Informal insurance and its complementarity with development

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Preliminary version

Abstract

In this paper, we build a theoretical model where rural communities, in the absence of insurance markets, provide insurance and investment in local public good. Taking the agents’ heterogeneous willingness to contribute into account, we solve the implied conflict of interest in a way coherent with social choice theory and we study the trade-off between informal insurance and development in two comparative statics exercises. Better returns to investment or higher levels of future income do not necessarily trigger higher contributions to the public good. Better outside options are equally detrimental to informal insurance and to contributions to the project.

Keywords: informal insurance, public good, median voter.

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I. Introduction

In rural areas of developing countries, failing capital markets and the lack of State intervention leave a leading role to local communities in the provision of credit, insurance and public goods through voluntary mechanisms. In such environments, people tend to form social groups - often called kin systems - in order to fill these gaps. Wolf (1955) defines a kin system as "a system of shared rights and obligations encompassing a large number of near and distant relatives." This institution may be viewed as "a social contract of mutual assistance among members ... providing critical community goods and insurance services in the absence of market or public provision of such goods and services." (Hoff K. & Sen A., 2005).

Multifunctionality - credit, insurance, public good provision,... - is a major trait of kin systems. Most of them have been studied in the literature. For instance, the occurrence of insurance mechanisms in local communities has been vastly discussed. In a seminal paper, Coate & Ravallion (1993) characterize the best informal insurance arrangement that can be sustained as a noncooperative equilibrium. The role of ex post participation constraints is crucial and allows them to show that when the latter are not binding, the community perfectly equalizes - ex ante risky - incomes. If participation constraints were not satisfied for some agents, they would prefer to leave the community.

However, to our knowledge, the literature has always studied these various activities separately. In this paper, we study the interactions between insurance mechanisms and the provision of a local public good. In our model, the latter increases the future productivity of the community. The presence of collective action issues in the question we address makes the introduction of heterogeneity particularly relevant in our model. Indeed, it is well-known that heterogeneity is a powerful and ambiguous determinant of collective action (Baland and Platteau, 1999). In the domain of insurance as well as public good provision, heterogeneity in the agents’ preferences is a source of conflicts of interests. In our model, we depart from Coate & Ravallion (1993) by introducing a second mission to the community, namely the provision
of a public good, and account for the heterogeneity of agents. Heterogeneous preferences are aggregated through majority voting. The level of "community tax receipts" is determined by the participation constraints. The latter depends itself on the level of insurance transfers and on the investment level in the local public good. Given this endogenously determined amount of "community tax receipts", agents vote on the share of tax revenues to be devoted to insurance transfers (and as a consequence the share devoted to public good). It can be shown in this setting that agents have single-peaked preferences. As a result, we are able to make use of standard median voter tools since the voting space is one-dimensional.

The model is developed in section 2. Section 3 discusses some comparative statics. First, we do some plausibility checks of the model. We then study the impact of a change in the outside option on both activities of the community. It has a negative impact on both the development of the community and the insurance level. Finally, better returns to investment are analyzed.

II. The model

A community is composed of a continuum of individuals (each of which is indexed by $i$, $i = 1, \ldots, \infty$) and there are two periods of consumption. During the first period of consumption, each agent receives a random income $y_1$ which is high $\overline{y}$ with probability $p$ and low $\underline{y}$ with probability $(1 - p)$, with $\overline{y} > \underline{y}$. Each unlucky agent receives an amount $s$ which is chosen by majority voting. The difference between the total amount of taxes and the total amount of transfers $k$ is invested in a local public good. The invested capital has a positive impact on the second period income. This second period represents the rest of their life during which individuals face a similar risky prospect but share income perfectly and obtain $y_2 = p\overline{y}(k) + (1 - p)\underline{y}(k)$. Both second-period incomes are increasing and strictly concave in $k$. As in the first period, $y(k)$ is high $\overline{y}(k)$ with probability $p$ and low $\underline{y}(k)$ with probability $(1 - p)$.

As usual in the literature on insurance, we assume that it is impossible to sign credibly
a contract ex ante and that participation constraints ad interim matter. If an individual chooses not to participate to the insurance mechanism in the first period, he has an outside option in the second period, \( w < p\bar{y}(0) + (1 - p)y(0) \). This assumption on the exit option motivates perfect income sharing in the second period. Indeed, if period 2 is composed of a large number of sub-periods, the participation constraint to future insurance arrangements is simply assumed not to be binding given that the exit option is sufficiently low. Coate & Ravallion (1993) already mentioned that perfect income sharing is optimal when the participation constraint is not binding.

