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Informal Risk-Sharing and Poverty Persistence[1]

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1. Introduction

An old intuition suggests that poverty may perpetuate itself due to mild risk taking. Risk-averse individuals remain in poverty while their more daring peers escape by means of high-return, high-risk activities. As a growing literature increasingly highlights the role of insurance as a trigger for income-enhancing choices, several implications arise – informal risk-sharing agreements have found new attention, private microfinance and micro-insurance products have been promoted, and also public funds have been called to provide the poor with safety nets and thus encourage them into more entrepreneurial choices.

However, the evidence thus far has consistently pointed out the limits of these insurance mechanisms. In the case of informal risk-sharing, its inability to cope with village-level shocks is well recognised. Furthermore, these arrangements may fail if partakers are not sufficiently similar in at least a few certain characteristics, i.e. each individual may need to bear in mind that certain choices are banned for her, unless she is willing to relinquish the protection provided by the arrangement.

In this sense, when the activity promising enough earnings to escape poverty is at odds with those network requirements, the risk-sharing arrangement may become a poverty trap. The model in this paper depicts an instance of this scenario. Here, some members take the risk and leave, while others stay behind. The ability of the network to retain at least some of its members (and trap them into the low-earnings choice) will depend crucially on its initial size and on the initial distribution of income (human capital) among partakers. The model thus sheds light on the conditions under which the network collapses.

At any rate, the literature has already made a cogent case for public resources to be devoted to the promotion of insurance products, either directly or through market-driven mechanisms. The paper is in keeping with this view. A planner intending to attract workers into better-paid (but say, distant, lonely) jobs will need to look into the safety nets potential employees will be hoping for. However, the model also suggests that, in some cases, a budget-constrained government should refrain from intervening – one by one, individuals will drift away from the network and migrate to the higher-earnings activity. Thus, public funds should not be necessarily allocated to promote the highest-earnings activities, but to those competing with a too big, too strong risk-sharing network.

While the model accommodates other interpretations, it can be useful to think initially of the choice between staying in the friendly rural village and venturing out into an anonymous, lonely life in the big city, where earnings are however expected to be significantly higher. Some individuals will then dread life away from their home village, since they know no peer support will come to the rescue if misfortune strikes. Importantly, individuals are all identical, except for their human capital, which is exogenous to them, time-invariant, and observable to all others in the network. In particular, they are all equally risk-averse. Thus, those who remain in poverty are not too fearful, but just as risk-averse as the rich. Should a poverty trap exist, its rationale will lie elsewhere, namely on the distribution of human capital endowments and the initial network size. The existence of a poverty trap will depend on large enough networks and, also, on initial distributions where the poverty headcount is too high. In this sense, our result is at odds with the attention which has been paid to the advantages derived from social cohesion and reciprocal trust.

Section 2 surveys the literature on a number of issues closely related to our main arguments. Section 3 presents the model and its implications, and section 4 provides a particular example as an illustration. Section 5 concludes.

2. Review of the literature

2.1. Informal risk-sharing

A wealth of empirical evidence supports the existence of informal risk-sharing arrangements among the poor of several developing countries. Unable to buy formal insurance, the poor help each other in the face of negative shocks. In the same line as Townsend (1994), who found household consumption in India not to depend on household income, but on village-level aggregate income, others have tested risk-sharing elsewhere, e.g. Dercon and Krishnan (2000, 2003), who focus on Ethiopia. Further empirical work has pinned down the channels through which, when shocks occur, fortunate households deliver help to the unfortunate (Fafchamps and Lund 2003).

The evidence is also robust on the inability of such arrangements to provide perfect insurance (Morduch 1999, Dercon 2005), so that network members are shielded to some extent from some shocks, but cannot fully escape exposure to risk. For instance, risk-sharing is no help when all members simultaneously suffer a negative shock. As Sen (1983) stressed in his path-breaking work on famines, covariant risks entail scenarios where no member is in a position to help the rest, so that all will have no choice but asset depletion, which will be all the more detrimental because asset markets will flood and prices will plunge.

Analytical models have also been advanced to pinpoint the conditions allowing risk-sharing agreements to thrive or, to the contrary, limiting their scope or forcing them to close down. In particular, to account for their inability to provide full insurance, models usually invoked imperfect enforcement *ex-post*. In this case, incentive compatibility constraints are in place to exclude scenarios where the fortunate refuse to help the needy (Genicot and Ray 2003). Forward-looking members thus restrict the set of acceptable agreements, with the number of network members, the degree of risk aversion and risk exposure levels as the chief determinants of network stability (Kimball 1988, Attanasio and Rios-Rull 2000, Ligon, Thomas and Worrall 2002).

