Voting and enforcing informal risk-sharing rules

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`Preliminary and uncomplete version`

Abstract

A community of agents vote over risk-sharing rules to cope with random revenues. Risk-sharing rules are then enforced through peer-pressure: those who comply exert a negative externality on those who do not. People are differently affected by this externality. I determine the elected risk-sharing rules and the level of compliance. It turns out that full-risk sharing is achieved only if everybody comply to this rule. Otherwise, the political equilibrium leads to partial risk-sharing. In particular, it often leads to a political equilibrium where a majority of people comply to the risk-sharing rule that maximizes their own expected payoff.

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1 Introduction

High income fluctuations is part of life in developing countries. To cope with a risky environment, households have as developed risk-sharing strategies, including mutual assistance, credit with contingent repayments, or simply private transfers within extended families, lineage or kinship groups (e.g. Fafchamps, 1992,, Udry, 1994,, Besley, 1995, Fafchamps, 2003, Dercon 2004). Most of these strategies are informal and, therefore, not legally enforceable. They somehow respond to the lack of formal risk-sharing devices, such as private insurance, credit, welfare-state benefits, health insurance, income redistribution. This devices are absent or inefficient in developing countries due to strong informational asymmetries and a weak legal enforcement system. Informal risk-sharing strategies are designed to fit with economic environments with poor institutions but strong social customs and obligations.

In a world of risk-averse agents facing with random shocks, sharing risk is individually efficient. Consequently, people would certainly agree on the idea of sharing risk. However, some risk-sharing strategies imply some from of income redistribution from most successful persons to the unsuccessful ones. Individuals might be reluctant to share their income with their poorest peers, especially when endowed with permanent high income flows. They would certainly refuse to follow what risk-sharing prescribes (i.e. to share their income), even if they previously (i.e. before becoming rich) adhered to the principle of sharing risk. This raises the issue of the enforcement of such risk-sharing strategies in economies without legal enforcement systems.

This paper address the issue of the design and enforcement of risk-sharing rules in developing countries. It models the design of risk-sharing rules as a collective choice through majority voting. People vote behind a veil of ignorance over future incomes: They face with identical random revenues. This paper also posits an enforcement mechanism based on social pressure. Compliance to the risk-sharing arrangement is an individual decision in a non-cooperative game. It is undertaken once people's income are known. Those who comply exert a negative externality on others. They produce a non-market bad assigned to those who deviate form the rule. By refusing to transfer part of his income, a successful person incurs an utility loss proportional to the level of compliance. It affects people differently so that, for a same level of compliance, some people are more inclined to comply than others.

Such an enforcement mechanism is limited in the sense it is sometime impossible or, at least too costly, to make everybody comply to a given risk-sharing rule. People are awarded of limited enforcement when they design risk-sharing rules. Consequently, unlike in a world with perfect enforcement, full risk-sharing might not be implementable or even desirable. It is indeed achieved only if fulfilled by everybody. Otherwise, and more generally, partial risk-sharing arises. In particular, the model often leads to a political equilibrium where a majority of people votes for and complies to the risk-sharing rule that maximizes their expected payoff.

The rest of the paper proceeds as follow. Section 2 motivates the main assumptions and relates the paper with the literature. Section 3 presents the model. Section 4 analyzes the enforcement to a given risk-sharing rule in a non-cooperative game. Section 5 endogenizes the risk-sharing rule in a voting stage. Section 6 concludes with two remarks.

2 Motivation and related literature

So far, the design and enforcement of risk-sharing arrangements has been analyzed in repeated relationships (e.g. Coate and Ravallion, 1993, Ligon, Thomas and Worral, 1997, Genicot and Ray, 2003). These papers have formalized the idea that people are motivated by reciprocity when they perform private transfers: A rich person agrees to share his or her higher income because he or she expects to paid back when he or she is on need. Formally speaking, in these papers, informal risk-sharing arrangements emerge as self-enforcing contracts among risk-averse agents facing random shocks in a repeated game.[1]

Undoubtedly, reciprocity plays a rule in motivating the emergence and perenniality of risk-sharing arrangements in developing countries. However, it fails to explain why people

[1] I should add that the literature also pointed out altruism as a motive for informal risk-sharing (see e.g. Dearden and Ravallion, 1988).

with high and secure income levels subsidize poor relatives with limited future opportunities. For example, Lucas and Stark (1985) observed that migrants remit part of their revenue to their family even if they do not expect to be paid back. Fafchamps (1995) points out that people suffering from incurable diseases, and physical or mental handicap, are not excluded from the mutual assistance network. Fafchamps (2003) questions the support to old people who are likely to be net recipient of assistance and, due to short like expectancy, have not much time left to reciprocate. He argues that, in order to obtain this support, old people have granted a lot of political and economic power in pre-industrial society. They are thus armed to exert pressure and social sanctions to younger people.

More importantly, the repeated game approach ignores the influence of communities (families, villages, kinships,...) on individual's behavior. It postulates that people enter into risk-sharing agreements on an individual basis in an economic environment free of any obligation, customary law or social norm. In contrast, anthropologists emphasize the role of the community (the extended family, lineage or kinship group) in the behavior of individuals within traditional societies, especially regarding redistribution and mutual assistance (see Platteau, 2000, Fafchamps, 2003). They argue that unwritten rules and behavioral codes do exist in these communities. When people make choices, they take into account how their behavior will be perceived by the members of their group. Thus, a person's behavior should be analyzed in conjunction with their community. I briefly illustrate this point with two anthropological studies.

The first one, "Kwanim Pa", Wendy James (1979) analyzes the behavior of the Uduk, an ethnic group of cultivating people located in the Sudan-Ethiopian borderlands. The author argues that strong sharing obligations within the so-called birth-group based on principles of equality, partnership and reciprocity do exist in the Uduk society. She writes:

"Between persons, there are conventional expectations of cooperation and sharing in terms of which the Uduk judge individual behavior."

