Voting over informal risk sharing rules

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October 2006

Abstract

This paper posits a new approach to informal risk-sharing in developing countries. A risk-sharing rule is a collective choice which is individually enforced through peer-pressure. I determine the elected rule and the level of compliance. Full risk-sharing is achieved only if everybody complies. Partial risk-sharing arises more often with, sometime, some level of non-compliance. In many cases, a majority of people votes over and complies with the risk-sharing rule that maximizes their own expected payoff. Yet, for some parameters, a minority of people might comply with a rule that is detrimental to them.

Key words: risk sharing, mutual insurance, enforcement, peer-pressure, political economy.
JEL classification: H21, O15, O17.

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1 Introduction

High income fluctuations is part of life in developing countries. To cope with a risky environment, households have developed risk-sharing strategies, e.g., mutual assistance and private transfers within extended families, lineage or kinship groups (Fafchamps 1992, Besley, 1995, Fafchamps, 2003, Dercon 2004). Most of those strategies are informal in the sense that they are 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.

In a risky world populated by risk-averse agents, sharing risk is individually rational. Yet it entails some form of income redistribution from the most successful persons to the less successful ones. Even if they originally agreed on the rule, the formers might be reluctant to redistributed part of their income. This raises the issue of the enforcement of such risk-sharing rules in economies without legal enforcement systems.

This paper address the issue of the design and the enforcement of informal risk-sharing rules. It models the design of risk-sharing rules as a collective choice through a voting game. People vote behind a veil of ignorance over future income. The enforcement mechanism based on social pressure. People decide to comply or not with the risk-sharing arrangement after observing their income. Those who comply exert a negative externality on others. Those who do not comply incur an utility loss proportional to the level of compliance. This externality affects people differently. Some people are thus 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 with a rule. People aware of this enforcement problem 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 such a rule is fulfilled by everybody. Otherwise, and more likely, partial risk-sharing is achieved. In particular, the model often leads to a political equilibrium where a majority of people votes for and then complies with the risk-sharing rule that maximizes their own expected payoff.

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 or compliance problem in a non-cooperative game. Section 5 endogenizes the risk-sharing rule in a voting game. Section 6 examines the individual's incentives to increase personal wealth when people enforce a risk-sharing rule. Section 7 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, Bloch , Genicot and Ray, 2004, Dubois, Jullien and Magnac, 2005). These papers have formalized the idea that people are motivated by reciprocity when they perform private transfers: A rich person agrees to share his higher income because he expects to be paid back when he is in 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 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) also 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,

[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).

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 his community. I briefly illustrate this point with two anthropological studies.

The first one, "Kwanim Pa", by 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 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. James argues that 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. If his fields appear to do surprisingly well, he will be criticized to the same extent as if he 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).[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

[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.

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 that 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.

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 its members. People are governed by these informal rules which are enforced through social pressure: those who deviate suffer from public disapproval and/or social sanctions.

Accordingly, in this paper, risk-sharing is an informal rule which is designed democratically by the community through a voting process. Then each member individually decides to comply or not with the elected risk-sharing rule. People suffer from social pressure and/or sanctions if they do not comply. This translates formally in the model into an utility loss which is proportional to the level of compliance within the community.

This paper is not the first to model the cost of deviating from social norms. In his theory of social customs, Akerlof (1980) assumes that person's utility include his reputation within the community he or she belongs (an idea that goes back to Becker, 1974). As in the present paper, deviating from social customs imply a loss of reputation proportional to the level of norm obedience.[4]

The utility loss from non-complying to the solidarity obligation captures personal's feelings such a guilt or shame. 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. Shame might require a public observation of people's behavior. Therefore, one might expect that, consistency to empirical evidences, a large part of private transfers are performed during ceremonies like funerals (e.g. Parkin, 1972). The emotions are also intensified during those social events. There are experimental evidences that public judgement, rewards

[4]In labor economics, Kandel and Lazear (1992) have modeled peer pressure on work norms in a similar way.

and criticizes influences people's behavior. Experiments run in developed (Gächter and Fehr, 1999) and developing (Barr, 2001) countries suggest that socialization (i.e. discussion among player before or/and after the game) increases cooperation in public good games. They point out that non-pecuniary shame-based sanctions alone foster cooperation.[5]

The paper is related to the literature on the political economy of unemployment insurance. In Lindbeck, Nyberg and Weibull (1999), people vote over redistribution schemes from the workers to the jobless in an economy where living off one's own work is a social norm. The peer pressure to comply with the norm is modeled as in the present paper. However, the two papers differs on the policy and the social norm considered. Lindbeck and al. (1999) focus on redistribution with an exogenous working norm but legal enforcement (at no cost), whereas, here, peer pressure is a device to enforce redistribution. Also, in Lindbeck and al. (1999), people perfectly foresight their own income when they vote whereas here they vote behind a veil of ignorance. As a consequence, they are less prone to redistribution: If workers constitute a majority, the unique political equilibrium prescribes no income redistribution at all. In contrast, here, the political equilibrium entails some redistribution even with a majority of tax payers.