Other approaches to the limits of informal risk-sharing agreements need not assume away perfect enforcement. In Fafchamps (1992, 2005), heterogeneities among network members cause the arrangement to evolve into some form of patronage, whereby the rich formally insure the poor. In Hoff and Sen (2006), agreements are allowed to rely on perfect enforcement, but still, they may collapse as market interactions between members and non-members turn intricate and provide some of the former with an incentive to break away from their group.

Heterogeneity among members (as in Fafchamps) and interactions with non-members (as in Hoff and Sen) thus underlie a further limitation of informal risk-sharing – it needs partakers to be similar and close enough to each other. Hence, risk-sharing networks may outcast those who move too far away from other partakers or choose an occupation with little interaction with them. If links with non-members become stronger than the bond with the own folk, the agreement is in peril. Likewise, some choice or attitude of the individual may alienate her in the face of her usual peers, who will refuse to share their risks with her.

All throughout, both the empirical and the theoretical veins of this literature are motivated by the view of risk sharing as a safety net for the poor. Thus, they are concerned with the *ex-post* impact of a strike of misfortune (e.g., a loss in family wealth, due to a flood or a theft), which may become a long-lasting impact if multiple equilibria exist and the one-off shock forces households into the low long-run equilibrium basin, e.g. if that drop in wealth discourages further investment in the education of their offspring, say due to higher interest rates (Galor and Zeira 1993) or to impatience to save (Ljundqvist 1993). Empirical work has frequently found that shocks can indeed have such lingering effects, both on physical and human capital (Dercon 2004, Jacoby and Skoufias 1997). Uninsured households may fail to rebuild the assets they deplete in the wake of a shock.

Furthermore, the literature also stresses that lack of insurance exhibits perverse *ex-ante* effects, which remain at work even if no negative shock ever materialises *ex-post*. Namely, in the face of a risky project with high expected returns, poor risk-averse households may fail to seize their opportunity and escape poverty. Kihlstrom and Laffont (1979) formalised this long-standing intuition, even though the main intuition was already present in Stiglitz (1969) and Sandmo (1971).

In this view, the long-run poor differ from the rich because of their greater exposure to risks (the poor are too vulnerable) or, otherwise, because of their greater risk aversion (the poor are too fearful). Either way, safety nets and insurance are consequently envisaged as triggers for entrepreneurship. For instance, Eswaran and Kotwal (1989) and Morduch (1994) obtain poverty persistence results by assuming that the poor have restricted access to consumption credit and thus cannot borrow if their investment fails. Similarly, in Townsend and Ueda (2001), poverty results from failure to meet the entry cost into a financial system which brings all individual investments into one melting pot and pays a fixed return on deposits – the initially poor thus invest little and remain poor.

Other examples abound in the theoretical literature. As for the relevance of this view as a guide for policy seeking to provide the poor with insurance, either formally or by preserving their informal arrangements, take the World Bank's 2000/1 World Development Report, which invokes growth-enhancement as a strong argument for social protection spending, and thus goes beyond the intention to preserve *ex-post* living conditions when hardship strikes.

2.2. Income distribution and activity choices

This paper also links up with the literature on the relation between poverty persistence and occupational choices. Models have explicitly allowed some activity choices to be unproductive, and even harmful to productive efforts of other agents (e.g. Sah and Stiglitz 1989, Murphy, Shleifer and Vishny 1993, Acemoglu 1995). However, no such perverse structures are necessary features of an economy where stable low-equilibria can arise.

In Banerjee and Newman (1993), the choice set for individuals includes only entrepreneurship, self-employment, employment and subsistence. Activities are chosen on the grounds of alternative returns and their wealth – in turn, returns are determined by aggregate supply for each activity. The initial wealth distribution will thus matter to these individual choices and, likewise, individual decisions will shape both individual and aggregate steady-states. Multiple equilibria arise for suitable conditions.

Whenever multiple long-run equilibria exist, other models also suggest that the initial distribution of income plays a crucial role in the selection of the particular equilibrium which the economy will head for. Focusing on occupational choices and credit market failures, Banerjee and Newman (1994) expose financial intermediaries to the risk of failing to detect reneging borrowers. The cost of this uncertainty ultimately hits the individuals with lower initial wealth – below a critical wealth level, credit will be restricted, since the threat of losing everything is on its own not enough to deter risk-neutral borrowers from defaulting. The initial wealth distribution will thus determine long-term equilibria.

