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INSURANCE COMPANIES OF THE POOR[†]

Abstract

We model the emergence of formal insurance institutions as equilibria under limited contract enforceability where groups are required to be coalition-proof but also can use fines for enforcement. The model can generate coexistence of formal and informal groups without requiring heterogeneity in insurance demand, because coalition-proof equilibria can fail to exist. It also predicts where formal insurance is likely to flourish: insurance groups that hold savings become more prevalent the more enforcement power communities have, and the more enforcement power, the better insurance. We use data on Ethiopian funeral insurance groups and their members to motivate and test our model. Those which hold savings and collect regular premia provide better insurance than informal ones, and both sets of groups employ a variety of punishment mechanisms to induce their members to share risk. Despite the observed positive correlation between formality and the quality of insurance, informal and formal groups co-exist. Consistent with predictions generated by the model, we find that standard measures of social cohesion are linked to the use of punishment mechanisms, the quality of insurance and the prevalence of formal insurance institutions.

JEL Classification: C73, D02 and E21
Keywords: institutions, insurance, limited commitment, savings and social capital

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1 Introduction

The ability to enforce contracts is a necessary requirement for a formal economy to emerge. Historically, and in many developing countries, legal and other institutions have been insufficient to guarantee enforceability. Contracts then need to be self-enforcing, and as a result need not offer first-best outcomes – not least for trading across time, states of the world or space. Nevertheless, legal institutions do not emerge out of nothing, and diverse informal institutional arrangements may emerge as self-enforcing equilibria, which may only later – if at all – be formalised in rules and laws (Greif and Kingston 2011).

In this paper we present a model of how formal companies for trading risk emerge and evolve as self-enforcing equilibria alongside more informal institutions. Our model is the first to show that both formal and informal insurance groups may co-exist in a coalition-proof equilibrium even if all individuals are identical without heterogeneity in their insurance demand. This is contrary to the prediction from a first-best world in which formal groups holding savings would always be superior to informal groups that do not engage in savings, or a world of imperfect enforceability where groups' deviations do not need to be coalition-proof. The model also predicts that trust in the enforceability of contracts is crucial for the spread of these more formal institutions.[1] Our tests of these features support the predicted correlations between the use of financial penalties for non-compliance with both the degree of insurance and the ability to enforce contracts; and a positive correlation between the ability to enforce and the prevalence of insurance groups that hold savings.

We motivate and then test the predictions of our model in a setting where formal insurance markets have not yet penetrated: rural Ethiopia. Our focus is on the Iddir, a membership-based funeral organisation, where one form functions as a premium-based organisation with substantial reserves (group savings), while another is more informal with membership but no savings. The premium-based version with reserves is effectively a nascent mutual insurance company (i.e. owned and controlled by its policy holders). As such, this organization is similar to Friendly or Amicable Societies that focused on mutual insurance and that evolved over centuries in Europe, the US and beyond and who are in turn predecessors of the type of large mutual insurance companies in richer economies that emerged when economies developed and became more formalised.[2]

[1] Trust has also been identified as an important predictor of the uptake of micro insurance products (see Cai, Chen, Fang and Zhou (2009), Dercon, Gunning and Zeitlin (2011) and Shawn, Giné, Tobacman, Topalova, Townsend and Vickery (2013))

[2] Mutual insurance companies tend to account for about half of all life insurance in the US and a quarter of property insurance, and a quarter of the global insurance market (Hansmann 1985). Many grew out of Friendly Societies, which functioned long before they were regulated including offering funeral insurance (Cordery 2002). In the UK they were regulated by the Friendly Societies Act (1875), which formed the legal basis for these growing companies. Mutuals focusing on burials

We present evidence that the reserves-based funeral organization is superior to the informal version in terms of welfare by showing that members' consumption is better protected against mortality shocks, and model how the two different institutions may co-exist in an environment of imperfect contract enforceability. Our basic setting is a model in which risk-averse and impatient agents operate in an environment with both idiosyncratic and aggregate risk. They can insure each other in risk-sharing groups and have access to a savings technology. Since insurance groups in rural Ethiopia operate outside any regulatory framework, we posit that groups are subject to limited commitment problems: ex-ante participants are keen to contract with each other, but once the state of the world is known, those with lucky draws have an incentive not to honor the agreement.