This means that not only agricultural production must be shared, but also the work must be fairly distributed within the community. A man is duty-bound not only to cultivate fields for himself and his immediate dependants, but also to assist in the cultivation of other men's fields, especially those of his immediate birth-group. To avoid public disapproval, he must be careful not to work too hard on his own fields at the expense of others. A man whose fields appear to do surprisingly well, will be criticized to the same extent as one who has shirked his duty. He will be perceived as having invested far more effort in his own fields, than on the land of others, for the purpose of self-enrichment.[2] Not surprising, amassing wealth without sharing, is disapproved in Uduk communities as in many others traditional society (see Platteau 1996 for further evidence, and Fafchamps, 2003, page 81, for a discussion on this issue).[3]

The second ethnographic work, "Palms, Wine, and Witnesses" by David J. Parkin (1972), about in the Giriama of Southern Kenya, highlights the importance of redistribution in a society relying on customary law. The Giriama's economy is based on palm trees which requires long term investment and, therefore, secure property rights. Parkin argues it involves a "redistributional economy", in which wealth is mainly invested in the "purchase" of people for support on matters such as such as the ownership of land, palm trees, moveable inherited wealth, or bridewealth.[4]

The anthropological literature suggests two levels of decision-making in traditional societies: the community level and the individual level. The community designs rules that must be followed by members. People are governed by these informal rules enforced through social pressure: Those who deviate suffer from public disapproval and/or social sanctions.[5]

Accordingly, in this paper, risk-sharing is an informal rule designed democratically by the

[2]James reported that a man sabotaged his own successful new plants because he was afraid people might think he was trying to get rich!

[3]For the Uduk, the sole way to save is to convert crop surplus into animal wealth. This is precisely because animals are jointly owned by birth-group members.

[4]In addition, since palm wine cannot be preserved more than a couple of days, it cannot be stored until periods of scarcity (as precautionary saving). Any surplus is thus spread out in the kinship neighborhood through a system of redistributional obligation.

[5]This approach is consistent with Elster (1989)'s view that social norms include a penalty to sanction disobedience.

community members.[6] Then each member individually decide to comply or not to the elected risk-sharing rule. People suffer from social pressure and sanctions if they do not comply. It translates formally into an utility loss which is proportional to the level of compliance in the community. This formalization has been introduced by Akerlof (1980). In his theory of social customs, he assumes that person's utility include his reputation within the community he belongs.[7] Deviating from social customs imply a loss of reputation proportional to the level of norm obedience.

This utility loss from deviating from informal rules (such as solidarity obligation) has several interpretations. First, it might capture personal's feelings such a guilt or shame.[8]As argued in Elster (1998), these feelings can be modeled as utility losses that depend on the morality of other agents in regard to the code of behavior. The larger the percentage of the population adhering to this code, the more intensely it is felt by the individual.[9] Second, it might be a pecuniary sanction such as exclusion from resources controlled by the community,[10] or others punishment from any form of informal justice (e.g. witchcraft).[11] These sanctions are more likely to be applied and to be costly as more people follow what the risk-sharing rule prescribes.

The paper is related to the literature on the political economy of unemployment insurance.

[6]Although the cooperative decision-making rule is here a majority voting rule, I could have considered other cooperative decision rules.

[7]The idea of including the opinion of others as a commodity into one agent utility function goes back, at least, to Becker (1974).

[8]This may explain why a large part of private transfers are performed during social event and ceremonies (e.g. funerals in Parkin, 1972), i.e. when people's behavior regarding gifts are observable by the whole community.

[9]See also Kandel and Lazear, 1992, for similar formulation applied to work norms in labor economics.

[10]It includes access from common-pool resources (land, forest, fishery, water), lose of inheritance as in Hoddinott (1994), or their property rights on land, as in Parkin (1972).

[11]According to Platteau (1996) sorcery or witchcraft serves as a form of social justice in many traditional societies. Also Parkin (1972) notices that *"the assumption seems to be widespread in Africa that economically successful persons are likely to suffer the sorcery or witchcraft of those who feel relatively deprived."* Consistently to the model, people might differ on their vulnerability to sorcery (e.g. their beliefs).

It shares several features with Lindbeck, Nyberg and Weibull (1999)'s paper in which people vote for a redistribution scheme from the workers to the jobless in an economy where living off one's own work is a social norm. They introduce a similar utility loss proportional to the adherence to the social norm if people prefer to live on welfare. However, Lindbeck and al. (1999) focus on redistribution with an exogeneous working norm with legal enforcement (at no cost), whereas I endogenize a risk-sharing norm with peer-pressure as a device to enforce redistribution. Here, people vote in uncertain world behind a veil of ignorance over their future income. In contrast, in Lindbeck and al. (1999), people perfectly foresight their own income when they vote. As a consequence, in their paper, people are less prone to redistribution: If workers constitute a majority, the unique political equilibrium prescribes no income redistribution at all.[12] In contrast, here, the political equilibrium entails some redistribution even with a majority of tax payers (i.e. rich people transferring part of their income).

In Wright (1986), people vote on an unemployment insurance knowing their current employment status but under uncertainty on their future status. The elected unemployment insurance maximizes the expected utility of current employed voters because their constitute a majority of voters. Since their are currently tax payers, they prefer uncomplete insurance. Wright does not address the issue of enforcement. The partial insurance result is due to the predominance of tax payers.

