Policy Making and the Adaptability of Informal Institutions

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Abstract

This article discusses several of the insights generated by a theory of the formation of relationships between heterogeneously risk-averse individuals who lack access to formal insurance. An example illustrates the policy relevance of the theory, and demonstrates a relationship between the emergence of entrepreneurship in developing economies and higher income inequality. Reducing aggregate risk is a strict Pareto improvement if relationships in the status quo are assumed to remain constant, but is shown to be particularly harmful for the most risk-averse individuals and to exacerbate inequality when the endogenous network response is taken into account: the least risk-averse individuals abandon their roles as informal insurers in favor of entrepreneurial partnerships.

Economists have long recognized the gravity of the burden that risk imposes on the very poor, and the importance of understanding the channels by which the absence of formal

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insurance and credit institutions affects their lives (Morduch (1995)). Beginning with fundamental questions, such as whether the poor insure at all in the absence of formal institutions (Townsend (1994)), research has more recently focused on characterizing the differences between informal and formal insurance arranagements. But what distinguishes "informality"? The consensus thus far seems to be the contracting environment–insurance is informal when parties cannot commit to honoring their risk-sharing agreement, and must enforce cooperation by severing ties with defectors in the future. Existing literature takes the risk-sharing group or the network formation process as given, and studies the insurance arrangement that emerges under limited commitment (Ligon, Thomas, and Worrall (2002), Bloch et al. (2008)).

But what if there is more to informality than the contracting environment? I focus on the structure of the risk-sharing groups or networks which form in the first place (related papers include Legros and Newman (2007) and Schulhofer-Wohl (2006). Instead of a single-dimensional relationship with a risk-neutral formal insurer, a risk-averse, poor individual must build and use multi-dimensional relationships with other risk-averse, poor individuals. For example, Rosenzweig and Stark (1989) show that insurance is layered into household formation: daughters of more risk-averse farmers are married to more distant villages, to minimize the correlation between farming incomes. Ackerberg and Botticini (2002) find evidence that insurance is layered into production: heterogeneously risk-averse farmers and landlords in medieval Tuscany strategically formed sharecropping relationships based on differing risk attitudes.

The rest of this note discusses the importance of understanding the emergence and evolution of informal institutions for policy analysis and design, as well as the connections this theory enables us to make between the equilibrium composition of informal relationships and the risk environment, income inequality, and entrepreneurship. These insights are drawn from the results of Wang (2014), where generalizations, extensions, empirical support, and proofs may also be found.

1 Model

Agents: there are two groups of agents, $G1$ and $G2$, $|G1| = |G2|$, where agents differ in their Arrow-Pratt degrees of *absolute risk aversion* $r > 0$. Type r_i's utility from consuming x units of output is $u_i(x) = -e^{-r_i x}$.

Risk and production: a project $p > 0$ returns output $Y_p = p + V(p)^{\frac{1}{2}} Y$, where Y has well-defined cdf $F_Y : \mathbb{R} \to [0, 1]$, and $E(Y) = 0,\ V(Y) = 1$. This allows for a large class of symmetric and skewed distributions.

Hence, a project p has mean return $E(Y_p) = p$ and variance of return $V(Y_p) = V(p)$, and $V'(p) > 0$: projects with higher mean also have higher variance. (This is without loss of generality, as projects with higher variance but lower mean are never desired by any risk-averse agent with the preferences described above.)

Any project p requires the collaboration of at least two agents, one from $G1$ and one from $G2$, where a matched pair (r_1, r_2) jointly selects a project.[1] For example, landowners and farmers choose between portfolios of crops, land plots, and inputs which differ in price and yield risk, and investors and entrepreneurs choose between business opportunities of differing riskiness.

All matched pairs face the same spectrum of projects $p > 0$, each agent can be involved in at most one project, and there are no "project externalities": one pair's project choice does not affect availability or returns of any other pair's project.

Information and commitment: all agents know each other's risk types and the risk environment.