Insurance may still be sustained as the equilibrium of an infinitely repeated game, given the potential for future reciprocal benefits and punishments via exclusion from the group (Coate and Ravallion 1993, Kocherlakota 1996, Ligon, Thomas and Worrall 2002, Attanasio and Rios-Rull 2000). In particular, we present a theoretical model that incorporates different institutional features, in terms of the possibility of penalizing deviators and savings. We focus on self-enforcing agreements, and model a new class of contracts by extending Gauthier, Poitevin and Gonzalez (1997) and Ligon, Thomas and Worrall (2000) that does not just allows for penalties and savings, but is also required to be coalition-proof.

Coalition-proof equilibria need to satisfy that any subset of agents excluded from the insurance group can nevertheless continue to insure each other in the future provided these smaller groups are themselves stable to deviations (Bernheim, Peleg and Whinston 1987, Genicot and Ray 2003). This seems a natural specification given that insurance across space requires groups to coordinate their activities. Furthermore, informal groups, including those studied, may employ a variety of punishment mechanisms. In particular, we assume that groups can impose fines for deviation, the size of which varies with the group members' ability to enforce contracts.

We then solve for the symmetric and stationary n-player contract that is coalition-proof, building on Coate and Ravallion (1993) who model a two agent static and symmetric insurance game under limited commitment, Attanasio and Rios-Rull (2000), Kocherlakota (1996) and Ligon et al. (2002), who model the same game in a dynamic setting and finally Ligon et al. (2000) who examine the interplay of insurance and savings in a two-person dynamic setting.

How could this kind of environment give rise to the emergence of formal in-

go back to burial clubs, which have existed and continue to exist in various forms across the world. In Ancient Rome soldiers and the lower orders of society formed Collegia Funeraticia to meet monthly to pay premiums for funerals of their members. Roth (2001) describes funeral insurance institutions in South Africa and Berg (2011) discusses some of the history of burial societies across the world also with a particular focus on South Africa.

surance arrangements alongside more informal ones? When equilibria have to be self-enforcing, savings can have an ambiguous effect on the quality of insurance (Ligon et al. 2000). Because savings can be used for self-insurance, they make the threat of exclusion from an insurance group less severe. As a result, it may be optimal not to save.

When equilibria are required to be coalition-proof, not saving may also be self-enforcing. Because coalition-proof equilibria may fail to exist (Genicot and Ray 2003, Bernheim et al. 1987), it is possible that insurance groups that do not save are stable, but groups that save are not. This can arise in one of two ways: (i) enforcement constraints are violated for some positive asset level, but hold for zero assets. (ii) Enforcement constraints are violated for subgroups that save, but hold for subgroups that do not save.

That coalition-proofness can lead to coexistence of insurance contracts with and without savings is a novel mechanism. There is a growing literature that has focused on low levels of individual savings in developing countries and hypothesized that these are due to competing demands from relatives or self-control issues (Dupas and Robinson 2013, Ashraf, Karlan and Yin 2006), effectively deviations from standard neoclassical behavioural assumptions. Here, we focus on savings as part of an insurance arrangement and show why savings may not be sustainable even in a neoclassical framework. In the existing literature on insurance and saving, insurance without saving tends to arise only when there is no aggregate uncertainty. Whether the constrained-optimal contract then includes savings or not depends on whether the underlying preferences and structure of shocks make the first-best contract enforceable or not (Ligon et al. 2000, Chandrasekhar, Kinnan and Larreguy 2010). In contrast, our model requires no heterogeneity in preferences – or for that matter the ability to enforce contracts – to generate heterogeneity in contracts.[3]

We do show, however, that heterogeneity in the ability to enforce contracts predicts where formal contracts are likely to flourish. Groups that save need to be sufficiently close to first-best to be stable, and are therefore more likely to exist when enforcement ability is high, because groups that have a higher ability to enforce contracts can coordinate on outcomes closer to first-best even in the coalition-proof equilibrium. In turn, this implies that insurance with savings delivers better protection against shocks in equilibrium – just as we observe in the data – and higher welfare than insurance without savings.