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

3 The model

A community is composed of a continuum of individuals of measure 1. Agents have quasi-linear preferences on consumption C and peer disapproval or social sanction S represented by the utility function $u(C) - \theta S$. The function u is assumed increasing and strictly concave

[5] In Harsanyi's words *"People's behavior can largely be explained in terms of two dominant interests: economic gain and social acceptance"* John Harsanyi (1969) (cited by Gächter and Fehr, 1999).

($u' > 0$, $u'' < 0$). All agents are thus equally risk averse but they are differently affected by peer disapproval/social sanction S. The parameter θ represents individual's taste for social sanction: Agents with a higher (lower) θ are more (less) hurt by the same sanction S. It is private information distributed in $\Theta = [\underline{\theta}, \bar{\theta}]$ according to a publicly known density function f. The cumulative is denoted F. The function f is strictly positive and twice continuously differentiable on Θ, and $f'(\theta) \geq 0$ for every $\theta \in \Theta$.[6] A person endowed with a utility parameter θ will be referred as a θ-person or a person of type θ.

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 $(t, r) \in \mathbb{R}^+ \times \mathbb{R}^+$. t is the tax paid by a successful/rich person while r is the subsidy received by a unsuccessful/poor person. It forces a rich person to consume only $\bar{y} - t$ and allows a poor person to consume $\underline{y} + r$. A risk-sharing rule must be budget balanced: what is given to the poor must be entirely financed by what is collected within the rich population share. However, some rich might not comply with the rule, i.e., not pay the tax t. We denote μ the proportion of compliance to the rule *within the rich population* (with $1 \leq \mu \leq 1$). The sanction incurred from non-compliance is $S = v(\mu)$, where v is an increasing and differentiable ($v' > 0$) and $v(0) = 0$.[7]

Since the $1 - p$ poor receive r and a share μ of the p rich pay t, the budget balance constraint writes,

$$p\mu t = (1 - p)r.$$

People make two choices. First, they vote over risk-sharing rules. Second, they individually

[6]The later assumption are useful to characterize more precisely the elected policies: it insures that objective function of Section 5's maximization programs are concave. Interpreting θ as the individual's distance (physical or psychological) from the "core" of the community located at $\theta = \bar{\theta}$, the assumption of f non-decreasing simply imposes that the proportion of community members does not increase as we move away from the core of the community.

[7]The sanction is in general increasing with the proportion of poor people in the community. Thus v might be an implicit function of $1 - p$ but I have chosen not to write it explicitly because p is exogenous.

decide wether to comply or not with the elected rule which means paying the tax t if they are rich.[8] 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".[9] 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 5).

4 Compliance with a risk-sharing rule

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 $u(\underline{y}+r)$.

Second, 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 a social sanction $S=v(\mu)$. His utility is $u(\bar{y})-\theta v(\mu)$. For a given proportion of the compliant rich μ, the rich θ-person decides to comply if:

$$u(\bar{y}-t) \geq u(\bar{y})-\theta v(\mu),$$

that is,

$$\theta \geq \frac{u(\bar{y})-u(\bar{y}-t)}{v(\mu)}.$$

To properly characterize the critical taste $\tilde{\theta}$ which divides the rich population among those who comply (those of type $\theta \geq \tilde{\theta}$), and those who do not (those of type $\theta < \tilde{\theta}$), we need new

[8] A poor would obviously comply with a rule that provides him more consumption.

[9] To be precise, the veil of ignorance is on income but not on references since each agent knows his θ when he votes. There is no veil of ignorance on income opportunities because the probability p is perfectly forecasted and homogeneous.

notation. Let $\bar{\mu}$ denote the minimum proportion of an compliant rich that convinces an agent of type $\theta = \bar{\theta}$ to comply, formally:

$$u(\bar{y} - t) = u(\bar{y}) - \bar{\theta} v(\bar{\mu}).$$

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

$$u(\bar{y} - t) = u(\bar{y}) - \underline{\theta} v(\underline{\mu}).$$

Since $\bar{\theta} > \underline{\theta}$, $v(\bar{\mu}) < v(\underline{\mu})$ and $\bar{\mu} < \underline{\mu}$. Notice that $\underline{\mu}$ does not exist if agent $\underline{\theta}$ does not comply when $\mu = 1$. That is, if $u(\bar{y} - t) < u(\bar{y}) - \underline{\theta} v(1)$. In this case, we set $\underline{\mu} = 0$.