A pair (r_1, r_2) commits *ex ante* to a feasible return-contingent sharing rule $s : \mathbb{R} \to \mathbb{R}$, where r_2's share is $s(y_{p_{12}})$, and r_1's is $y_{p_{12}} - s(y_{p_{12}})$.

The equilibrium: An equilibrium is[2]:

[1] See Wang (2014) for a proof of equivalence between this model and one in which individuals choose own income and share the pooled returns, as well as one in which agents match within one group instead of across two groups. See Wang (2013) for an explicit treatment of moral hazard.

[2] Existence is assured by Kaneko (1982).

1. *The matching pattern*: a match function $\mu : \mathbb{R}^+ \rightarrow \mathbb{R}^+$, mapping each agent in group 1 to a single agent in group 2. Thus, r_1's partner is denoted by $\mu(r_1)$, and $\mu(\cdot)$ assigns distinct members of group 1 to distinct partners in group 2.[3]

   Moreover, the matching pattern described by $\mu(\cdot)$ must be stable. It must be that no agent is able to propose a feasible project and sharing rule to an agent not matched to her under μ, such that both agents are happier when matched with each other in this proposed arrangement than they are with the partners assigned by μ ("no blocks").[4]

2. *The risky projects*: a project choice for each matched pair, such that no pair can achieve weakly better outcomes for both partners (and a strictly better outcome for at least one partner) by choosing a different project. In other words, the project chosen by a matched pair must be optimal for that pair.

3. *Individual payoffs and sharing rules*: a sharing rule for each matched pair, describing the amount each partner receives given each possible return realization, where the sum of shares cannot exceed the total return (feasibility). The sharing rule must be such that no pair can achieve weakly better outcomes for both partners (and a strictly better outcome for at least one partner) by choosing a different sharing rule. In other words, the sharing rule chosen by a matched pair must be optimal for that pair.

   Individual payoffs will not be unique in the equilibrium of this model. Instead, the stability conditions will determine a set of equilibrium surplus divisions. For a matched pair $(r_i, \mu(r_i))$, let v_i denote the expected utility of $\mu(r_i)$ in equilibrium, and $\phi(r_i, \mu(r_i), v_i)$ denote r_i's maximal expected utility given that $\mu(r_i)$'s expected utility is v_i. Then a vector of individual payoffs described by $(v_1, ..., v_N)$ can be supported in equilibrium if

[3] In practice, characteristics other than risk aversion, such as kinship and friendship ties, surely factor into matching decisions. However, the model is still key for understanding the equilibrium match. For example, friends and family are more likely to know each other's risk types, and are more likely to trust each other, and to monitor and discipline each other. Hence, an individual might first identify a pool of feasible risk-sharing partners, where this pool would be shaped by kinship and friendship ties, due to good information and commitment properties. Individuals would then choose their risk-sharing partners from these pools based on risk attitude.

[4] Individual rationality holds, as individuals cannot produce on their own.

and only if for each r_i:

$$\phi(r_i, \mu(r_i), v_i) \geq \phi(r_i, \mu(r_j), v_i) \; \forall j \neq i$$

That is, given the divison of surplus described by $(v_1, ..., v_N)$, no two individuals who are unmatched are able to match with each other instead, and split the surplus they generate in such a way that they are both weakly better off, and at least one of them is strictly better off.

Matching patterns: Let $G_j = \{r_j^1, r_j^2, ..., r_j^Z\}$, $j \in \{1, 2\}$, ordered from least to most risk-averse. Then under "positive assortative matching" (PAM), the i^{th} *least* risk-averse person in $G1$ is matched with the i^{th} *least* risk-averse person in $G2$: $\mu(r_1^i) = r_2^i$, $i \in \{1, ..., Z\}$.

Under "negative assortative matching" (NAM), the i^{th} *least* risk-averse person in $G1$ is matched with the i^{th} *most* risk-averse person in $G2$: $\mu(r_1^i) = r_2^{Z-i+1}$, $i \in \{1, ..., Z\}$.