3 The model

A community composed of a continuum of individuals of measure 1. Agents have quasi-linear preferences on consumption C and social pressure and/or sanction S represented by the utility function $U(C, S, \theta) = u(C) - \theta S$. The function u is assumed increasing and strictly concave ($u' > 0$ and $u'' < 0$) so that all agents are equally risk averse. However, they are differently affected by social disapproval S. The parameter θ represents individual's taste for

[12] They introduce altruism to produce some income redistribution emerges with a majority of workers.

social sanction: Agents with a higher (lower) θ are more (less) hurt by the sanction. It is private information distributed in $\Theta = [\underline{\theta}, \bar{\theta}]$ according to a publicly known cumulative F. The cumulative first and second derivatives are denoted f and f', respectively. The median voter's type is denoted θ_m.

Each agent produces a random income which is high $\bar{y}$ with probability p and low $\underline{y}$ with probability $1-p$, with $\bar{y} > \underline{y}$. Agents face independent and identical probability distributions. An agent who receives $\bar{y}$ ($\underline{y}$), henceforth qualified as "successful" or "rich"("unsuccessful" or "poor").

A risk-sharing rule is a vector $(t, r) \in \mathbb{R}^+ \times \mathbb{R}^+$ where t is the transfer given by a successful or rich person while r is the transfer received by a unsuccessful or poor person. According to such a policy, a sucessful/rich person is asked to consume $\bar{y} - t$ while a unsuccessful/poor person should consume $C = \underline{y} + r$. When not complying to risk-sharing, a person suffers from an utility loss $S = \alpha s$ where $\alpha \in [0, 1]$ is the proportion of people who indeed comply to the rule and $s > 0$ is a fix cost.

In the above framework, people have two choices to make. First, they vote over risk-sharing rules. Second, each person decides to comply or not to the elected rule. The design of a risk-sharing rule is a collective choice selected *ex-ante*, i.e. before observing income, or under a "veil of ignorance". The compliance strategy is an individual choice undertaken non-cooperatively *ex-post*, i.e. after observing income. It leads to Nash equilibria level of compliance to the elected rule. In what follows, we proceed by backward induction: We first analyze the second choice (i.e. compliance to a given risk-sharing rule, Section 4) before turning to the first choice (vote for a risk-sharing rule, Section 6).

4 Compliance to a risk-sharing policy

In this section, we find out the Nash equilibria of the compliance non-cooperative game.

First, consider a poor person. Of course, it is in his self-interest to comply: his consumption is increased and he does not suffer from any social disapproval. Therefore, all poor individuals comply, thereby enjoying an utility of $u(\underline{y}+r)$.

Now, consider a rich person of type θ. If he complies, he consumes only $\bar{y}-t$ but does not suffer from any social sanction, thereby enjoying a utility level $u(\bar{y}-t)$. If he does not, he consumes all his revenue $\bar{y}$ but suffers from public disapproval. Let us denote μ the proportion of those who comply *within the rich population share.* The social sanction exerted by the $1-p$ poor who comply and μ of the p rich who comply is $(1-p+p\mu)s$. The agent's utility is $u(\bar{y})-\theta(1-p+p\mu)s$. For a given proportion of compliant rich μ, the rich agent θ decides to comply if:

$$u(\bar{y}-t) \geq u(\bar{y})-\theta(1-p+p\mu)s,$$

that is,

$$\theta \geq \frac{u(\bar{y})-u(\bar{y}-t)}{(1-p+p\mu)s}.$$

To properly characterize the critical taste $\tilde{\theta}$ which divides the rich population among conformists (those of type $\theta \geq \tilde{\theta}$), and opportunists (those of type $\theta < \tilde{\theta}$), we need new notation. Let $\bar{\mu}$ denote the minimum proportion of compliant rich that convinces the $\theta=\bar{\theta}$ type agent to comply:

$$u(\bar{y}-t) = u(\bar{y})-\bar{\theta}(1-p+p\bar{\mu})s.$$

I assume that the sanction imposed by the poor share of the population alone does not induce the higher θ type agent to comply, i.e. $\bar{\mu}>0$. Let $\underline{\mu}$ denote the minimum level of compliance within the rich population that convinces the $\theta=\underline{\theta}$ type agent to comply. It is defined by:

$$u(\bar{y}-t) = u(\bar{y})-\underline{\theta}(1-p+p\underline{\mu})s.$$

Hence, $\bar{\mu}$ and $\underline{\mu}$ are respectively defined by $\bar{\mu}=\frac{u(\bar{y})-u(\bar{y}-t)}{\bar{\theta}ps}-\frac{1-p}{p}$, and $\underline{\mu}=\frac{u(\bar{y})-u(\bar{y}-t)}{\underline{\theta}ps}-\frac{1-p}{p}$. Since $\bar{\theta}>\underline{\theta}$, then $\bar{\mu}<\underline{\mu}$. Notice that $\underline{\mu}$ does not exist if agent $\underline{\theta}$ does not comply when $\mu=1$. That is, if $u(\bar{y}-t)<u(\bar{y})-\underline{\theta}s$. In this case, we set $\underline{\mu}=0$. We will denote $\hat{s}(t)=\frac{u(\bar{y})-u(\bar{y}-t)}{\underline{\theta}}$ as the lower bound on s that could make everyone comply to a given risk-sharing rule (t,r).

The taste $\tilde{\theta}$ of the agent indifferent between complying or not to (t, r) for a given μ is defined by:

$$\tilde{\theta}(\mu) = \begin{cases} \underline{\theta} & if \quad \mu > \underline{\mu} \\ \dfrac{u(\bar{y}) - u(\bar{y} - t)}{(1 - p + p\mu)s} & if \quad \underline{\mu} \geq \mu \geq \bar{\mu} \\ \bar{\theta} & if \quad \mu < \bar{\mu} \end{cases} \tag{1}$$

While expecting μ, people with $\theta \geq \tilde{\theta}(\mu)$ (respectively $\theta < \tilde{\theta}(\mu)$) comply (do not comply) to (t, r).