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

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

While expecting μ, people with $\theta \geq \tilde{\theta}(\mu)$ (respectively $\theta < \tilde{\theta}(\mu)$) comply (do not comply) with (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). They are defined by:

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

or, more precisely,

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

Mathematically, here, an equilibrium is a fixed point. Since the right-hand side in (3) is increasing and continuous on $[0,1]$, there exists at least one fix point.

Figures 1 and 2 below provides two graphic illustrations in the case θ uniformly distributed in $[\underline{\theta}, \bar{\theta}]$ and $v(\mu) = (1 - p + p\mu)s$ with $s > 0$. It represents the function $\tilde{\theta}(\mu)$ defined in (1) by the plain line and the relation (2) by the dotted line.

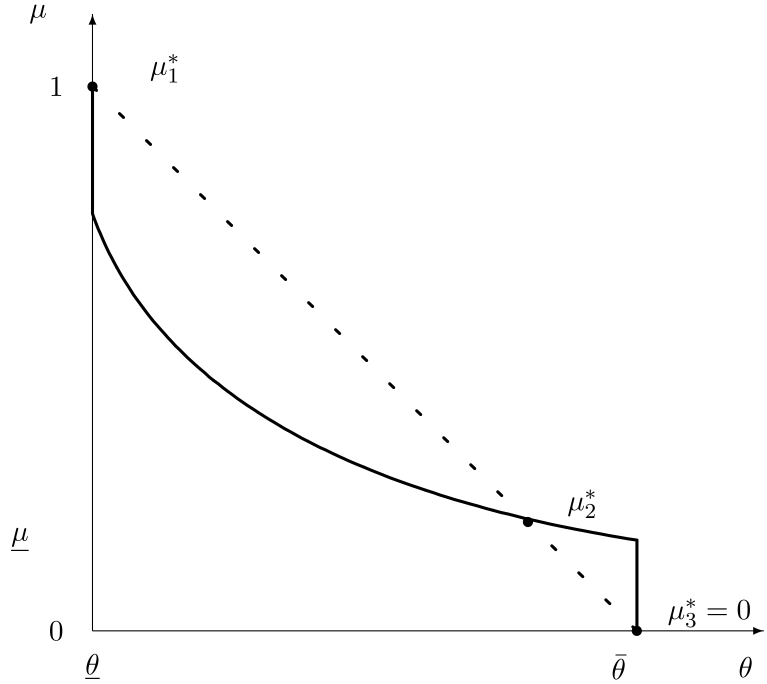

Figure 1

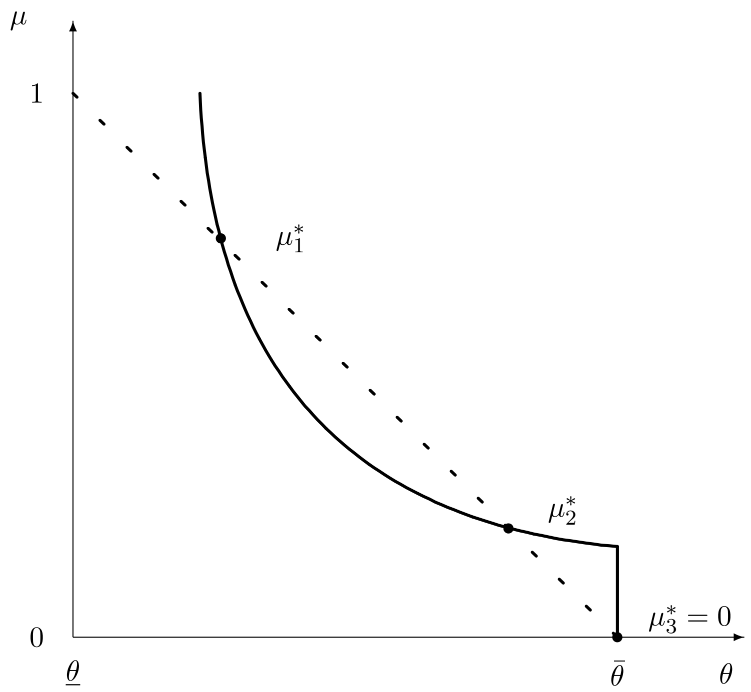

Figure 2

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 level (full compliance in Figure 1 and partial compliance in Figure 2) and one equilibrium μ_2^* with low compliance level. The peer-pressure v might be high enough to make everybody comply. Graphically, when v increases for any level of compliance μ, the plain curve moves downward in Figure 2. It might then crosse the vertical axe and then $\mu_1^* = 1$. Otherwise, some rich people deviate from the risk-sharing rule.