The above mechanism leads to three core predictions, which we test and confirm in the data. Linking a group's ability to enforce contracts to measures of the social capital of its members, we test for (i) a positive correlation between the ability to en-

[3]In a related paper, Mobarak and Rosenzweig (2012) show that demand for formal insurance can exist alongside informal insurance arrangements if the latter insure idiosyncratic risk, but not if they also cover aggregate risk.

force contracts and financial penalties, (ii) a positive correlation between the ability to enforce contracts and the prevalence of insurance groups that hold savings, and (iii) a positive correlation between the degree of insurance – measured as the drop in a member's consumption following a mortality shock – and the use of financial penalties in each contract type and overall.[4,5]

This paper adds to the limited applied literature focusing on contract design to understand in detail the functioning of informal institutions and the emergence of more formal institutions. Banerjee, Besley and Guinnane (1994) study the design of 19th century credit cooperatives. Cabreales, Calvo-Armengol and Jackson (2003) use mechanism design to analyze the functioning of a mutual fire insurance mechanism in Andorra. Anderson, Baland and Moene (2009) examine how the organizational structure of Kenyan urban Roscas may be designed so as to address enforcement issues and emphasize the importance of social pressure in allowing more formal structures to emerge. Key contributions of our paper are that we do not just model competing institutional insurance design, but also study how formal designs emerge and co-exist with more informal ones in a coalition-proof equilibrium, and link the designs directly to welfare outcomes at the level of individual participants in the insurance groups.

The model and the empirical findings emphasize both the opportunities and difficulties for more formal (and more welfare-enhancing) organisational forms to emerge when enforcement is difficult and highlight the importance of social capital – as a facilitator, not a necessary requirement – for the more formal institution to flourish. At the same time, they highlight that formal institutions may emerge that offer higher welfare to their members if sustainable, even if informal institutions are prevalent and in equilibrium may coexist until other circumstances change to disturb this equilibrium.

2 Funeral Insurance in Rural Ethiopia

The data are based on a sample of funeral societies and their members in six villages in rural Ethiopia in 2003, Funeral Insurance Survey (FIS). In total, detailed data has been collected on 78 funeral societies using interviews of its key members, and the sample covered about half the number of those present in these villages. These

[4]Here, we follow the literature reviewed in Durlauf and Fafchamps (2005) that has suggested that social cohesion and social capital may be linked to the ability to enforce and coordinate on better outcomes. For example, Attanasio, Pellerano and Polanía (2009) show that social capital, measured as trust, is positively related to contributions in a public good game. Similarly, Karlan (2005) finds that individuals identified as 'trustworthy' in experimental games are more likely to repay their loans to a Peruvian group-lending microfinance program.

[5]To proxy social capital, we include two standard measures of social capital suggested by the *World Bank Social Capital measurement tool* (n.d.) and the *World Value Survey* (n.d.): mutual trust and a measure of the density of groups and networks.

data were matched to household panel data, collected as part of the Ethiopian Rural Household Survey, which has been conducted in these (and 9 other) villages since 1994. In each of the villages, the household survey is a random sample. We will restrict our analysis to those households we could match, covering 301 households with detailed information over time (6 rounds) and the funeral societies they belong to.

Iddir are semi-formal insurance associations that ensure a payout in cash and in kind at the time of a funeral for a deceased relative of a group member (for a detailed description of these groups see Dercon, Bold, De Weerdt and Pankhurst (2006)). These groups do not consist of loose and rapidly changing associations of people. Instead, observed groups have been in existence for an average of 18 years. Iddir have a stable and clearly defined membership, usually based on written lists, and payouts are made when members incur costs related to the funerals of a well-defined set of relatives in their household. The insurance groups have written statutes, bylaws and records of contributions and payouts. The rules define membership procedures, payout schedules, contributions and also a set of fines and other measures for nonpayment of contributions.

