital and Market Institutions - A Theory of Development. University of Vienna Working Paper 0311

4. Glaeser, E.L., Laibson, D., Sacerdoter, B. (2002), 'An economic approach to social capital', The Economic Journal 112, F437-58.

5. Grafton, Q.R., Kompas, T., and Owen, D. (2004). "Productivity, Factor Accumulation and Social Networks: Theory and Evidence," Economics

and Environment Network Working Papers 0401, Australian National University, Economics and Environment Network.

6. Grootaert, C, G-T Oh and A Swamy (2002) Social Capital, Household Welfare and Poverty in Burkina Faso. Journal of African Economies 11 (1). p 4-38.

7. Malecki, E. (2000) Network Models for Technology-Based Growth. In: Acz, Z. (ed.) Regional Innovation, Knowledge and Global Change. London: Pinter

8. Maluccio, J, L Haddad and J. May (2000) Social Capital and Household Welfare in South Africa, 1993-98. The Journal of Development Studies. Vol. 36 (6). p 54-81

9. Petrongolo, B. and C. Pissarides (2001),'Looking into the Black Box: A Survey of the Matching Function', *Journal of Economic Literature* 39, 390-431.

10. Putnam, Robert (2000), *Bowling alone: the collapse and rivival of American community*, NY: Simon and Schuster.

11. Routledge, B and Von Amsberg, J (2003) Social Capital and Growth. Journal of Monetary Economics. Vol. 50 (1). P 167-93

12. Sobel, J (2002), 'Can we trust social capital', Journal of Economic Literature 40, pp. 139-54.

13. Westlund, H and R Bolton (2003) Local Social Capital and Entrepreneurship. Small Business Economics. Vol. 21 (2). p 77-113

14. Wilson, P (2000) Social Capital, Trust, and the Agribusiness of Economics. Journal of Agricultural & Resource Economics. Vol. 25 (1). p 1-13. July 2000.

15. Winn, J (2002) Social Networks and Electronic Commerce in China. Global Economic Review 31 (2). p 21-34