Clearly, in general, the game leads to several equilibrium levels of compliance. Multiplicity of equilibria raises the question of the equilibrium selection that I address now.

First, among this equilibria, some of them are unstable. For instance, 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.[10] They are therefore excluded. An interior equilibrium μ^* is

[10]Indeed, a deviation from a (positive measured) subset of agents from μ_2^* leads to either μ_1^* and μ_3^* when people readjust their expectations following a tâtonnement process. Consider, for instance, a deviation from

locally stable if it satisfies:[11]

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

with $\tilde{\theta}'(\mu^*) = -\frac{v'(\mu^*)}{v(\mu^*)^2}(u(\bar{y}) - u(\bar{y} - t))$. It implies that less people comply in equilibrium when the informal tax t increases, i.e.,

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

Second, the risk-sharing rule itself coordinates people's expectation on an unique level of compliance through the budget balance. Indeed, knowing the level of per-capita tax t and subsidy r, people can perfectly foresee the unique stable equilibrium level of compliance that balances the risk-sharing rule. Formally, they compute μ^* that satisfies:

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

When deciding to comply or not, a rich person expects the level of compliance to satisfy (6). Doing so, she selects a single equilibrium among the set of equilibria. Moreover, in the voting process, people only consider the risk-sharing rules that are budget-balanced by a stable level of compliance as potential candidates. They vote only on risk-sharing rules (t, r) for which there exists a level of compliance μ^* that satisfies equations (3), (4) and (6). I now turn to the voting process.

5 Political equilibria

A rule (t, r) such that there exists an equilibrium level of compliance μ^* that satisfies (3), (4) and (6) will be referred as a *feasible* risk-sharing rule. The set of such risk-sharing policies is denoted Φ.[12] Only feasible risk-sharing rules are candidate.

the out-of-equilibrium level of compliance $\mu' \neq \mu_2^*$. Assume that, staring from the expected level of compliance μ', people play their best reply until they reach the next Nash equilibrium. Then μ_3^* or μ_1^* would be reached, not μ_2^*.

[11] $\tilde{\theta}'$ denotes the first derivative of the function $\tilde{\theta}$. Notice that the interior stable equilibrium is unique if the proportion of type θ agents is not decreasing with θ.

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

When deciding to vote for or against a feasible risk-sharing rule $(t,r)\in\Phi$, 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,

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

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

Anticipating her future compliance choice, a person's expected payoff with the risk-sharing rule (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 $U(t,r,\theta)\geq U(t',r',\theta)$.

I now present two specific risk-sharing rules. First, the *best compliant rule* is the risk-sharing rule that maximizes the expected utility of those who comply with it. It is denoted (t^c,r^c). Formally, the tax level t^c solves,

$$\max_t pu(\bar{y}-t)+(1-p)u(\underline{y}+\frac{p\mu^*t}{1-p}), \tag{9}$$

subject to μ^* satisfies (3) and (4). The subsidy is $r^c=\dfrac{p\mu^*t^c}{1-p}$.

Notice that the equilibrium level of compliance μ^* selected in the program (9) is the highest among all that can be implemented by t^c because it maximizes the subsidy r^c.

Second, *θ's best uncompliant rule* (t^θ,r^θ) is the rule that maximizes a θ-person's expected utility. The transfer t^θ solves,

$$\max_t pu(\bar{y})-\theta v(\mu^*)+(1-p)u(\underline{y}+\frac{p\mu^*t}{1-p}), \tag{10}$$

subject to μ^* satisfies (3) and (4). The subsidy is $r^\theta=\dfrac{p\mu^*t^\theta}{1-p}$.

We compare the above rules in the next subsections.

strictly positive transfer t and equilibrium level of obedience μ^* are generally included in Φ (see the examples hereafter). A necessary condition for Φ to include non-nil risk-sharing rules is $\underline{\theta}>0$ and $v(1)>1$: every rich people pay a low enough tax t, i.e. close enough to 0.

5.1 The best compliant rule as a Condorcet winner

Denote the median voter θ_m. The next proposition provides a necessary condition of the best compliant rule to be elected.

Proposition 1 *If $U_c(t^c, r^c) \geq U_n(t^{\theta_m}, r^{\theta_m}, \theta_m)$ then the best compliant risk-sharing rule (t^c, r^c) is a Condorcet winner and a majority of rich complies.*

(Proof are relegated to the Appendix).

The starting assumption of Proposition 1 is that the median voter is better-off with the first option. In this case, the majority complies with (t^c, r^c). By definition of (t^c, r^c), those who comply cannot increase their expected payoff with another rule. For them, the only way to increase their payoff is to elect a rule they do not comply with, preferably their best uncompliant rule. But, by assumption, the median's voter uncompliant rule yields a lower expected payoff to the median voter. In addition, the θ's best uncompliant rule yields lower expected payoff to any individuals of type $\theta \geq \theta_m$ because those persons are more affected than the median voter by the social sanction. Since they constitute a majority, no rule can defeat (t^c, r^c), which is a Condorcet winner.