We now set up the proportion of rich who comply for a given $\tilde{\theta}$. Since f is the density of the agents type within the rich population share, the proportion of rich of type higher than $\tilde{\theta}$ is,

$$\mu = \int_{\tilde{\theta}}^{\bar{\theta}} f(\theta) d\theta.$$

Or,

$$\mu = 1 - F(\tilde{\theta}). \tag{2}$$

The Nash equilibria level of compliance within the rich population μ^* are determined by combining equations 1 and 2. It is defined by:

$$\mu^* = 1 - F(\tilde{\theta}(\mu^*)),$$

which can be summarized as:

$$\mu^* = \begin{cases} 1 & if \quad \mu^* > \underline{\mu} \\ 1 - F\left(\dfrac{u(\bar{y}) - u(\bar{y} - t)}{(1 - p + p\mu^*)s}\right) & if \quad \underline{\mu} \geq \mu^* \geq \bar{\mu} \\ 0 & if \quad \mu^* < \bar{\mu} \end{cases} \tag{3}$$

Mathematically, an equilibrium is a fixed point. Since the function defined by 3 is an increasing continuous function of μ mapping $[0, 1]$ into itself, there exists at least one equilibrium proportion of enforcers.

Figures 1 below provides a graphic illustration in the case θ uniformly distributed in $[\underline{\theta}, \bar{\theta}]$. It represents the function $\tilde{\theta}(\mu)$ defined in 1 by the plain line and the relation 2 by the shaded line.

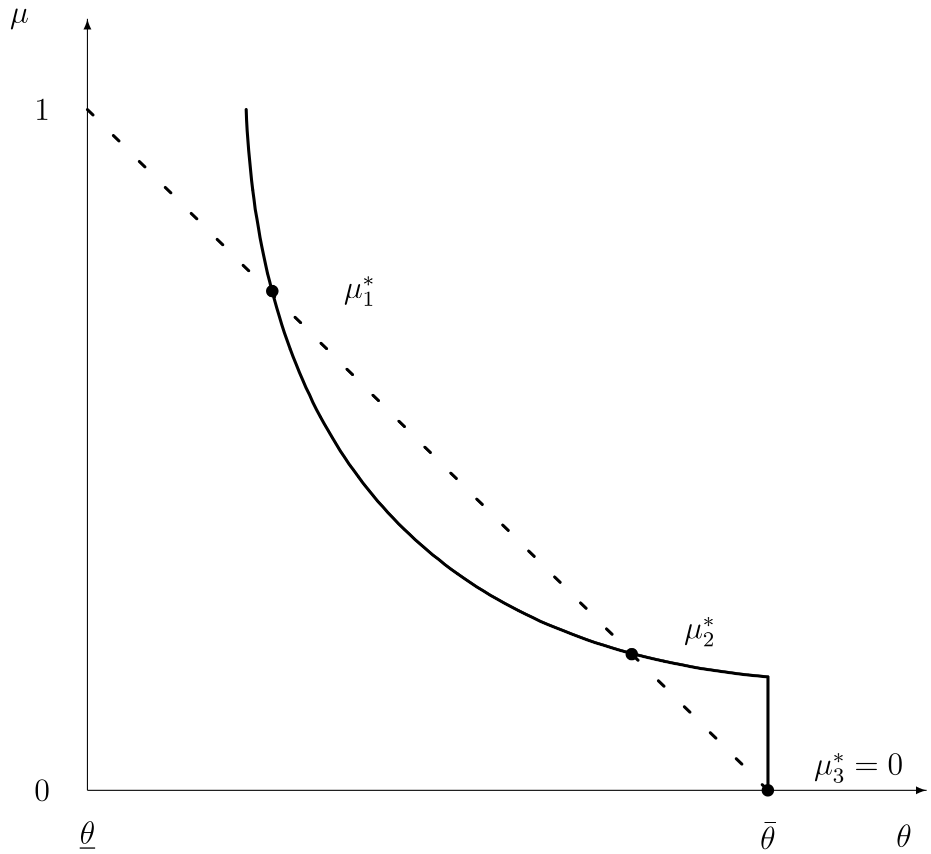

Figure 1

The equilibrium μ_3^* where none of the rich comply ($\mu_3^* = 0$) always exists. Other equilibria may exist, depending on the economic environment. There is one equilibrium μ_1^* with high compliance and one equilibrium μ_2^* with low compliance. If $s \geq \hat{s}(t)$, then peer-pressure is high enough to make everybody comply and, therefore, $\mu_1^* = 1$. Graphically, when s increases, the plain curve moves downward in figure 1 up to cross the vertical axe as $s \geq \hat{s}(t)$. Otherwise, some rich will not comply to the risk-sharing rule.

Clearly, in general, the game leads to several equilibrium level of compliance (within the successful population). Multiplicity of equilibria raises the problem of equilibrium selection: One may ask which equilibrium level of compliance would arise for a given risk-sharing rule. In the following section, I introduce two criteria, stability and a budget balanceness, that have the effect of selecting precisely one equilibrium. I argue that these two criteria induce the agents to coordinate their behavior on one single Nash equilibrium.