Death and funerals are certainly a frequent cause of unforeseen expenditure in rural Ethiopia. In our sample, 45% of households report at least one death of a household member in the survey period, despite the fact the households are relatively nuclear (with an average household size of 7.5 in the first round). In each round of the data, on average 18% report a death shock.

Virtually all households in our sample – 96.5% – are members of at least one Iddir. Just under 30% report belonging to one Iddir, 33% belong to two, and another 33% belong to three or more. Each village contains at least a dozen Iddir, but the number can rise as high as 30 or 40 Iddir in some communities. With an average size of 85 members (households), these groups are significantly smaller than the village population.

In the villages studied, and elsewhere in Ethiopia, there are two clearly distinguishable types of Iddir: those which hold savings and those that do not. The latter are relatively informal and members make (pre-determined) contributions when a funeral occurs directly to the member who incurs the funeral expense. The former are more formal and operate in a fashion similar to mutual insurance companies. They collect regular actuarial premia stored in a communal Iddir fund, and members make a claim when a death occurs in their household and are reimbursed directly out of the Iddir fund. As a result, these groups accumulate substantial savings. More formal groups incorporate mutuality – i.e. members' payments are dependent on the overall performance of the insurance group – through the payment of potential dividends and the possibility of 'assessing' members for additional payments if aggregate losses become too large, a practice which 32% of groups reported having used in the past 5 years.

Table 1 details contributions, payouts and accumulated savings of the two types of groups. All amounts are reported in 1994 Ethiopian Birr and 1 USD = 9 Birr. The average contribution at the funeral for the more informal Iddir is 3.67 Birr, while the average monthly contribution for the formal Iddir is 2.35 Birr. In some cases, the more informal Iddir also collect a small regular contribution, but this is significantly smaller at just 0.27 Birr, usually meant for specific spending related to the running of the Iddir. Similarly, members of the formal Iddir may also make relatively small direct contributions of about 0.13 Birr at the time of the funeral. When hosting a funeral, members of the informal Iddir receive an average of 143 Birr (16 USD). Members of the formal Iddir receive almost twice as much from the Iddir funds, 277 Birr (31 USD). These groups also retain substantial savings. With an average of 3488 Birr (388 USD), current funds are almost nine times larger than in the more informal groups. The total insurance payouts made by Iddir in the past year average 1116 Birr (124 USD), with more informal Iddir paying out a total of 564 Birr (63 USD) and Iddir that hold savings paying out three times as much at 1952 Birr (217 USD).

Because Iddir operate in a weak regulatory environment and rely on their members making contributions voluntarily, they also have a sophisticated system of punishments if members fail to comply – ranging from payment delays to fines and exclusion and even taking members to court. As can be seen from Table 1, groups are similar in terms of the types of punishments they mete out, but fines are significantly higher in the more informal groups.

As we show formally below, this difference can be traced back to the fact that groups that hold savings make most of their payments ex-ante while groups that do not hold savings make most of their payments ex-post. Because enforcement issues are most acute at the ex-post stage when members know whether they stand to gain or lose from the arrangement, we should expect fines to be larger in groups that do not save. Put another way, we can think of ex-post fines and regular ex-ante payments as substitutes in terms of enforcement mechanisms.

Clearly, these groups are rather different from each other and those groups that hold savings share similarities with mutual insurance companies or at least microinsurance companies. In what follows, we examine whether Iddir and especially Iddir that hold savings, are successful at insuring funeral costs and thereby improve household welfare.

2.1 Insurance for funeral costs across different Iddir types

To investigate the insurance benefits of Iddir, we relate per-capita consumption outcomes of household i to its experience of deaths in the household. If death shocks are fully insured by the Iddir, then we would expect that such shocks are not significantly affecting consumption. However, there is no reason that the Iddir fully insures the household: it only insures the funeral costs, not the impact a death in the family may have on its earning potential. The question of interest for our purposes is more subtle: we are primarily interested in knowing whether belonging to an Iddir with savings offers more protection than belonging to the more informal version.[6] A priori we would expect this to be the case: being able to save, formal groups can reduce aggregate as well as cross-sectional variation.