Under the assumptions v twice continuously differentiable and not "too convex",[13] and $f'(\theta) \geq 0$ for every $\theta \in \Theta$, the objective function of the above maximization program are concave with a unique solution. In particular, the best complaint rule is thus defined by the following first order condition:[14]

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

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

First, (12) implies that if there is full compliance ($\mu^* = 1$) but full risk-sharing ($\bar{y} - t^c = \underline{y} + r^c$) 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 prescribe only partial risk-sharing.

[13] Formally, $v'(\mu^*) \geq f(\tilde{\theta}(\mu^*))\tilde{\theta}(\mu^*)v''(\mu^*)$.

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

Second, (12) characterizes the trade-off between risk-sharing and enforcement. Remember that 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, which is the full risk-sharing rule, equalizes the individual's marginal utilities in each state of nature ("successful" or "unsuccessful"). Here, due to limited by enforcement, the risk-sharing rule equalizes the marginal utilities adjusted by the losses resulting from noncompliance. This term reflects the fact that when the transfer t is increased, the utility lost when successful does not fully compensate for the utility earned when unsuccessful. If a successful person has to give one extra unit of consumption, a unsuccessful person would only receive μ^* units for a constant level of compliance. Moreover, an increase of t makes the risk-sharing rule less attractive for the successful persons. Therefore, the equilibrium level of compliance μ^* decreases (Recalls that $\frac{d\mu^*}{dt} < 0$ for stable equilibria). Hence, the increase of the subsidy r is less than μ^*.

The empirical literature regarding informal risk-sharing has extensively tested and, in general, rejected a full sharing of (idiosyncratic) risk (e.g. Townsend, 1994, Ligon, Thomas and Worral, 2002). Corollary 1 provides conditions for the emergence of full risk-sharing.

Corollary 1 *Full compliance with the full risk-sharing rule is a necessary condition for the full risk-sharing rule to be elected. It is also a sufficient condition when* $U_c(t^c, r^c) \geq U_n(t^{\theta_m}, r^{\theta_m}, \theta_m)$.

In this model but without enforcement problems, full risk-sharing is efficient. It indeed maximizes people's expected utility when everybody comply. If everybody comply with the full risk-sharing rule, everybody would also comply with less demanding risk-sharing rules. But such rules assign lower expected payoff to anybody. Therefore people unanimously prefer the full risk-sharing rule when they all comply with this rule. Full risk-sharing would therefore be elected when everybody comply with it.

5.2 The best uncompliant rule

The first order condition that satisfies θ's best uncompliant transfer (if exists) is:

$$u'(\underline{y} + r^\theta)\left[\mu^* + t^c \frac{d\mu^*}{dt}\right] = \theta v'(\mu^*)\frac{d\mu^*}{dt}, \tag{12}$$

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

It equalizes the marginal benefit of the subsidy adjusted by the loss due to noncompliance to the marginal cost of the transfer which is, for a noncomplying person, the utility loss due to social disapproval.

It is easy to show that any individual θ's best uncompliant rule imposes a higher tax than his best compliant rule, i.e., $t^\theta > t^c$. Indeed, since, by definition, θ complies with (t^c, r^c) but not (t^θ, r^θ), the reverse assumption $t^\theta \leq t^c$ could only be explained by a higher social sanction with t^c than with t^θ. But that would imply a higher expected level of compliance μ^* with a higher tax which is a contradiction. However, even if the tax is higher, the subsidy might be lower since less people comply.

The example in the next section shows that the median voter's best uncompliant rule $(t^{\theta_m}, r^{\theta_m})$ might be elected. In this case, only a minority of people (some of those with θ strictly higher than θ_m) complies. This happens of course when the reverse of Proposition 1's condition $U_c(t^c, r^c) \leq U_n(t^{\theta_m}, r^{\theta_m}, \theta_m)$ holds. In this case, the example also shows that other risk sharing policies might be elected.

5.3 A three-type example

Assume that the heterogeneity of preferences is reduced to three values $\underline{\theta}$, θ_m, $\bar{\theta}$, with $\underline{\theta} < \theta_m < \bar{\theta}$, in respective proportion $\underline{q}$, q_m, $\bar{q}$, in the community, with $\underline{q} + q_m + \bar{q} = 1$. θ_m is still the median voter's type which implies $\underline{q} + q_m > \frac{1}{2}$ and $\bar{q} + q_m > \frac{1}{2}$. Notice that, due to the discontinuity of the density function for this three-type case, we cannot use the previous differentiation and integration techniques. Therefore, the optimality conditions previously derived will be slightly different. Nevertheless, by restricting to three types of θ, this example is simple and rich enough to convey some intuition.