5 Equilibrium selection

5.1 Stability

Among the equilibrium levels of compliance, some of them are unstable. For instance, in the example illustrated in Figures 1, μ_2^* is unstable whereas μ_1^* and μ_3^* are stable. These unstable equilibria are unlikely to arise because there are difficult to sustain. Indeed, a deviation from a (positive measured) subset of agents from μ_2^* leads to either μ_1^* and μ_3^*. Consider a deviation to the out of equilibrium level of compliance $\mu' \neq \mu_2^*$. Assume that people readjust their behavior by playing a tâtonnement process. Given their expected level of compliance μ', they play their best reply until they reach the next Nash equilibrium. Only one of the two stable equilibria, μ_3^* or μ_1^*, would be reached, not μ_2^*. Formally, an interior equilibrium μ^* is locally stable if and only if:

$$1 + f(\tilde{\theta}(\mu^*))\tilde{\theta}'(\mu^*) > 0. \tag{4}$$

It implies

$$\frac{d\mu^*}{dt} = -\frac{\dfrac{u'(\bar{y}-t)}{(1-p+p\mu^*)s}}{1 + f(\tilde{\theta}(\mu^*))\tilde{\theta}'(\mu^*)} < 0. \tag{5}$$

Equation 5 states an intuitive property of stable equilibrium. In words, it tell us that less people comply in equilibrium if rich/successful people are more taxed.[13]

5.2 Budget balanceness

So far, no connection has been assumed between the contribution t paid by rich/sucessful persons and the subsidy r received poor/unsucessful persons. Budget balancing imposes that

[13]Notice that the interior stable equilibrium is unique if the proportion of type θ agents is not decreasing with θ.

the sum of transfers given equal the sum of subsidies received. Among the p rich, each of the μ^* persons gives t, yielding an aggregate level of contribution $p\mu^* t$. This amount is shared between the $1-p$ poor, each of them receiving r. Hence, the budget balanced constraint writes:

$$p\mu^* t = (1-p)r. \tag{6}$$

For any risk-sharing rule (t, r), equation 6 together with 3 defines an unique equilibrium level of compliance μ^*. A rule (t, r) such that there exists an equilibrium level of compliance μ^* that satisfies 3 and 6 will be referred as *balanced*. Moreover, if this level of compliance is (locally) stable (i.e. satisfies 4) we will say that (t, r) is a *feasible* risk-sharing rule. The set of such risk-sharing policies is denoted Φ.[14]

In the voting process, I restrict attention to feasible risk-sharing policies. I assume perfect foresight: When a person votes for a risk-sharing rule, he correctly anticipates the unique population share which is stable and which balances contributions and subsidies. His expectation guides also his future choice to comply or not. I turn now to the voting process.

6 Political equilibrium

When deciding to vote for or against a feasible risk-sharing rule (t, r), an arbitrary agent of type θ computes his expected payoff if he complies,

$$U_c(t, r) = pu(\bar{y} - t) + (1-p)u(\underline{y} + r), \tag{7}$$

as well as his expected payoff if he does not,

$$U_n(t, r, \theta) = p\{u(\bar{y} - t) - \theta(1 - p + \mu^* p)s\} + (1-p)u(\underline{y} + r), \tag{8}$$

where μ^* is defined by 3 and 6, and satisfies 4.

[14] It is easy to show that Φ is not empty. Indeed, if both transfers are zero, then all individuals enforce the policy which is budget balanced (at zero) and stable. This establishes that $(0, 0) \in \Phi$.

Anticipating her future choice to comply or not the candidate policy, a person's expected payoff with the risk-sharing policy (t, r) is the maximal value of 7 and 8, formally,

$$U(t, r, \theta) = \max\{U_c(t, r), U_n(t, r, \theta)\}.$$

A person prefers $(t, r) \in \Phi$ to $(t', r') \in \Phi$ if and only if $U(t, r, \theta) \geq U(t', r', \theta)$.

In this section, I use the political equilibrium notion of *unbeatable rule*, by which I mean a feasible risk-sharing rule such that there is no other feasible risk-sharing rule that a majority of the population would prefer. Formally, $(t, r) \in \Phi$ is an unbeatable policy if no other $(t', r') \in \Phi$ is such that more agents prefer (t', r') to (t, r).[15]

We will focus on two specific risk-sharing rules. The first one is called the *best compliant rule*. Denoted (t^c, r^c), it is defined as the risk-sharing rule that maximizes the expected utility of those who comply to it, formally $U_c(t, r)$. More precisely, (t^c, r^c) solves

$$\max_{t,r} pu(\bar{y} - t) + (1 - p)u(\underline{y} + r) \text{ subject to 3, 4, and 6.} \tag{9}$$

The second specific risk-sharing rule is the *median voter's uncompliant rule* denoted (t^m, r^m). It is defined as the rule that maximizes the median voter's expected payoff when he does not comply to it, formally $U_n(t, r, \theta_m)$. To be precise, (t^m, r^m) solves:

$$\max_{t,r} p\{u(\bar{y}) - \theta_m(1 - p - p\mu^*)s\} + (1 - p)u(\underline{y} + r) \text{ subject to 3, 4, and 6.} \tag{10}$$

The following propositions and corollaries establish the central rule played the best compliant policy.

Proposition 1 *If the best compliant risk-sharing rule (t^c, r^c) is an unbeatable rule then a majority of rich comply to it.*

Proof Suppose that (t^c, r^c) is an unbeatable rule and that only a minority of rich comply to it. Then all rich agents $\theta \in [\underline{\theta}, \theta_m]$ (recalls that θ_m denotes the median voter's type) at least do not comply. In particular, if the median voters θ_m does not comply. He would therefore

[15] The same notion of unbeatable policy is used in Lindbeck and al. (1999)

prefer (t^m, r^m) to (t^c, r^c), i.e. $U_n(t^m, r^m, \theta_m) \geq U_c(t^c, r^c)$. Moreover, since U_n is decreasing with θ, $U_n(t^m, r^m, \theta) > U_n(t^m, r^m, \theta_m) \geq U_c(t^c, r^c)$ for every $\theta < \theta_m$. Hence all voter $\theta \in [\underline{\theta}, \theta_m]$ prefer (t^m, r^m) to (t^c, r^c) which contradicts that (t^c, r^c) is an unbeatable risk-sharing rule.□