A number of papers have followed in this vein (Legros and Newman 1996, Ghatak, Morelli and Sjöström 2001, and Ghatak and Nien-Huei 2002). Of particular interest to us are Banerjee and Newman (1998), who allow occupational changes to require a change in physical location. Since a migrant loses contact with his previous peers and becomes a newcomer among his new neighbours, she lands in an environment fraught with information asymmetries. Rather than suffering the consequences of a malfunctioning credit market, some of the poor may prefer not to migrate, even at the cost of forgoing higher earnings.

In fact, the credit market is the usual instance of an exchange mechanism where entry is not guaranteed to newcomers. This intuition is reminiscent of Hoff and Sen (2006), where the choice for a more profitable activity comes at the cost of losing previous network links and toiling to enter new groups. In such settings, the initial wealth distribution is allowed to drive long-run results by determining who (how many) will be willing to take the risk.

3. The model

We recall the main argument. The opportunity to raise expected consumption may crop up outside the network, so that the way out of poverty jeopardises initial risk sharing requirements. Thus, under some conditions, networks and the protection they offer may deter individuals from grabbing their chance. For this trap to result, the risk-sharing arrangement must not collapse, which will critically depend on the initial distribution of human capital among the partakers, as well as on their initial number.

3.1. Basic setup

n individuals are members of a network, with $n>1$. Each uses her human capital, $y_i>0$, to produce a non-storable good s which she later will either consume or share with her network partners. Heterogeneity lies in the distribution of human capital across individuals, who are otherwise identical. For each individual, y_i is her only asset and is risk-free, time-invariant, and observable to all other individuals. Let $F(y)$ denote the initial distribution function of y.

Two occupations exist, V and C, each defined by a production function where both human skills and sheer luck play a role. In activity V, $s_i=y_i+e_i$, where e_i is a shock on the ability (productivity) of human capital y to produce s. In activity C, $s_i = wy_i + e_i$, with $w>1$. Shocks are idiosyncratic and independent over time, i.e. $\text{cov}(e_i, e_j)=0$, for $i \neq j$, and $\text{cov}(e_{i,t}, e_{j,t+\kappa})=0$ for $\kappa \neq 0$. For convenience, assume them to be drawn from a normal distribution, with mean $\mu=0$ and variance σ^2.

Preferences are described by CARA utility functions $U(x_i) = -e^{-Ax_i}$, where x stands for consumption and A measures absolute risk aversion. These preferences will allow the model to depart from the view of those remaining in poverty as too risk averse, i.e. here risk aversion is not allowed to decrease in consumption, so that the rich fear shocks as much as the poor do. In this model, those who will be finally trapped in a low-consumption equilibrium will be as fearless as those reaching higher outcomes – their poor performance will be related to some other reason, chiefly the initial network size and the initial distribution of y_i.

Henceforth, we will sloppily use poverty as tantamount for 'low consumption', with no reference to a specific poverty line. Broadly speaking, the poor will be those who invest their little human capital into the low return activity. Further on, poverty lines will be defined more formally.

3.2. Risk-sharing and credit

Risk is fully shared within the n-member network. We thus may imagine the network as a group of village dwellers who know and trust each other perfectly. In particular, shocks are public knowledge, so that each member knows how fortune treats all others, i.e. e_i for all i. Formally, this implies that perfect enforcement is in place, so that risk-sharing is not constrained by fears that, *ex-post*, a lucky member may refuse to help out the needy.

To begin with, imagine this tightly-knitted social fabric is sustainable by virtue of a code whereby leavers are stigmatised as untrustworthy and fall into anonymity, as in Kranton (1996). By the same token, outside agents are not allowed to join the network.[3]

Given human capital endowments, note there is no reason for intertemporal transfers between any two individuals. Given y_i and given no expectation of a change in w, expected income is time-invariant for individual i, so that no smoothing over time occurs.[4] Finally, since leavers are not trustworthy, credit for them is simply unfeasible. With no access to either credit or

[3] In her empirical study, Das Gupta (1987) finds that "the crucial point about these rights is that only those who are recognised members of the village have them. The rights accrue by birth as a member of the village and do not lapse on leaving the village, even after a generation has passed. It is also extremely difficult to obtain these rights in any other village (…)" (p. 103).

[4] To see this, bear in mind that there is no incentive to switch activities back and forth.

insurance, they are left to cope with adversity on their own. Policy implications will follow swiftly, as we discuss further on.