First, of course, Corollary 1 still hold: full risk-sharing is elected if (i) everybody comply with it and (ii) it is the median voter's best rule. Indeed, in this case, the best compliant rule (t^c, r^c) prescribes to share fully risk. Full risk-sharing with full compliance implies the same level of consumption for all revenues, equals to the average revenue, formally, $\bar{y} - t^c = \underline{y} + r^c = p\bar{y} + (1-p)\underline{y}$. The full risk-sharing rule is a Condorcet winner when all $\underline{\theta}$-persons comply with this rule, i.e., if $u(p\bar{y} + (1-p)\underline{y}) \geq u(\bar{y}) - \bar{\theta}v(1)$.[15]

Second, when the above condition does not hold (i.e. some people do not comply with the full risk-sharing rule), the best compliant rule (t^c, r^c) prescribes only partial risk-sharing. It can be still with full compliance. In this case, t^c is the highest tax that makes a $\underline{\theta}$-person comply. Formally, t^c is such that $u(\bar{y} - t^c) = u(\bar{y}) - \bar{\theta}v(1)$. It can also be with partial compliance. Since it might be too costly in term of risk-sharing to make everybody comply, people might prefer an higher tax even if they loose all $\underline{\theta}$-persons as contributors. Then only individuals of type θ_m and $\bar{\theta}$ comply with (t^c, r^c). The level of compliance within the rich population is $\mu^* = q_m + \bar{q}$. The budget balance constraint writes $(q_m + \bar{q})pt^c = (1-p)r^c$. The best compliant rule (t^c, r^c) is then defined by the following first-order condition:[16]

$$u'(\underline{y} + r^c)(q_m + \bar{q}) = u'(\bar{y} - t^c).$$

Such a rule is elected against all other feasible rules when the median voter complies with it, that is when $u(\bar{y} - t^c) \geq u(\bar{y}) - \theta_m v(q_m + \bar{q})$.

Third, when the above condition is not satisfied, then the best compliant rule is not elected.[17] The median voter's best uncompliant rule, denoted $(t^{\theta_m}, r^{\theta_m})$, might be elected. In the present example, t^{θ_m} is simply the highest tax that a $\bar{\theta}$-person is willing to pay. Formally, t^{θ_m} is such that a $\bar{\theta}$-person is indifferent between complying or not. It satisfies $u(\bar{y} - t^{\theta_m}) = u(\bar{y}) - \bar{\theta}v(\bar{q})$. As long as $t^{\theta_m} \neq t^c$, since both tax yield the same level of compliance $\bar{q}$, we have $r^{\theta_m} > r^c$. Given that both rules yield the same level of compliance and, therefore, the same social sanction S, all those who do not comply with both rules, i.e., people of type $\underline{\theta}$ and θ_m, prefer the median voter's best uncompliant rule $(t^{\theta_m}, r^{\theta_m})$ than the best compliant rule (t^c, r^c) because the subsidy is higher: $r^{\theta_m} > r^c$. Since they constitute a majority, then $(t^{\theta_m}, r^{\theta_m})$ defeats (t^c, r^c).

Yet, another rule (other than $(t^{\theta_m}, r^{\theta_m})$ or (t^c, r^c)) can be elected still when the median

[15] As before, it is assumed that a agent's weigh is nil in the non-cooperative compliance subgame: When deciding not to comply, an individual does not consider the simultaneous deviation of all persons of same type. Nevertheless, the model could accommodate for a simultaneous deviation of all agents of same type without changing the results qualitatively.

[16] This condition is a special case of the first-order condition (12).

[17] This corresponds to the case $U_c(t^c, r^c) < U_n(t^{\theta_m}, r^{\theta_m}, \theta_m)$ not addressed so far.

voter does not comply with (t^c, r^c). People of type $\underline{\theta}$ and $\bar{\theta}$ could agree to reduce the tax level at $t' < t^{\theta_m}$ in order to make the median voter comply. The elected tax level t' is then the highest tax that make the median voter be indifferent between complying or not. Formally t' is such that $u(\bar{y} - t') = u(\bar{y}) - \theta_m v(q_m + \bar{q})$. For (t', r') to be elected, the people of type $\underline{\theta}$ and $\bar{\theta}$ must constitute a majority, i.e., we must have $\bar{q} + \underline{q} > \frac{1}{2}$. Furthermore, the $\underline{\theta}$-persons should prefer (t', r') to $(t^{\theta_m}, r^{\theta_m})$, i.e., $U_n(t', r', \underline{\theta}) \geq U_n(t^{\theta_m}, r^{\theta_m}, \underline{\theta})$. For the second condition to hold, the elected rule must yields a higher subsidy $r' > r^{\theta_m}$ to compensate for a higher social sanction due to more compliance ($q_m + \bar{q}$ instead of $\bar{q}$).