To assess this we first estimate equation (1), in which per-capita consumption of household i is regressed on the number of deaths in household i in period t. In addition, we include household fixed effects (λ_i), time fixed effects (λ_t) and village-time fixed effects (λ_{vt}). To investigate the differential impact of the different Iddirs, we also include an interaction term of deaths with whether the household belongs to an Iddir with savings. Finally, we include a set of time-varying controls X_{it}.

$$\ln\left(\frac{c_t^i}{n_t^i}\right) = \beta\mathsf{death}_{it} + \gamma(\mathsf{death}_{it} \times \mathsf{contract}_{it}) + \delta X_{it} + \lambda_i + \lambda_t + \lambda_{vt} + \varepsilon_{it} \quad (1)$$

We estimate two versions of the model. In the first version, X_{it} only includes a set of time-varying household characteristics to capture preference-shifts. In the second version, we additionally include a set of time-varying Iddir fixed effects to capture common shocks to all members of the Iddir.[7]

[6] The tests implemented here build on a vast literature that has studied the strategies households use to smooth consumption in the face of large income fluctuations and unforeseeable expenditure needs (see Morduch (1999), and Deaton (1997) for surveys). A particular strand of this literature has focussed on testing whether rural communities manage to replicate Arrow-Debreu economies by employing these risk-coping strategies and achieve full risk-sharing in the absence of complete markets (Deaton 1992, Townsend 1994, Ravallion and Chaudhuri 1997, Udry 1994, Ogaki and Zhang 2001, Ligon et al. 2002, Gertler and Gruber 2002), with the majority of these papers rejecting full insurance. Finding partial insurance at the village level has led to a literature exploring risk-sharing at the level of groups or networks. For example, Grimard (1997) studies risk-sharing among ethnic groups in Cote d'Ivoire; Morduch (1991) and Mazzocco and Saini (2012) test insurance within castes in the ICRISAT data; and Dercon and Krishnan (2000a) find some evidence of full risk-sharing within nuclear households in Ethiopia. While risk-sharing may be incidental to the above groupings, more recently much work has been undertaken to map relevant insurance networks by asking households to identify insurance partners they rely on in times of need (Fafchamps and Lund 2003, De Weerdt 2004)) and to estimate the extent of insurance among them (De Weerdt and Dercon 2006).

[7] There are a few households that changed Iddir during the estimation period implying that one should also include $\mathsf{contract}_{it}$ to capture the level effect of being in a particular Iddir. There is however so little variation in this variable over and above the household fixed effect that its inclusion (or exclusion) has no impact on the results.

Since there are a large number of Iddir in each village and households are members of several of them, we do not have enough degrees of freedom to estimate the time-varying Iddir fixed effects directly. Instead, we subtract the average consumption in period t of all other households that are connected to household i through membership of an insurance group, $C_t^g = 1/|N_t^i| \sum_{j \in N_t^i} \ln\left(c_t^j/n_t^j\right)$, from the left-hand side and estimate the model with demeaned consumption, $\ln\left(c_t^i/n_t^i\right) - C_t^g$, as the dependent variable. We subtract the leave-out-mean (rather than the mean) because we want the coefficient on death_{it} and $\mathsf{death}_{it} \times \mathsf{contract}_{it}$ to capture the quality of both cross-sectional and intertemporal insurance.[8]

Of course, contract choice may be driven by time-varying unobservables also affecting consumption outcomes c_{it} implying that the coefficient on $(\mathsf{death}_{it} \times \mathsf{contract}_{it})$ may not be interpreted as the causal effect of holding savings on how well the insurance groups manage to insure funerals. To convince the reader that the quality of insurance is indeed driven by contract type – and not by other variables that affect both the likelihood of selecting into insurance groups that save and how well shocks are insured – we offer two placebo tests.