3.3. The opportunity to migrate

Thus, in this model, choices about network membership and occupation come hand-in-hand. In particular, activity *C* offers higher expected earnings ($wy_i > y_i$), but requires the individual to first forfeit the network and its protection. Away from her network, she is anonymous and finds no aid. For instance, this may be interpreted as the result of migrating to a different location, so that physical distance precludes further risk-pooling and the new neighbours are reluctant to put their trust in the newcomer. Thus, the model invokes the much-repeated story of a farmer leaving the security of her village (*V*) and heading for the wild city (*C*), where she will lack social capital.

However, the model does not necessitate this story – all it needs is the activity switch to erode trust. In this vein, the network may seclude members who change their occupation. Consider a case where income is not perfectly observable, and hence network-members regard occupational changes as attempts to dissimulate income and avoid compliance to the risk-sharing agreement (Fafchamps 1992). Alternatively, the activity switch may trigger a compelling incentive to abandon the network, as in Hoff and Sen (2006), where non-members are unwilling to trade with members at normal prices, e.g. because they suspect network-requirements induce members into some form of foul play.

To sum up, if we use e_V to denote the relevant shock for those enjoying perfect risk-sharing in activity *V*, then

$$e_V = \frac{\sum_{i=1}^{n} e_i}{n}, \text{ with } \mu_V = 0 \text{ and } \sigma_V^2 = \frac{\sigma^2}{n},$$

For those who leave for activity *C*, the increase in expected income comes at the cost of losing the protection of the risk-sharing network, i.e. $\mu_C = 0$ and $\sigma_C^2 = \sigma^2$.

3.4. Myopic expectations

For convenience, let individuals assume that the network size they last observed will not change in the future. Myopic expectations are supported by much empirical evidence and, in our case, allow the model to produce step-wise adjustments, so as to elude instantaneous mass migrations and violent network collapses. However, the model equilibria and main conclusions will not depend on this assumption. Alternatively, other assumptions could be drawn on, e.g. agglomeration costs in activity *C* may arise (Adsera and Ray 2001).

3.5. Equilibrium

In each period, consumption x_i is determined by available income $s_{i=}\ y_i+e_v$ i.e. after shocks occur and payments due to the risk-sharing agreement are made. When the individual chooses activity *C*, no such payments exist ($s_{i=}\ wy_i+e_i$). Thus, each individual maximises her intertemporal utility, choosing the optimal period t^* to leave the network:

$$t^* = \arg\max_t \left\{ \frac{1-\delta^t}{1-\delta} \mathbf{E}\left[U\left(y_i + e_{V,t}\right)\right] + \frac{\delta^t}{1-\delta} \mathbf{E}\left[U\left(wy_i + e_{i,t}\right)\right] \right\} \quad \text{......... (1)}$$

where δ is the time discount factor (notice $t^* \to \infty$ is possible). Since individuals are myopic, their expectations about future utility only consider the number of individuals of the last period for all the future periods. Thus, n_{t-1} remains constant along all periods.

Since expected intertemporal utility is monotonic in *t*, departure time t^* will be a corner solution. In particular, utility will increase (decrease) in *t* and the individual will never (immediately) depart if and only if the following condition holds true (untrue):

$$\mathbf{E}\left[U\left(wy_i + e_{i,t}\right)\right] > \mathbf{E}\left[U\left(y_i + e_{V,t}\right)\right] \quad \text{.............................. (2)}$$

Recall shocks are normally distributed. Under CARA, (2) can be written as a comparison of certainty equivalents:

$$wy_i - \frac{A}{2}\sigma^2 > y_i - \frac{A}{2}\frac{\sigma^2}{n_{t-1}} \quad \text{.................................. (3)}$$

where both myopic expectations and the definitions of e_V and e_C (with and without risk-sharing, respectively) are in place. Rearranging the expression above,

$$y_i \geq \hat{y}_t\left(n_{t-1}, A, \sigma^2, w\right) \equiv \frac{A\sigma^2}{2(w-1)}\left(1 - \frac{1}{n_{t-1}}\right) \quad \text{.................... (4)}$$

At time *t*, only individuals with initial income above $\hat{y}_t$ will break away. This threshold is higher (and departure more difficult) when uncertainty is greater (higher σ^2), when agents are more risk averse (higher *A*), or when the gains from switching are lower (lower *w*). It is also a function of the network size, which determines how much protection members will receive.