To sum-up, when the best compliant rule is not elected, this example shows first that the median voter's uncompliant rule might be elected. In this case, only a minority of people complies with the elected rule. Moreover, the elected rule maximizes the expected payoff of a non-compliant person, namely the median voter. Second, a rule which prescribes a "medium" tax level $t^c < t' < t^{\theta_m}$ might also be elected. This rule is supported by a coalition which includes people with high θ who comply anyway and people with low θ who do not comply but can cope with higher disapproval due to a higher level of compliance. In this case, the median voter's favorite rule is not elected.

Clearly, the above results and example show that people have conflicting interests when they collectively choose an informal risk-sharing rule. Does that mean that some people are worse off with the elected rule? This question is examined in the next subsection.

5.4 Welfare impact of the informal risk-sharing rule

First, it is easy to see that having (t^c, r^c) elected and enforced is better than the status quo (no risk-sharing) for everybody. Indeed, when $(t^c, r^c) \neq (0, 0)$,[18] then $U(t^c, r^c, \theta) \geq U_c(t^c, r^c) > U_c(0, 0)$ for every $\theta \in [\underline{\theta}, \bar{\theta}]$. In words, with (t^c, r^c), everybody gets at least the expected utility level of a compliant person. Since, by definition, this person is strictly better-off with her best complaint rule than with no risk-sharing (as long as no risk-sharing is not the best compliant rule), then everybody is also strictly better-off with (t^c, r^c) than with the status quo.

[18] $(t^c, r^c) = (0, 0)$ means that the best compliant rule prescribes no risk-sharing and then is equivalent to the status quo.

Second, when (t^c, r^c) is not elected, people comply with a rule that does not maximize their own expected utility. Rather, the rule maximizes the utility of someone who do not comply with it. Are the compliant persons always better-off with the elected risk-sharing rule than without any rule? The answer is no. Recall that the example in Section 5.3. All of those who comply with $(t^{\theta_m}, r^{\theta_m})$ are indifferent between complying or not. They are better without risk sharing if $U_c(0,0) > U_c(t^{\theta_m}, r^{\theta_m}) = U_n(t^{\theta_m}, r^{\theta_m}, \bar{\theta})$, which reduces to $p\bar{\theta}v(\mu^*) > (1-p)(u(\underline{y} + r^{\theta_m}) - u(\underline{y}))$, i.e., the sanction from deviating weighted by the probability of becoming rich exceeds the marginal benefit of the risk-sharing rule weighted by the probability of being poor. The inequality holds for a subsidy r^{θ_m} low enough and a social sanction $\bar{\theta}v(\mu^*)$ high enough. It would be the case if a majority of people are not affected by the sanction, i.e. $\underline{\theta} = \theta_m \approx 0$, whereas those who are incurs a high cost from not complying ($\bar{\theta}$ very high). Then the majority who do not comply when rich imposes a high tax level which finances a low subsidy r. They somehow "free ride" on the compliant minority by imposing a high transfer without paying it.

Proposition 2 *If (t^c, r^c) is elected then everybody benefit from informal risk-sharing. Otherwise some of those who comply might not benefit from it.*

Before concluding, notice Proposition 2 implies that if (t^c, r^c) is elected by a majority voting rule, it would also be elected with a more stringent voting rule such as unanimity.

6 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" about future income. The redistribution scheme is then enforced through social pressure: Those who comply exert a negative externality on the others. In this framework, some risk-sharing (ex post redistribution) might emerge. The political equilibrium is often such that a majority of people complies with the risk-sharing rule that matches with their own taste, while the others does not. In this case, the risk-sharing rule is welfare enhancing for everybody. Yet the political equilibrium might be such that only a minority of people complies with a risk-sharing rule that maximizes the expected payoff of a non-compliant person. In this case, those who comply with the rule might be worse off than without risk-sharing.

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 they vote but they are uncertain about their future revenue as in Wright (1986). This assumption creates some heterogeneity among the voters. Following Wright (1986), one can expect that the richest ones would favor less redistribution compared to the poorest ones, especially if rich (poor) people are more likely to remain rich (poor) in the future. As a result, risk-sharing would still be uncomplete not only due to limited enforcement but also to fit with the tastes of rich people when they constitute a majority of voters as in Wright (1986).