Specifically, we interact the contract variable with shocks for which the Iddir expressly do *not* offer insurance: these are illness and deaths which the households themselves identify as having had a significant negative effect on income – such as the death of a spouse. Intuitively, if insurance contracts with savings are better simply because members of these groups are inclined to share more risk, then shocks other than funeral costs should also be better insured among members of these groups. If superior contract structure is driving better insurance, then this should only apply to those shocks for which the Iddir offer insurance.

We are now ready to estimate the regression in (1) using household panel data from six villages with complete matched data on the funeral groups they are members of. From the survey data, it is possible to construct an estimate of monthly household consumption for each round of the survey that will be used in this test. The consumption data are obtained by summing over all sources of food and non-food consumption, deflated by a consumer price index using average prices in the first round as a base (Dercon and Krishnan 2000b). The data are purged of any additional expenditure, linked to exceptional items, such as health treatment or ceremonial expenditure, so any increases in consumption directly related to the mortality episode in the household are excluded. Total consumption is expressed

[8] Conditioning on the mean of group resources, we would be comparing 'winners' and 'losers' in groups with the same aggregate resources in each period. If both Iddir types offer full insurance in the sense that own consumption is completely determined by group consumption, the coefficient on death_{it} and $\mathsf{death}_{it} \times \mathsf{contract}_{it}$ would be zero even though it is likely that groups that hold savings offer better insurance for aggregate variation. Conditioning on the leave-out-mean allows us to pick up some of this intertemporal insurance, because we are comparing consumption of households that are winners and losers across groups where the average consumption of everyone else is the same.

in per capita terms and in Ethiopian Birr of 1994 (1 USD = 9 Birr). Average per capita consumption is low at about 86 Birr per month or just US$0.32 per day.

To estimate the impact of death shocks on household consumption we use an aggregate measure of deaths that have occurred in a household, which has been constructed from detailed ERHS household composition and mortality data. The measure is heavily weighted to deaths of dependents (78% of recorded deaths), which trigger the need for ceremonial expenditure. The illness and catastrophic death variable used in the placebo tests come from a household module asking for number of days of illness in the household in the past four weeks and a module administered in the last ERHS round in 2004 asking the household to recall significant negative shocks over the past 10 years.

To control for the effect of Iddir contract type and resources, we need to identify the different funeral insurance groups and their membership in the sample. Triangulating the ERHS and FIS data, we have detailed data on 78 funeral groups and their members. About a quarter of the members of each group were found to be included in the household sample in each village.[9] The contract design variable is based on the interviews with the Iddir leadership, and as Table 1 showed the two types are well identified in the data.[10]

The model controls for a full set of interactions of village and time dummies, capturing in each period total resources available in the village, as well as taste shifters using time-varying demographic characteristics (namely changes in household size). It is estimated both with and without controlling for a full set of Iddir-time varying fixed effects.[11]

Table 2 gives the results. As can be seen, insurance groups that hold savings are clearly superior in terms of consumption smoothing. On average, a household that is insured in a group that does not save suffers a significant drop in consumption of 12% following a death shock in column (2), and the effect is roughly the same regardless of whether we control for common Iddir shocks or not. If a household is insured in a group that does save, the drop in consumption is reversed completely and the

[9] When controlling for common shocks to Iddir consumption, we include only those groups for which at least 5 or more members have been identified. We do this for two reasons: first, the fewer households that report membership and therefore information about a group, the less confident one can be that a group has actually been identified correctly. Second, the fewer members of a group that are observed in the sample, the bigger the approximation error in computing mean group consumption. Comparison of a number of socio-economic characteristics shows that included and excluded households are not systematically different. Similarly, the characteristics of insurance groups whose membership has been successfully mapped do not differ significantly from groups for which matching of members has not been possible.

[10] For a very small number of groups, based on the data of the Iddir, arguments could be made that they need to be included in another type than what the leadership had reported in the survey. Using alternative classification was found to never make any difference in the results and their significance.

[11] Controlling for a larger set of time-varying demographic characteristics gives identical results.

effect of a death is no longer distinguishable from zero. Hence, there is substantial variation in the extent of insurance across contract types with full insurance offered only by groups that hold savings.