2 Example

Many of the world's very poor depend on agriculture for subsistence. Crop price stabilization is frequently proposed as a tool for alleviating the substantial risk burden shouldered by poor farmers, especially the poorest and most risk-averse. Notable examples include maize, sorghum, and rice in Venezuela, bananas and grains in Ethiopia, and many others (Knudsen and Nash (1990)).

Poor farmers often face an unforgiving risk environment, and lack access to formal insurance. Because a slight increase in profitability of crop portfolio comes at the cost of extremely high variance, they are trapped into growing crops that are safe but not very profitable, and they forgo innovations for less profitable, traditional methods. To encourage the farming of crops with higher expected profitability, the government places price bands of the form $[p_L, p_H]$ on each crop's price. If the world price of a crop happens to fall within this band, that is the price the farmer faces. However, if the world price falls below the price floor, the farmer is guaranteed to receive p_L, and if the world price is above the price ceiling, the farmer faces p_H. The marginal impact of stabilization is largest for crops with the most volatile prices: the variance of every crop falls, but the variance of the riskiest crops falls by the largest amount. Thus, the policy leads to a change in the curvature of the marginal variance cost across different crop portfolios.

A numeric example illustrates the effects of this change in the risk environment on the broader economy. Suppose $G1 = \{0.5, 0.8, 0.9, 1\}$, and $G2 = \{1, 2, 3, 4\}$, so that the agents in the second group are more risk-averse than the first (typically believed to be the case with landowners and tenant farmers, although any risk types could be chosen, as the predictions for matching depend only on the risk environment, not on population specifics).

For simplicity, assume that the returns of different crop portfolios are distributed normally. In particular, suppose that pre-policy, the profits of a crop with mean p are: $\pi_p \sim N(p, p^{2.05})$. Following the stabilization policy, the distribution of profits is $\pi_p \sim N(p, p^{1.95})$. Note that the policy changes the risk environment in two ways: the variance of each project $p > 1$ has fallen, and the previously convex marginal variance cost becomes concave in mean return. The change in *levels* of risk is small ($V_{pre}(p) = p^{2.05}$ is similar to $V_{post}(p) = p^{1.95}$), but the change in *curvature* is great (global convexity to global concavity). The change in levels is intentionally minimized, to isolate the change in curvature: we know from Wang (2014) that it is the change in curvature which triggers a change in the unique equilibrium matching. Pre-policy, individuals match negative assortatively in risk attitudes, while post-policy, the match is positive assortative. This enables us to characterize the welfare impact stemming solely from the endogenous response of the informal insurance network.

Now, suppose we analyze this policy without accounting for the response of informal institutions.

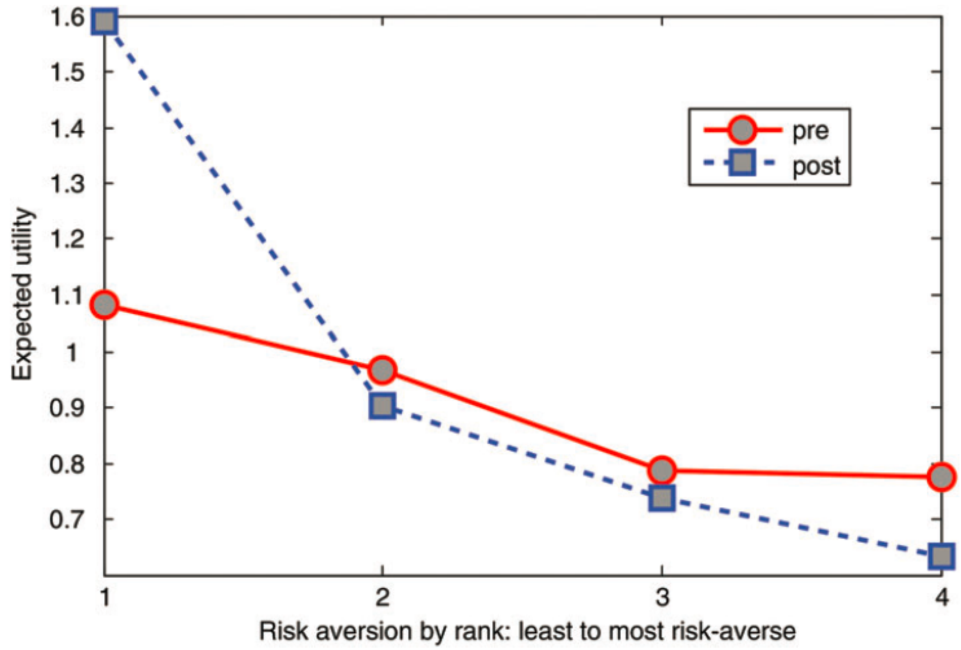
Lemma 1 *A policy which reduces the variance of every available project is a strict Pareto improvement if the composition of partnerships remains unchanged.*