Proposition 2 *If $U_c(t^c, r^c) \geq U_n(t^m, r^m, \theta_m)$ then the best compliant risk-sharing rule (t^c, r^c) is the unique unbeatable rule and a majority of rich complies.*

Proof Suppose $U_c(t^c, r^c) \geq U_n(t^m, r^m, \theta_m)$. I show that (t^c, r^c) is the only unbeatable risk-sharing rule. Consider another feasible risk-sharing rule (t', r'). By definition of (t^c, r^c), (t', r') can be preferred only by those who do not comply to it. Since $U_n(t', r', \theta_m) \leq U_n(t^m, r^m, \theta_m) < U_c(t^c, r^c)$, the median voter prefers (t^c, r^c) to (t', r'). Now, for any θ, define (t^θ, r^θ) as θ's best (feasible) uncompliant rule, formally $(t^\theta, r^\theta) = \max_{\theta \in \Phi} U_n(t, r, \theta)$. The envelope theorem yields:

$$\frac{dU_n(t^\theta, r^\theta, \theta)}{d\theta} = \frac{\partial U_n(t^\theta, r^\theta, \theta)}{\partial \theta} = -p(1 - p + \mu^* p)s,$$

where μ^* denotes the level of compliance which balances (t^θ, r^θ). Since the right-hand side is non-positive, for any $\theta > \theta_m$, $U_n(t', r', \theta_m) \leq U_n(t^\theta, r^\theta, \theta) \leq U_n(t^m, r^m, \theta_m) < U_c(t^c, r^c)$. Hence, all individuals $\theta \in [\theta_m, \bar{\theta}]$ prefer (t^c, r^c) to (t', r'). Since they constitute a majority, (t^c, r^c) is unbeatable.□ At this stage, it might be useful to provide a graphic representation

of the political equilibria. The case $U_c(t^c, r^c) \geq U_n(t^m, r^m, \theta_m)$ is represented below.

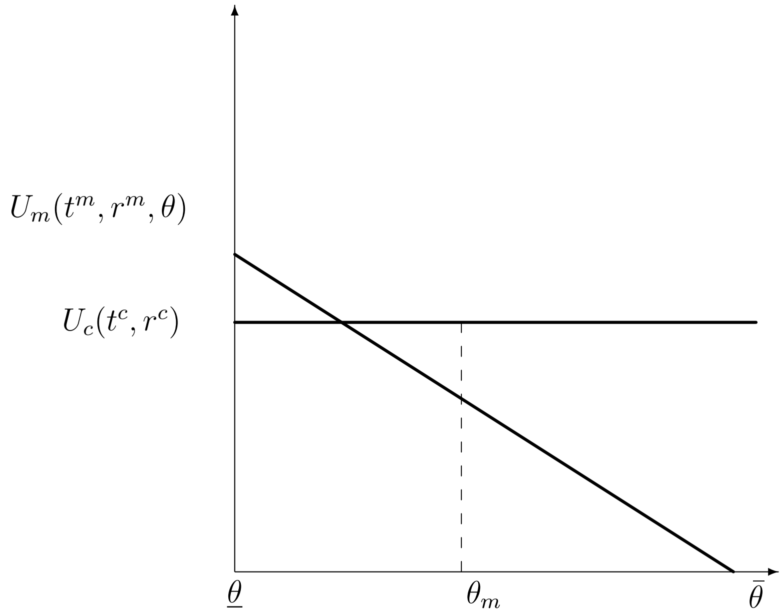

Figure 2

In this case, as shown in Proposition 1, a majority comply to (t^c, r^c). The only way for those who comply to increase their payoff is to adopt a risk-sharing rule they do not comply to. But, by assumption, such a rule does not improve the median voter's expected payoff. Moreover, it does not improve the expected payoff of all individual of higher type because they incur higher utility loss from not complying. Any other risk-sharing rule is therefore rejected by at least all $\theta \in [\theta_m, \bar{\theta}]$ who indeed constitute a majority of voters.

Consider now the case $U_c(t^c, r^c) \leq U_n(t^m, r^m, \theta_m)$. Then (t^c, r^c) might still beat other feasible risk-sharing rules, for instance (t^m, r^m) as in Figure 3 below.

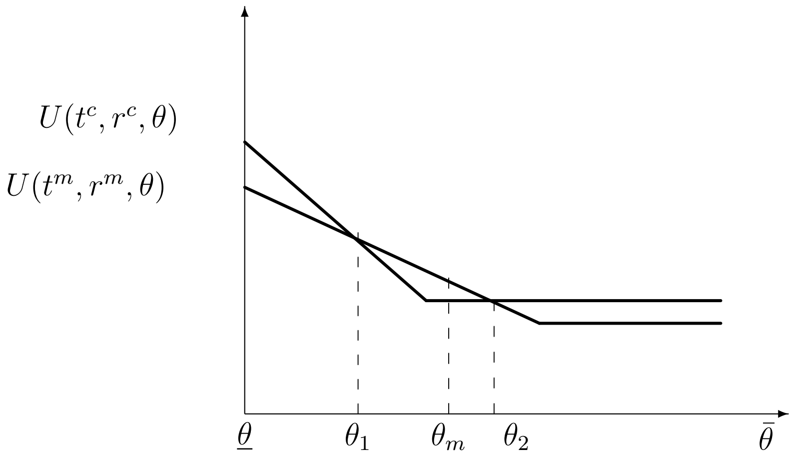

Figure 3

Here, (t^c, r^c) supported by a coalition of a groups of people with low θ (i.e. $\theta \leq \theta_1$) and another group of people with high θ (i.e. $\theta \geq \theta_2$). People with $\theta \leq \theta_1$ prefer (t^c, r^c) to (t^m, r^m) because they can support a (possibly) higher level of compliance than θ_m and value a (possibly) higher subsidy $r^c > r^m$ due to more compliance. People with $\theta \geq \theta_2$ comply to both rules so they obviously prefer (t^c, r^c). This example illustrates that there can still exist a support for (t^c, r^c). Yet other risk-sharing rules might be elected. In particular, (t^m, r^m) might be an unbeatable policy. It is obviously the case, for instance, if the median voter is $\theta_m = \underline{\theta}$. Notice that if (t^m, r^m) is elected, then it is easy to show that only a minority (i.e. people with $\theta > \theta_m$) complies.