From (4), those preferring to stay behind and benefit from the insurance provided by the network will be the less skilful. However, they may change their minds in the future, as in fact the network will shrink and provide less protection after the high-income members depart. Since $\partial\hat{y}_t/\partial n_{t-1}>0$, a smaller network implies a lower human capital threshold and more people – who previously were 'not skilful enough' – will switch occupations.

As more and more people leave and network protection gets weaker and weaker, all agents (even those with very low human capital) may eventually take on the high-earnings, uninsured occupation. However, this is not a necessary result. Instead of collapsing, the network may stabilise at some critical size, with its remaining low-capital members locked in the low-profit occupation. In this sense, poverty persistence may obtain. By protecting its members, the network paradoxically anchors them in poverty.

To see this formally, rewrite (4) as

$$\frac{n_{t-1}}{n_0} = \frac{1}{n_0}\left[\frac{A\sigma^2}{A\sigma^2 - 2(w-1)\hat{y}_t}\right] \qquad (5)$$

To locate the equilibrium, the distribution function F of human capital y plays a crucial role, since

$$\frac{n_{t-1}}{n_0} = F(\hat{y}_t) \qquad (6)$$

i.e. those actually willing to share in the network will only be those below $\hat{y}_t$. The equilibrium (n_t=n_{t-1}) is then defined by $\hat{y}^*$, such that

$$F(\hat{y}^*) = \frac{1}{n_0}\left[\frac{A\sigma^2}{A\sigma^2 - 2(w-1)\hat{y}^*}\right] \qquad (7)$$

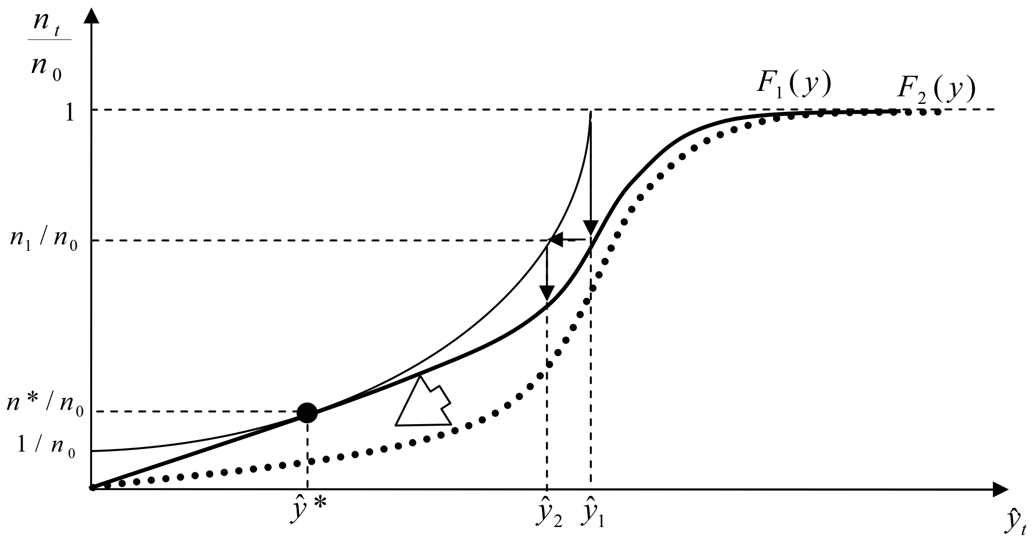
If no $\hat{y}^*$ satisfies (7), then the network necessarily collapses and no poverty trap will exist. Otherwise, given $\hat{y}^*$, the equilibrium will also entail a positive value for network size $n^*\equiv n_0F(\hat{y}^*)$.

Figure 1 shows the mechanism whereby poverty persistence may result. The thin curve starting at $1/n_0$ depicts the 'threshold function', as defined by (5).[5] Then, the human capital distribution $F_1(y)$ (solid line) is such that the network does not collapse. Given the initial network size n_0, myopic individuals take $\hat{y}_1$ as the relevant threshold. Individuals with human capital

[5] Note $\hat{y}_t$=0 when the network has collapsed to one individual (n_{t-1}=1).

above $\hat{y}_1$ break away, staying only n_1, i.e. $F_1(\hat{y}_1)n_0$. Idiosyncratic shocks then hit all individuals. Remaining network members share them and are mesmerised to realise that some of their peers had left. The next period, a new threshold $\hat{y}_2$ is established, conditional on n_1. Once again, individuals with human capital higher than $\hat{y}_2$ leave and the network shrinks further to n_2 members, i.e. $F_1(\hat{y}_2)n_0$. Finally, when the individual with $\hat{y}^*$ human capital finds herself indifferent, the network stabilises and $F_1(\hat{y}^*)n_0$ individuals remain trapped in poverty.