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 when a majority of people behave like them. The social sanction from deviating from the rule may be effective only if a majority complies with the rule. This restriction on social sanction would obviously favor the best compliance risk-sharing rule (defined as the rule that maximizes the expected utility of those who comply). It would indeed be a Condorcet winner because any majority in favor of another rule would be composed by those who expect not to comply with it and, therefore, would never be enforced.

A Proof of Proposition 1

Suppose $U_c(t^c, r^c) \geq U_n(t^{\theta_m}, r^{\theta_m}, \theta_m)$. I first show that (t^c, r^c) is a Condorcet winner. 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 with it. Since $U_n(t', r', \theta_m) \leq U_n(t^{\theta_m}, r^{\theta_m}, \theta_m) < U_c(t^c, r^c)$, the median voter prefers (t^c, r^c) to (t', r'). Now, for any θ, using envelope theorem, we have:

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

where μ^* denotes the level of compliance which balances (t^θ, r^θ). Since the right-hand side is strictly negative, then for any $\theta > \theta_m$, $U_n(t\theta, r^\theta, \theta) < U_n(t^{\theta_m}, r^{\theta_m}, \theta_m)$. Therefore, we have $U_n(t', r', \theta_m) \leq U_n(t^\theta, r^\theta, \theta) < U_n(t^{\theta_m}, r^{\theta_m}, \theta_m) \leq U_c(t^c, r^c)$. 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 a Condorcet winner.

Second, when $U_c(t^c, r^c) \geq U_n(t^{\theta_m}, r^{\theta_m}, \theta_m)$ and (t^c, r^c) is elected, all agents $\theta \in [\theta^m, \bar{\theta}]$ comply. They constitute a majority.

B Proof of Corollary 1

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 rule 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 comply with such a rule which means that everybody 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 elected. Suppose further that some persons do not comply with it, i.e. $\mu^* < 1$. Then (t^f, r^f) does not satisfy (12). In other words, it is not the best compliant risk-sharing rule which contradicts it is elected when $U_c(t^c, r^c) \geq U_n(t^{\theta_m}, r^{\theta_m}, \theta_m)$.

C First and second order conditions

The best compliant transfer t^c solves:

$$\max_{t,r} pu(\bar{y} - t) + (1-p)u(\underline{y} + \frac{p}{1-p}\mu^* t) \tag{13}$$

The first order condition is:

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

with $r = \frac{p}{1-p}\mu^* t$, which yields:

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

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

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 $\tilde{\theta}'(\mu^*) = -\dfrac{(u(\bar{y})-u(\bar{y}-t))v'(\mu^*)}{v(\mu^*)^2}$, the first derivative can be rewritten as:

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

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

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

The second derivative is:

$$p\left\{u''(\underline{y}+r^c)\frac{p}{1-p}[\mu^* + t^c\frac{d\mu^*}{dt}]^2 + u'(\underline{y}+r^c)\left[\frac{d\mu^*}{dt} - A\right] + u''(\bar{y}-t^c)\right\},$$

where

$$A = \frac{1}{D}\left\{f'(\tilde{\theta}(\mu^*))\frac{d\tilde{\theta}}{dt}(\mu^*)t^c u'(\bar{y}-t^c) + f(\tilde{\theta}(\mu^*))u'(\bar{y}-t^c) - f(\tilde{\theta}(\mu^*))t^c u''(\bar{y}-t^c)\right\}$$
$$- \frac{1}{D^2}f(\tilde{\theta}(\mu^*))t^c u'(\bar{y}-t^c)\left\{\left(v'(\mu^*) - f(\tilde{\theta}(\mu^*))\tilde{\theta}(\mu^*)v''(\mu^*)\right)\frac{d\mu^*}{dt} - f'(\tilde{\theta}(\mu^*))\frac{d\tilde{\theta}}{dt}(\mu^*)\tilde{\theta}(\mu^*)v'(\mu^*)\right\},$$

with $D = v(\mu^*) - f(\tilde{\theta}(\mu^*))\tilde{\theta}(\mu^*)v'(\mu^*)$, and,

$$\frac{d\tilde{\theta}}{dt}(\mu^*) = -\frac{v'(\mu^*)}{v(\mu^*)^2}(u(\bar{y}) - u(\bar{y}-t^c))\frac{d\mu^*}{dt} > 0.$$

Since $\dfrac{d\mu^*}{dt} = -\dfrac{f(\tilde{\theta}(\mu^*))t^c u'(\bar{y}-t^c)}{D} < 0$, the denominator D is positive. Under the assumptions $v'(\mu^*) \geq f(\tilde{\theta}(\mu^*))\tilde{\theta}(\mu^*)v''(\mu^*)$ and $f'(\theta) > 0$ for every θ, we have $A \geq 0$ and thus the second derivative is strictly negative.

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