I now put further the investigation by imposing unanimity in the voting process.

Corrolary 1 *If unanimity is required then the best complaint risk-sharing rule* (t^c, r^c) *is the unique unbeatable rule and everybody comply to it.*

Proof For a feasible risk-sharing rule to be elected by unanimity, it must have the support of those who comply to it but they prefer (t^c, r^c). Hence, any feasible risk-sharing rule other than (t^c, r^c) is rejected by those who comply to it. For (t^c, r^c) to have an unanimous support, any individual must prefer (t^c, r^c) to his best noncompliance rule (t^θ, r^θ) (i.e. the feasible rule that maximizes $U_n(t, r, \theta)$) which holds if he complies to (t^c, r^c). Hence, everybody comply to (t^c, r^c).□

I now characterize more precise the best compliant risk-sharing rule (t^c, r^c), assuming that the proportion of type θ agents is not decreasing with θ, i.e. $f'(\theta) \geq 0$ for every $\theta \in [\underline{\theta}, \bar{\theta}]$.[16] The above condition guarantees that, after substituting for the constraints 3 and 6, the objective of program 9 is concave on t. The best compliant rule is then defined by the following first order condition:[17]

$$u'(\underline{y} + r^c)\left[\mu^* + t^c \frac{d\mu^*}{dt}\right] = u'(\bar{y} - t^c), \tag{11}$$

with $\mu^* = 1 - F\left(\dfrac{u(\bar{y}) - u(\bar{y} - t)}{(1 - p + p\mu^*)s}\right)$, $(1-p)r^c = t^c p \mu^*$ and $\dfrac{d\mu^*}{dt} \leq 0$.

First, first order condition 11 implies that if there is full compliance (i.e. $\mu^* = 1$) but full risk-sharing is not achieved, the transfer made is the highest transfer accepted by the agent who is the least affected by social sanction (otherwise, we would have $\dfrac{d\mu^*}{dt} = 0$, therefore, full risk-sharing would be implemented). Therefore, even if everybody comply, the rule might impose only partial risk-sharing.

Second, 11 characterizes the trade-off between risk-sharing by ex post income-sharing and incentive to comply. Remember, the goal of the informal rule is to share risk ex ante by redistributing ex post the revenue. With fully enforceable rules, the first best risk-sharing rules (i.e. full income-sharing) equalizes the individual's marginal utilities in each state of nature ("successful" or "unsuccessful"). Here, this equality is limited by enforcement. The risk-sharing rule equalizes the marginal utility in the good state of nature to the marginal utility in the bad state of nature adjusted by the losses resulting from the noncompliance. This term reflects the fact that when the transfer is increased, the utility lost in the good

[16] This assumption is made reasonable by interpreting θ as the individual's distance (physical or psychological) from the "core" of the community located at $\theta = \bar{\theta}$. It simply imposes that the proportion of community members does not increase as we move away from the core of the community.

[17] The first and second order conditions are provided in Appendix.

state of nature does not fully compensate for the utility earned in the bad state of nature. If a successful person has to give one extra unit of consumption, a unsuccessful would only receive only μ^* units for a constant level of compliance. Moreover, an increase of t makes the risk-sharing rule less attractive. Therefore, the equilibrium level of compliance μ^* decreases (Recalls that $\frac{d\mu^*}{dt} < 0$ for stable equilibrium). Hence, the increase in transfer received by the unsuccessful person is less than μ^*.

One concern of the empirical literature regarding informal risk-sharing is to test if people share full idiosyncratic risk (e.g. Townsend, 1994). Going back to majority voting, Corollary 2 provides necessary and sufficient condition for the emergence of full risk-sharing.

Corrolary 2 *Suppose $U_c(t^c, r^c) > U_n(t^m, r^m, \theta_m)$. Then full risk-sharing is the the unique unbeatable risk-sharing rule if and only if everybody comply to it.*

Proof First suppose that everybody comply to complete risk-sharing, hereafter denoted (t^f, r^f). Then everybody gets in expectation $u(E[y])$ where $E[y] = p\bar{y} + (1-p)\underline{y}$. Since the policy is designed to share risk and not to exacerbate it, the only alternative feasible rule is such that $t' < t^f$. Since it requires to pay less, still everybody will comply to such a policy which means that everybody will gets $U_c(t', r')$ in expectation. However, u concave implies $U_c(t', r') < u(E[y])$ so that everybody prefer (t^f, r^f) to any other feasible rule $t' < t^f$.

Second, suppose that (t^f, r^f) is the unique unbeatable rule. Suppose further that some persons do not comply to it, i.e. $\mu^* < 1$. Then (t^f, r^f) does not satisfy 11. In other words, it is not the compliant best risk-sharing rule which contradicts it is the unique unbeatable rule. $\square$

7 Conclusion

This paper presents a political economy approach to informal risk-sharing. People share risk by redistributing ex-post their income. They vote over ex-post redistribution schemes under a "veil of ignorance", i.e. without knowing their income. The redistribution scheme is then enforced through social pressure: Those who comply to it exert a negative externality on the others. In this framework, some risk-sharing (i.e. ex-post redistribution) might emerge. In particular, it might leads to an equilibrium where a majority of people comply to the redistribution scheme that matches with their taste, while the others does not.