Figure 1



Obviously, the end of the story is different for the human capital distribution $F_2(y)$, which has no intersection with the threshold function. The network fully collapses and no individual is trapped. Formally, this case requires that, for all t,

$$\frac{n_{t-1}}{n_0} \equiv \frac{1}{n_0}\left[\frac{A\sigma^2}{A\sigma^2 - 2(w-1)\hat{y}_t}\right] > F(\hat{y}_t) \qquad (8)$$

Note that only large enough networks survive. To some extent, the relevance of this result rests on the perfect enforcement assumption, which allows arbitrarily large networks to exist in the first place. In this setting, and given other parameters, if the initial number of members n_0 is high, then (8) is unlikely to hold and the network will not unravel – it provides too much protection for the poor to dare losing it. Graphically, a high n_0 lowers the threshold function, i.e. for some t, the network will stand firm with no need to include too many individuals below $\hat{y}_t$. An intersection with $F(y)$ is thus more likely.

Similarly, a trap is likely when the degrees of uncertainty σ^2 and risk aversion A are both sufficiently high and expected income outside the network w is low enough. Graphically, this parameter configuration translates into a sufficiently low threshold function. These results accord well with intuition. The next section focuses on the role of the distribution of human capital.

3.6. The role of the initial distribution of *y*

Crucially, initial inequality within the network matters. From (7), it is obvious that the initial distribution of human capital will drive results to a great extent. However, it is difficult to draw clear-cut conclusions. Both a progressive and a regressive transfer could be imagined to undermine the trap. To see this, note that persistent poverty will be less likely if many agents break away promptly, so that the network quickly loses strength. In this sense, if agents slightly below the income threshold $\hat{y}^*$ were to receive a transfer from those well above, the trap could unravel. However, the network could also come apart if the same transfer proceeded from agents further down in the income distribution.

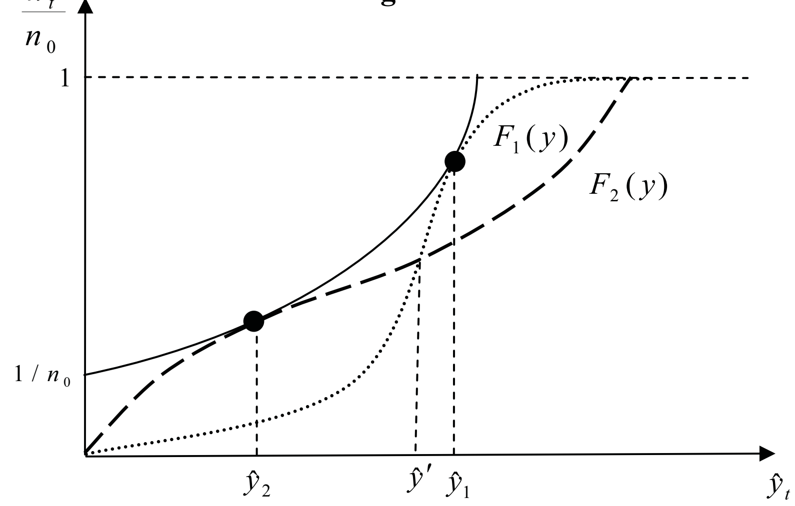
To seek clarity, construe the threshold curve as determining, for each $\hat{y}$, some minimum network strength, i. e. a certain headcount of individuals such that, if $F(\hat{y})$ includes those many low-productivity individuals in the network, then a trap obtains. By clinging to each other, the poor cling on to poverty.

In this sense, what really matters is the headcount. In fact, the model bears no predictions as to the depth or the severity of consumption shortfalls – it focuses on some critical headcounts. To see this, consider Figure 2, with human capital distributions F_1 (dotted) and F_2 (dashed). The former stochastically second-order dominates the latter, so that average capital is higher under F_1. However, neither avoids a trap. In fact, since $F_1(\hat{y}_1)>F_2(\hat{y}_2)$, the trap is (unexpectedly) stronger under F_1, at least according to the number of people in long-run poverty.