In column (3) to (6), we report the two placebo tests using illness shocks in the last four weeks and deaths which the household classified as having a large negative impact on income. The results show that there is no difference in the quality of insurance for these shocks between groups that hold savings and those that do not. Illness shocks are well insured everywhere, while catastrophic death shocks lead to a 19% reduction in consumption for members of both group types. Taken together, these results can give us some confidence that the coefficient on the contract variable does indeed measure the impact of the organizational structure of the Iddir itself, rather than merely reflecting the fact that households that form groups with savings are generally better at insuring each other.

3 The Model

In a first-best world and conditional on having the same preferences, a finding of higher insurance in Iddir that save would be synonymous with higher welfare – at least ex-post. Still groups co-exist, prompting the question why not everyone chooses the insurance contract that includes saving. The empirical results suggest where to start looking for an answer, and we now follow this lead and build a model that can match the most important features of the data: groups with savings provide more insurance than those without; both group types exist; and groups have access to a variety of punishment and enforcement mechanisms.

We consider communities, in which agents are impatient and risk-averse and face both idiosyncratic and aggregate risk. It is therefore desirable for them to insure each other and to smooth consumption over time.

The model is set in an environment where contracts are imperfectly enforced. In particular, an insurance contract for n members of an insurance group is self-enforcing only if it is coalition-proof, that is, if it is stable with respect to individual and coalitional deviations. Because groups operate in an environment of imperfect enforceability, we allow them to improve contract enforcement through some monetary – or social – penalties.

We then solve for the constrained Pareto-optimal equilibrium of the social planner version of an Arrow-Debreu contingent claims model and show that both insurance groups that save and those that do not emerge endogenously side-by-side when groups are required to be coalition-proof. We can also show that insurance groups that save will become more prevalent as enforcement ability increases. Because a higher ability to enforce contracts is also linked to higher welfare, this mechanism can replicate the empirical ranking of contracts i.e. insurance contracts with savings provide better protection against shocks than those without.

Setting our model in an Arrow-Debreu economy, we abstract from the fact that in both Iddir types dependence on aggregate states is – at least on the face of it – less than optimal. That is, in reality both contract types appear to be a mixture of pure risk-transfer and mutual contracts, perhaps because of transaction costs associated with writing fully contingent contracts.[12] The approach taken has a number of advantages: (i) in contrast to a pure risk-transfer contract, the contingent claims model takes consumers' utility maximization as a starting point, and we can therefore nest our model in the standard literature that examines optimal insurance under enforceability constraints (Coate and Ravallion 1993, Kocherlakota 1996, Ligon et al. 2002, Attanasio and Rios-Rull 2000). (ii) Rather than exogenously imposing the existence of two different contract types that differ in the degree of intertemporal smoothing, our model nests both insurance with and without savings, and agents endogenously choose which group to form. (iii) When insurance groups are large enough for average losses to be relatively certain, the difference in terms of welfare between a pure risk-transfer and a full contingent claims contract is negligible, and the two are observationally equivalent.[13]

We also purposefully abstract from all heterogeneity related to agents' preferences and shocks – in short anything related to insurance demand – to focus exclusively on the role played by limited enforceability in the emergence of formal and informal insurance institutions alongside each other.

The model has three purposes: first, it can be simulated to show that it indeed matches the patterns observed in the data. Second, it generates testable implications, which allow us to examine whether the model assumptions are both necessary as well as sufficient for understanding the existence of insurance institutions with different degrees of formality. Third, it will provide us with a way to separately identify the effects of enforcement ability and contract choice on the quality of insurance offered by these institutions.

3.1 The Environment

We consider a community of N households. In each period t, agent i receives income y with probability p and suffers a loss L with probability $1-p$. Aggregate income among a group $n \leq N$ agents follows a binomial distribution with the probability that k agents do not suffer a loss denoted by $p(k,n) = \frac{n!}{k!(n-k)!}p^k(1-p)^{n-k}$.

All agents are infinitely lived, risk-averse and discount the future by the com-

[12] In a pure risk-transfer contract, payments only depend on expected losses.