I now conclude with two remarks. First, to keep the analysis tractable, I have assumed that people vote being ignorant over their income. A more realistic assumption would be to assume that people know their current revenue when their vote but they are uncertain about their future revenue as in Wright (1986). This assumption creates more heterogeneity, in particular among the people who comply to the risk-sharing rule. Following Wright (1986), we can expect that the rich ones would favor less redistribution compared to the poor ones, especially if the rich (the poor) are more likely to remain rich (poor) in the future. As a result, risk-sharing would still be uncompleted not only due to limited enforcement but also to fit with the tastes of rich people when, as in Wright (1986), they constitute a majority of voters.

Second, it might also be more realistic to put some restriction on the social sanction. Indeed, it seems unlikely that people feel guilty or are punished if a majority of people behave like them. One might legitimately assume that the utility loss for deviating form the risk-sharing rule is incurred only if a majority complies to the risk-sharing rule. This restriction on social sanction would favor the best compliance risk-sharing rule defined in 9. In particular, if the compliance of the majority of the successful population is required, then the best compliance risk-sharing rule is obviously the unique elected rule. Furthermore, it implements full insurance if and only if everybody comply to this rule.

A Convexity

$\forall \mu : \underline{\mu} \geq \mu \geq \bar{\mu}$, $\tilde{\theta}(\mu) = \dfrac{u(\bar{y}) - u(\bar{y} - \alpha)}{[1 - p + p\mu]r}$. We have:

$$\tilde{\theta}'(\mu) = -p\frac{u(\bar{y}) - u(\bar{y} - t)}{(1 - p + p\mu)^2 s} < 0,$$

$$\tilde{\theta}''(\mu) = 2p^2\frac{u(\bar{y}) - u(\bar{y} - t)}{(1 - p + p\mu)^3 s} > 0.$$

B First and second order conditions

Substituting $r = \frac{p}{1-p}\mu^* t$ in the objective program, the transfer t^c can be found by maximizing $U_c(t, \frac{p}{1-p}\mu^* t)$ subject to 3 and 4. The first order condition writes:

$$\frac{\partial U_c}{\partial t} + \frac{\partial U_c}{\partial r}\frac{dr}{dt} = 0.$$

That is,

$$p\{u'(\underline{y} + r^c)[\mu^* + t^c\frac{d\mu^*}{dt}] - u'(\bar{y} - t^c)\} = 0,$$

where $\dfrac{d\mu^*}{dt} = -\dfrac{f(\tilde{\theta}(\mu^*))\dfrac{u'(\bar{y} - t^c)}{(1 - p + p\mu^*)s}}{1 + f(\tilde{\theta}(\mu^*))\tilde{\theta}'(\mu^*)}$.

Since $1 + f(\tilde{\theta}(\mu^*))\tilde{\theta}'(\mu^*) > 0$ for a stable equilibrium, then $\dfrac{d\mu^*}{dt} < 0$.

I now verify the second-order condition. Since $\tilde{\theta}'(\mu^*) = -p\dfrac{u(\bar{y}) - u(\bar{y} - t)}{(1 - p + p\mu^*)^2}$, the first derivative can be rewritten as:

$$p\{u'(\underline{y} + r)[\mu^* - \frac{f(\tilde{\theta}(\mu^*))t^c u'(\bar{y} - t^c)}{(1 - p + p\mu^*)s - pf(\tilde{\theta}(\mu^*))\dfrac{u(\bar{y}) - u(\bar{y} - t^c)}{1 - p + p\mu^*}}] - u'(\bar{y} - t^c)\}.$$

Substitute $\tilde{\theta}(\mu^*) = \dfrac{u(\bar{y}) - u(\bar{y} - t^c)}{(1 - p + p\mu^*)s}$ and rewrite the first derivative as,

$$p\{u'(\underline{y} + r^c)[\mu^* - \frac{f(\tilde{\theta}(\mu^*))t^c u'(\bar{y} - t^c)}{[1 - p + p\mu^* - pf(\tilde{\theta}(\mu^*))\tilde{\theta}(\mu^*)]s}] - u'(\bar{y} - t^c)\}.$$

The second derivative is:

$$p\{u''(\underline{y} + r^c)\frac{p}{1 - p}[\mu^* + t^c\frac{d\mu^*}{dt}]^2 + u'(\underline{y} + r^c)[\frac{d\mu^*}{dt} -$$
$$D\{u'(\bar{y} - t^c)[t^c f'(\tilde{\theta}(\mu^*))\frac{d\tilde{\theta}(\mu^*)}{dt} + f(\tilde{\theta}(\mu^*))] - f(\tilde{\theta}(\mu^*))t^c u''(\bar{y} - t^c)\} +$$
$$\frac{1}{D^2}\{f(\tilde{\theta}(\mu^*))t^c u'(\bar{y} - t^c)pr(\frac{d\mu^*}{dt} - f'(\tilde{\theta}(\mu^*))\frac{d\tilde{\theta}(\mu^*)}{dt}\tilde{\theta}(\mu^*) - f(\tilde{\theta}(\mu^*))\frac{d\tilde{\theta}(\mu^*)}{dt})\}] + u''(\bar{y} - t^c)\},$$

where $D = [1 - p + p\mu^* - pf(\tilde{\theta}(\mu^*))\tilde{\theta}(\mu^*)]s > 0$ (because $\dfrac{d\mu^*}{dt} < 0$) and, $\dfrac{d\tilde{\theta}(\mu^*)}{dt} = \tilde{\theta}'(\mu^*)\dfrac{d\mu^*}{dt} + \dfrac{u'(\bar{y} - t^c)}{[1 - p + p\mu^*]s} > 0$. Moreover, $u'' < 0$ and $f'(\theta) \geq 0$ for every $\theta \in \Theta$ by assumption. Hence, the second derivative is strictly negative.

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