Note F_1 retains more individuals in the low-productivity activity V because, for some critical $\hat{y}_1$, $F_1(\hat{y}_1)$ is ‘too high’. Briefly, imagine the poverty line happens to lie at $\hat{y}_1$. Then, $F_1(\hat{y}_1)$ should be read as the poverty headcount – there are initially too many poor. As compared with F_2, F_1 implies that more people will stay behind in the network and, indeed, in poverty.[6]

[6] If we alternatively imagine a lower poverty line $\hat{y}_2<\hat{y}_1$ (say, due to a greater concern with the worst-off), then F_2 is the case exhibiting too much poverty. Note this low poverty line implies that activity V cannot be read as a fateful state of poverty, which has been (and remains herafter) the underlying assumption throughout.

Figure 2



3.7. Multiple equilibria: an example

Our model exhibits multiple equilibria in the sense that the long-run size of the network is determined by the initial size – likewise, the long-run poverty headcount depends on the initial one, albeit less transparently. This section illustrates resorting to a particular case of the model, where *y* is assumed to be uniformly distributed between 0 and 1, so that *F*(*y*)=*y*.

Under this assumption, from (4), if $n_0 \geq \dfrac{A\sigma^2}{A\sigma^2 - 2(w-1)} \equiv \overline{n}$, then $\hat{y} \geq 1$. Since all individuals have $y<1$, they all will be willing to stay, and $n^* = n_0$. Thus, $\overline{n}$ imposes an upper threshold on the set of network sizes which still allow for some movement across activities. If $n_0 \geq \overline{n}$, the network provides enough protection to deter even the most productive individual from departing, and the model bears little meaning.

A lower threshold $\underline{n}$ also exists. Given a human capital distribution, if n_0 is low enough no poverty trap will occur, as illustrated by the dotted line in Figure 1. Intuitively, $\underline{n}$ is the lowest initial size of a network which stabilises at a non-zero long-run equilibrium. More formally, $\underline{n}$ may be pinned down where condition (6) holds cum tangency.[7] For this particular case where *F*(*y*)=*y*, we obtain $\underline{n} = \dfrac{8(w-1)}{A\sigma^2}$.

[7] Note that tangency is not necessary to generate a poverty trap. To understand this, imagine that the solid distribution in Figure 1 crosses twice the threshold curve. Thus, considering the dynamics of our model, the poverty trap is generated in the first crossing.

Next, from (5) and (6), and taking n_0 as given, the long-run equilibrium for n is $n^* = \frac{2n_0}{\underline{n}}\left[1+\sqrt{1-\frac{\underline{n}}{n_0}}\right]$, whenever $\bar{n} \geq n_0 \geq \underline{n}$. More explicitly,

$$n^* = \begin{cases} 0 & \text{if } \underline{n} > n_0 \\ \frac{2n_0}{\underline{n}}\left[1+\sqrt{1-\frac{\underline{n}}{n_0}}\right] & \text{if } \bar{n} \geq n_0 \geq \underline{n} \\ n_0 & \text{if } n_0 > \bar{n} \end{cases}$$

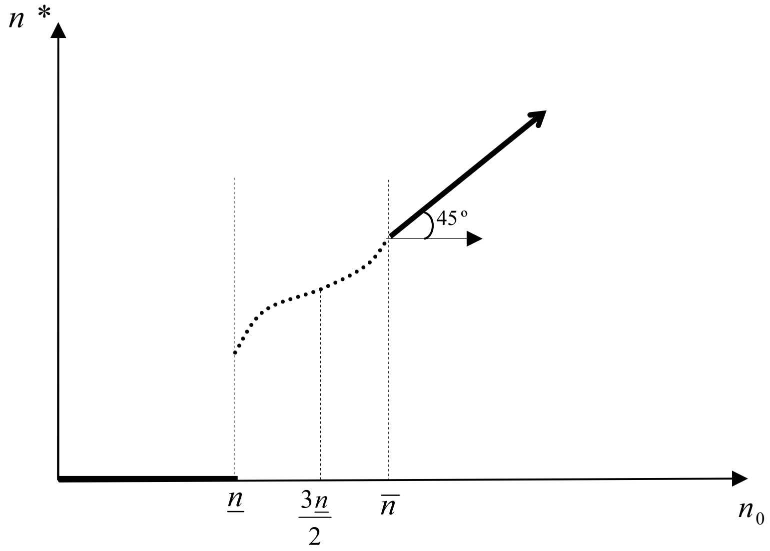
Note that, for $\bar{n} \geq n_0 \geq \underline{n}$, $\frac{\partial n^*}{\partial n_0} > 0$ always and $\frac{\partial^2 n^*}{\partial {n_0}^2} < 0$ only if $n_0 < \frac{3\underline{n}}{2}$.