Agents have the same attitude towards risk but different preferences. Individual i’s utility function is \( u_i = u(y_1) + \delta_i u(y_2) \) where the function \( u \) is assumed increasing and strictly concave (\( u' > 0 \) and \( u'' < 0 \)) and the discount rate \( \delta \) is different for each agent. \( \delta_i \) is observable and is uniformly distributed on an interval \([0, 1]\).

A tax is levied on the high-income agents while low-income agents are subsidized by the insurance mechanism at a level \( s \). All people in the bad state have the same income and their participation constraint is far from binding. They all receive the same level of transfer \( s \) because they are ex post identical and no revelation mechanism can elicit their respective types unless it is possible to contract ex ante (a possibility that would contradict our assumption of binding constraints ad interim).

The tax amount paid by a high-income agent \( i \), \( t_i^*(\delta_i) \), is such that the individual participation constraint is binding:

\[
(1) \quad u(\bar{y} - t_i) + \delta_i u(y_2) = u(\bar{y}) + \partial_i u(w)
\]

Indeed, because all individuals prefer to have an income as stable as possible ex ante, the community wants to transfer the highest possible \( s \) as long as \( k \) is sufficiently high and \( \bar{y} - t_i > \bar{y} + s \) for all \( i \).

The amount invested in the local public good is the difference between tax revenue and
insurance transfers:

\[ k = p \int_0^1 t_h d\delta_t - (1 - p)s \]

There is a conflict of interest on the choice of \( s \), which is a unidimensional problem. Indeed, the amount of money to invest in the local public good is given by the budget constraint which directly depends on the level of \( s \) and on the tax amount given by the participation constraint. Therefore the underlying social choice problem is the location of a uni-dimensional public good. Standard convexity hypotheses on the agents’ preferences insure that reduced-form preferences on levels of \( s \) are single-peaked.

Each individual has a preferred \( s^*(\delta_i) \) which is found by solving the maximization problem expressed below.

\[
\max_s [p.u(\bar{y} - t_i) + (1 - p).u(y + s) + \delta_i.u(y_2(k))]
\]

\[
\text{s.t. } k = p \int_0^1 t_h d\delta_t - (1 - p)s
\]

\[
\forall i, u(\bar{y} - t_i) + \delta_i.u(y_2) \geq u(\bar{y}) + \delta_i.u(w)
\]

The first order condition gives us an implicit function of \( s^*(\delta_i) \), which is

\[
u'(y + s) = \delta_i.u'(y_2(k)).y'_2(k).(1 - p)\]

while the second order condition is negative everywhere, not only in a neighbourhood of \( s^*_i \). This guarantees single-peaked preferences.

The level of \( s \) is chosen by majority voting before people know if they have a high or a low income in the first period.

Thanks to the single-peakedness of preferences, we know that there exists a unique Condorcet winner, \( s^*_m = s^*(\delta_m) \) where \( m \) is the median-voter.

In order to understand the interactions between equilibrium values of \( s^*_m \) and \( k \), we now proceed with several comparatives statics exercises.

Note that in this model, the question on the efficiency of \( s \) and \( k \) is not of real interest. Indeed, when the discount rate of each agent \( \delta_i \) is uniformly distributed, the median voter
coincides with the mean voter i.e. the voter who has the mean utility level whatever the level of \( s \). So, the chosen \( s \) is pareto optimal. No inefficien level of \( s \) may occur under a symetrical distribution of \( \delta_i \). However it is possible that, when there are more impatient agents than patient ones, an under-investment in the insurance scheme occurs. Hence, the efficiency of \( s \) and \( k \) depends on the distribution of types in the community.

III. Comparative Statics

In this section, we will first check whether our model is realistic by testing the impact of changes in the income variability and changes in the total wealth of the community. These two first exercises are mainly plausibility checks. Then, results are explored in two directions. Firstly, the impact of the outside option on local insurance and development is computed. Secondly, external shocks of the kind that may be generated by a foreign NGO are modeled as changes either in the return to public good investment or in the absolute level of future income.

A. Plausibility checks

In order to have a model representing in a relevant way reality, some phenomena have to take place within its frame. Indeed, the formalism adopted has to be compatible with straighforward behaviours.