The proof is intuitive: suppose that the four matched partnerships in the status quo undertook projects $\{p_1, ..., p_4\}$. Following the introduction of a policy which decreases the variance of every project, each partnership has the opportunity to stay on its original project, or to switch projects. If a partnership retains its original project, it is strictly better off, since the project has the same mean, but a lower variance, and all individuals are risk-averse. If a partnership switches to a different project, then by revealed preference, they must be even better off facing the new project than facing the old project with decreased variance. But this means that each partnership is strictly better off.

Now, suppose we account for the endogenous re-formation of partnerships triggered by the policy.

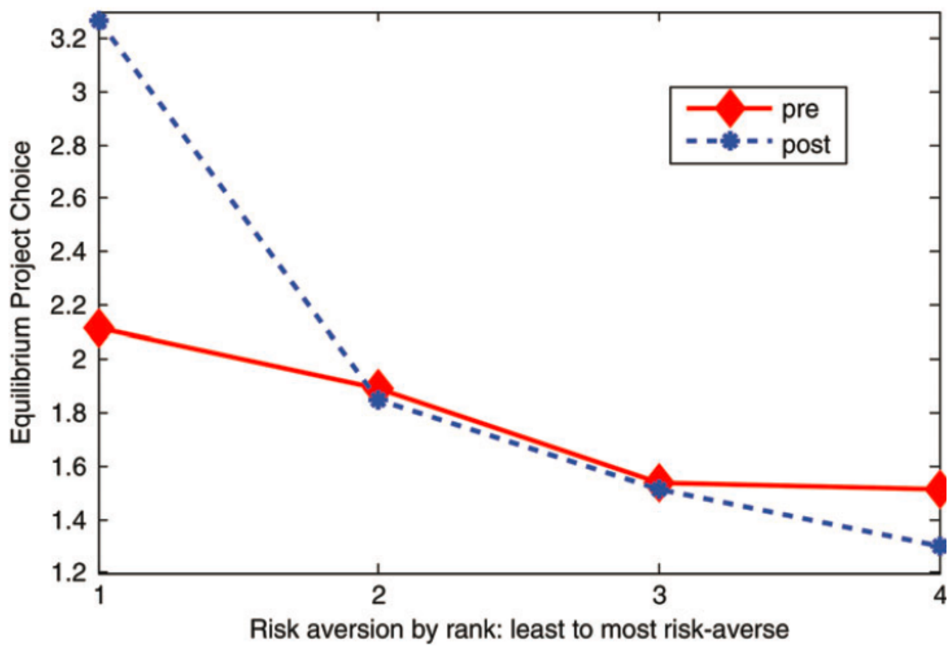
What happens to the expected utility generated by the collaboration of each matched pair? Figure 1 shows the expected utility of the i^{th} least risk-averse pair pre- and post-policy (that is, "1" on the x-axis represents the least risk-averse pair, and "4" on the x-axis represents the most risk-averse pair). Clearly, the least risk-averse benefit at the cost of the more risk-averse (and this is true of individual payoffs as well as joint payoffs):

FIGURE 1. Expected Utility Pre- and Post-Policy



In addition, equilibrium crop portfolio choices experience the following change:

FIGURE 2. Equilibrium Project Choice Pre- and Post-Policy



Clearly, this risk-reduction policy is *not* a Pareto improvement. We see that the more risk-averse agents are worse off after implementation of the policy, purely as a result of the endogenous network response: the policy causes the least risk-averse agents to abandon their roles as informal insurers of the most risk-averse agents, in favor of entrepreneurial partnerships with fellow less risk-averse agents. The poorest, most risk-averse agents are thus harmed via two channels: first, they've lost their informal insurers, and this weakens their capacity to smooth consumption, which reduces their welfare. To make matters worse, because the most risk-averse agents, who are now paired with each other, have very little capacity to smooth a given risk (as neither is willing to bear the volatility to smooth her partner's consumption), they must instead manage risk by choosing projects with low variance, which traps them into growing crop portfolios with low mean returns.

On the other hand, the least risk-averse agents, who are now paired with each other, no longer play the role of informal insurer, and this enables them to take advantage of the decreased aggregate risk and undertake the higher mean, entrepreneurial projects (e.g. use a new technology). They are better off post-policy.

Hence, a price stabilization policy which especially reduces the risk of crops with higher mean and higher variance of yield, and is intended to reduce the risk burden of the poor, may in fact exacerbate income inequality and particularly harm the most risk-averse, most impoverished agents. Further, the emergence of entrepreneurship may correspond with increased inequality.

This insight provides an interesting complement to the existing literature. Attanasio and Rios-Rull (2000) model the introduction of formal insurance as a policy which reduces the aggregate riskiness of the environment. They also find that such a policy may hurt the welfare of the most risk-averse agents. However, their model, which builds off Ligon, Thomas, Worrall (2002), considers a fixed group of risk-sharing members whose informal insurance arrangement is constrained by limited commitment. Two agents sustain informal risk-sharing by threatening credibly to cut off all future ties if someone reneges, that is, does not honor the risk-sharing agreement (e.g. a member keeps her own income realization instead of transferring some of it to an unlucky partner). Thus, anything that lowers the cost of autarky (the state of being alone and unable to share risk with somebody else) will decrease the level of informal insurance that can be sustained, because the punishment has become less costly. Since the introduction of formal insurance reduces aggregate riskiness, such a policy reduces the cost of autarky, and as a consequence informal insurance is weakened.

However, if commitment were perfect in Attanasio and Rios-Rull (2000), the introduction of formal insurance would strictly improve welfare, because lowering the cost of autarky matters only through the punishment of cutting off future ties, which would no longer be relevant. One contribution of this example, then, is to show that, *even when commitment is perfect*, introducing formal insurance might still reduce the welfare of the most risk-averse agents, because the composition of the informal risk-sharing network changes in response. Reducing the riskiness of the environment does increase the value of autarky, but it *also* increases the value of being in a relationship, and increases it heterogeneously across partnerships of different risk compositions.

This example also contrasts with Chiappori et al. (2011), who estimate that the *least* risk-averse individuals are the ones left worse off after the introduction of formal insurance, since they have been displaced as informal insurers. However, this exactly illuminates the need for a model of the *equilibrium network* of relationships–I show that the least risk-averse agents do leave their roles as informal insurers, but only because they prefer to undertake entrepreneurial pursuits instead. It would be interesting to see how their estimation changes after accounting for the endogeneity of matching.

3 Conclusion

This note discusses several of the many policy insights yielded by a theory of informal insurance as the risk-sharing achieved within an equilibrium network of partnerships, rather than within a single, isolated partnership. Furthermore, these insights illustrate what can be gained from broadening the way we think about informal insurance beyond the strength of the contracting environment. By developing a theory of the multi-dimensional relationships that poor, risk-averse individuals build and use with each other to manage risk in the absence of formal institutions, we are able to observe how individuals endogenously switch between and assume different informal roles in the economy, and we are able to make connections between informal relationships and the risk environment, income inequality, and entrepreneurship. Failing to account for the emergence and evolution of informal institutions in equilibrium may have grave consequences: we must be careful not to focus so much on what we would like the poor to do that we neglect an understanding of what they are already doing.

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