Figure 3 illustrates. The first solid line, from 0 to $\underline{n}$, describes the long run equilibrium when the network was too small to sufficiently protect its members. Thus, in this example, every network will collapse if $n_0 < \underline{n} = \frac{8(w-1)}{A\sigma^2}$. The second solid line, 45-degree slope, shows the long run equilibrium when all starting members end up trapped in poverty, i.e. $n^*=n_0$. All members are trapped in poverty if $n_0 \geq \bar{n} = \frac{A\sigma^2}{A\sigma^2 - 2(w-1)}$.

Finally, the dotted segment between $\underline{n}$ and $\bar{n}$ shows the combination of possible initial network sizes that will result in a poverty trap *after* some activity-switching has occurred.[8]

[8] Note that the dotted segment of the curve is first concave and later convex. This convexity only occurs if we have a risky enough environment in the sense that $\frac{3\underline{n}}{2} < \bar{n}$ or, in other words, $\frac{2\sqrt{3}(1+\sqrt{3})(w-1)}{A} < \sigma^2$. If this condition does not hold, the dotted segment will be only concave.

Figure 3



Finally, by replacing n^* in (4) we find the definitive threshold for y:

$$\hat{y}^* = \begin{cases} 0 & \text{if } n_0 < \underline{n} \\ \dfrac{4}{\underline{n}} - \dfrac{2}{n_0 + \sqrt{n_0(n_0 - \underline{n})}} & \text{if } n_0 \geq \underline{n} \end{cases}$$

which emphasises the idea that, given the human capital distribution, too small networks ($n_0 \leq \underline{n}$) will collapse.

Most of the results above still hold in a more general case where human capital does not necessarily follow a uniform distribution. In particular, both the solid lines and the dotted line in Figure 3 remain in place, needless to say with adjustments in $\underline{n}$ and $\overline{n}$, as well as in the shape of the dotted section. These changes will depend on the human capital distribution. Regardless of the exact changes, multiple equilibria can be presumed to still exist.

4. Policy implications

The model above depicts a case where low-earnings individuals forfeit a more profitable occupation because the move would come at a cost they are unwilling to meet. Departure from their initial risk-sharing network would leave them fully exposed to all sorts of risks, and fear of the ups and downs of life will suffice to convince them to stay where they presently are, earning what they presently earn.

The paper builds on *ad-hoc* assumptions. Firstly, individuals exhibit CARA preferences, which ensure poverty persistence is not driven by excessive risk aversion among the poor (as compared with those better-off). Secondly, bondages between these individuals are strong enough to rule out any enforcement failures. Perfect enforcement becomes crucial as large networks would be hard to imagine otherwise. Thirdly, the activity choice enabling the poor to raise their incomes lies away from the network and provides newcomers with no alternative shelter to resort to in stormy times. While this is an extreme scenario, the model can easily accommodate the case where the highly-paying activity does provide some form of insurance, as long as it is outweighed by the protection found in the traditional network.

In this concluding section, we take a slightly different stance and read the model as highlighting the failure of the highly-paid occupation to attract new labourers. From a policy viewpoint, we may imagine a drive to relocate some the poor into dwelling places or activities offering them a better chance to raise their income. For instance, think of a strategy to promote a new high-return crop (or harvest technique), hoping that poor peasants will accept to replace their traditional, centuries-old farming choices. Likewise, think of a plethora of remote, scantly-populated poor areas which public utilities are unable to cater for. The growth of some new industry in their midst may be in the interest of poverty alleviation, insofar as it may hire and bring together population from both neighbouring and distant villages.

For these interventions to succeed, some form of insurance will be in order. The poor realise that no free lunch exists and foresee trouble. Their livelihoods may be rather dim, but tradition allows them to count on the aid of their neighbours if the outlook turned dire. Interventions will thus require some substitute for such informal insurance – formal insurance, social safety nets, free emergency services are all policy tools at hand.

The model highlights this role of social protection and, furthermore, it guides budget allocation by identifying informal insurance groups which will let all their members go, with no need to set up a competing insurance scheme for those daring to migrate. Policymakers need only invest in social protection wherever a strong risk-sharing network may permanently retain some of its members and lock them in poverty. As developed above, strength here comes down to network size and initial income distributions, such that large networks with high 'enough' poverty headcounts are less likely to collapse. It is these 'strong' networks which should draw attention and resources. Policy failure to address them would be rued – solidarity networks equipped to act as propellers for joint progress would become dysfunctional hindrances to development.

5. References

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