The first one we can think of is in the case of risk increasing. Hence, the demand for insurance has to increase as well in such a case. To check if we observe this phenomenon in our model, we use a mean preserving spread of the income and we study the impact of a more variable income on the chosen \( s^* \) and \( k \) when the mean of the income is preserved. Let’s have,

\[
\underline{y} = -\sigma + x(k) \quad \text{with probability } (1 - p)
\]

\[
\bar{y} = \frac{1-p}{p} \sigma + z(k) \quad \text{with probability } p
\]

By allowing \( \sigma \) to increase, we introduce a greater ex-post inequality within the population
but without affecting the returns on the investment in the local public good.

The impact on $s^*$ is positive:

\[
\frac{ds}{d\sigma} = \frac{u''(y + s) + \delta_i(1 - p)^2 \int_0^1 \frac{u'(\bar{y} - t_h)}{u'(\bar{y} - t_h)} \, d\delta_h}{u''(y + s) + \delta_i(1 - p)^2 [u''(y_2) \cdot y_2^2(k) + u'(y_2) \cdot y''_2(k)]} > 0
\]

The model would be implausible if another result were deduced. Indeed, when risk increases the community chooses to increase the transfer to poor people as a simple and direct consequence of risk aversion.

The impact on $k$ is indeterminate:

\[
\frac{dk}{d\sigma} = p \int_0^1 \frac{\partial t_h}{\partial \sigma} \, d\delta_h - (1 - p) \frac{ds}{d\sigma} \succ 0
\]

This can easily be explained by the fact that when the variability of the income increase, the total amount of taxes that the community may take, $p \int_0^1 t_h \, d\delta_h$, is greater. Indeed, $p \int_0^1 \frac{\partial t_h}{\partial \sigma} \, d\delta_h = (1 - p) \int_0^1 \frac{u'(\bar{y} - t_h) - u'(\bar{y})}{u'(\bar{y} - t_h)} \, d\delta_h > 0$. Although this effect is positive, the amount devoted to $s$ also increases and we don’t know the sign of the total effect on $k$ for sure.

Another thing we can think of is the impact of a change in the global wealth of the community. The model has to preserve the indeterminate effect of income on the insurance demand. It must be compatible with assumptions on preferences that make richer people prefer more insurance and with opposite assumptions. Hence, we check how $s$ and $k$ will be affected if everyone in the community is richer. To evaluate this effect introducing other effects like income variability, let us define

\[
y = \mu - x'(k) \quad \text{with probability } (1 - p)
\]
\[
\overline{y} = \mu + z'(k) \quad \text{with probability } p
\]

A variation in $\mu$ will affect the whole community’s wealth. Note that the impact of a variation
of $\mu$ on $s^*$ is indeterminate:

$$\frac{ds}{d\mu} = \frac{u''(y + s) - \delta_1(1 - p) \left( u''(y_2(k)) \cdot y'_2(k) + \int_0^1 \frac{\partial h}{\partial s} d\delta_1 \cdot [u''(y_2(k)) \cdot y''_2(k) + u'(y_2(k)) \cdot y''_2(k)] \right)}{u''(y + s) + \delta_1(1 - p)^2 \left[ u''(y_2(k)) \cdot y''_2(k) + u'(y_2(k)) \cdot y''_2(k) \right] \left[ 1 - \frac{p}{1-p} \int_0^1 \frac{d\delta_1}{ds} d\delta_1 \right]} \approx 0$$

More assumptions in the utility function would be needed to know the sign of this derivative.

As for $s$, the impact of $\mu$ on $k$ is indeterminate:

$$\frac{dk}{d\mu} = p \int_0^1 \frac{\partial h}{\partial s} d\delta_1 - (1 - p) \frac{ds}{d\mu} \geq 0$$

Indeed, if we know that a greater income for everyone will positively affect the total amount of taxes the community may take, we don’t know if the community will decide to affect it to development or to insurance. This will depend on the agents’ preferences. The ambiguity of pure income effects is commonplace in microeconomics and should be viewed as a desirable feature of the model.

**B. Outside option variations**

The level of the exit option is a particularly interesting parameter in our model. Indeed, the implied context is one of a rural community with no capital or insurance markets. The outside option may therefore vary widely following a random shock or a public policy such as the building of a nearby road. The consequences of such events on the local group are important to understand. The impact of $w$ on $s$ is undoubtedly and quite surprisingly negative:

$$\frac{ds}{dw} = \frac{\delta_1(1 - p) \cdot p \int_0^1 \frac{\partial h}{\partial s} d\delta_1 [u''(y_2) \cdot y''_2(k) + u'(y_2) \cdot y''_2(k)]}{u''(y + s) + \delta_1(1 - p)^2 \left[ u''(y_2) \cdot y''_2(k) + u'(y_2) \cdot y''_2(k) \right] \left[ 1 - \frac{p}{1-p} \int_0^1 \frac{d\delta_1}{ds} d\delta_1 \right]} < 0$$
The participation constraint will be more quickly binding and the total amount of taxes will be less important. And people will decide to reduce the amount invested in development too:

$$\frac{dk}{dw} = p \int_0^1 \frac{\partial t_h}{\partial w} d\delta_h - (1 - p) \frac{ds}{dw} < 0$$

It means that when the outside option becomes more attractive, agents refuse to pay as much taxes as before. Hence, the level of insurance and of investment in the local public good are negatively affected. The unexpected impact on investment originates from the fact that insurance and public good are funded through the same channel. Tightening the source of funds by making participation constraints bind earlier is therefore equally detrimental to both activities of the community. Destructuration of local communities through massive urban investments can therefore be explained in our model. It must also be noticed that the building of a road, for example, does not only lower migration costs and hence increases $w$, but also has a positive impact on future rural incomes. The result about $w$ should therefore be looked at together with the next series of computations, since it is difficult to come up with a clear example of a raise in $w$ that is not accompanied by some change in $y_2$.

### C. Marginal and absolute returns on investment variations

A rural development project or a NGO may act on the community by several means. One is to increase the income of all the agents of the community in the second period. Another is an increase of the local returns to investment. The latter is typically the target of "participatory" or "community-based" projects. To model these impacts, the income functions may be written as follows:

$$y_1 = \begin{cases} y & \text{with probability } (1 - p) \\ \overline{y} & \text{with probability } p \end{cases} \quad \text{and} \quad y_2 = \begin{cases} \alpha + \beta(k) & \text{with probability } (1 - p) \\ \overline{\alpha} + \beta(k) & \text{with probability } p \end{cases}$$

First, let's study the impact of an unconditional income increase. The impact on $s$ is
positive:

\[
\frac{ds}{d\alpha} = \frac{\delta_i(1-p) \left[ u''(y_2).y_2'(k) + p \int_0^1 \frac{du}{d\alpha} d\delta_h \left[ u''(y_2).y_2'(k) + u'(y_2).y_2'(k) \right] \right]}{u''(y+s) + \delta_i(1-p)^2 \left[ u''(y_2).y_2'(k) + u'(y_2).y_2'(k) \right]} > 0
\]

Because the agents expect that in the future their income will be greater, they will accept to give a greater participation \( (t_1) \) in the first period if they are rich. This is the case because for a given level of \( t_i \) the lefthand side of the participation constraint is greater than before while the righthand side remains the same. So, the indirect effect of \( \alpha \) on \( s \) is positive and the direct effect too.

But the impact on \( k \) is indeterminate:

\[
\frac{dk}{d\alpha} = p \int_0^1 \frac{dt_h}{d\alpha} d\delta_h - (1-p) \frac{ds}{d\alpha} \geq 0
\]

Expectedly, the total amount of taxes collected is greater. A greater amount is devoted to transfers. We can’t say anything about the impact on \( k \).

The second way in which a NGO may increase the second period income in a community is to improve the return of investment in the local public good. So we study the impact on \( s \) and \( k \) of a change in \( \beta \). The impact on \( s \) is positive for the same reasons as before:

\[
\frac{ds}{d\beta} = \frac{\delta_i(1-p) \left[ k(u''(y_2).y_2'(k) + u'(y_2).y_2'(k)) + p \int_0^1 \frac{du}{d\beta} d\delta_h \left[ u''(y_2).y_2'(k) + u'(y_2).y_2'(k) \right] \right]}{u''(y+s) + \delta_i(1-p)^2 \left[ u''(y_2).y_2'(k) + u'(y_2).y_2'(k) \right]} > 0
\]

while the impact on \( k \) is indeterminate:

\[
\frac{dk}{d\beta} = p \int_0^1 \frac{dt_h}{d\beta} d\delta_h - (1-p) \frac{ds}{d\beta} \geq 0
\]

So, a NGO may have a certain effect on the insurance mechanism but its action will have indeterminate effects on the development of the community. The effect on development
will depend on the substitution between informal insurance and development.

IV. References

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