[13] See Marshall (1974) for a detailed discussion of pure risk-transfer and mutual contracts and circumstances under which they are equivalent.

mon discount factor β. They have identical twice continuously differentiable utility functions, which are defined over consumption $u(c)$.

Since all agents are risk-averse and are subject to idiosyncratic shocks, they can profitably enter into a risk-sharing relationship by forming an insurance group of size $n \leq N$. In particular, we assume that groups form symmetric and stationary risk-sharing arrangements.[14] This implies that all agents have the same expected utility from entering the insurance arrangement in each period. Denote consumption of an individual with (without) a loss when there are k individuals without a loss in the group by c_k^l (c_k^h). Similarly, denote the transfer from an agent with a good draw to an agent who suffered a loss when there are k good draws by τ_k.

Savings are possible at a rate r, where $r > 0$. In order to save, a group must invest in a savings technology, which can be purchased at cost ψ in period t to be used from period $t+1$ onwards. Once a group of size n has invested in the technology, it is available to all subgroups of n. Without loss of generality, we set $\psi = 0$. Since there is aggregate uncertainty, this implies that it is always desirable to invest in the savings technology under first-best.

We assume further that upon joining a group, savings are held at the group level. Total savings are denoted by $A(t) = ka_k^h + (n-k)a_k^l$ and per-capita savings are denoted by $a(t) = \frac{A(t)}{n}$. We impose the condition that $A(t) \in [0, \overline{A}]$, which implies that agents cannot borrow. In addition, we posit that if agents decide to join (and potentially save) via a risk-sharing group of size n, they cannot simultaneously save in a group of size $m < n$.[15]

Consumption in the risk-sharing arrangement in period t is then given by

$$c_k^h(t) = y - \tau_k(t) + (1+r)\frac{A(t)}{n} - a_k^h(t+1)$$

and

$$c_k^l(t) = y - L + \frac{k}{n-k}\tau_k(t) + (1+r)\frac{A(t)}{n} - a_k^l(t+1)$$

and the law of motion for capital is given by

$$A(t+1) \quad = \quad (1+r)A(t) + ny - (n-k)L - (kc_k^h(t) + (n-k)c_k^l(t))$$

If agents could sign binding agreements, the first-best contract would implement an equal sharing rule among all the members of the community in each period. Furthermore, with homogenous preferences and cost of capital across all agents, a contract with savings outperforms a contract without savings. Consequently,

[14]This assumption – mainly made for computational tractability – appears plausible given that equal sharing tends to be a focal point.

[15]This assumption does not imply that saving is only possible at the group level, but it implies that in each period, we only have to focus on one savings stream, that of the largest stable group and do not need to consider group and individual savings streams in parallel.

neither contract heterogeneity nor the finding of partial insurance can be understood without introducing further frictions.

In the context of insurance groups in developing countries, which operate in a weak regulatory environment, it makes sense to think of these frictions as limited commitment. Since groups cannot sign binding contracts ex-ante, contracts have to be self-enforcing, which requires that the benefit from complying with the contract outweighs the gain from reneging ex-post, when agents know whether they will be net contributors or net claimants. In particular, we require risk-sharing groups to be robust not only with respect to individual deviations but also with respect to deviations by subgroups, provided that these subgroups are themselves robust with respect to further deviations. As shown by Genicot and Ray (2003), the coalition-proof equilibrium risk-sharing contract may fail to exist and – as we show below – this will be crucial for the generation of contract heterogeneity.

To improve contract enforceability, we assume that groups can potentially punish those who do not comply with the contract. Punishment is modeled as a monetary penalty $0 < P < \bar{P}$, that can either take the shape of an ex-ante transfer – made before the agent knows whether he is a net contributor or net claimant – which is lost in case the agent does not make the required transfer ex-post, or an ex-post fine that does not depend on the state of the world.

In a first-best world, the size of the penalty P is undetermined, because all contracts are perfectly enforceable. When people cannot sign binding agreements, however, penalties play an important role, because they may help insurance groups to coordinate on better outcomes.

3.2 The constrained-optimal insurance contract for a given group size

To define the set of self-enforcing contracts, we first specify the consequences of reneging.

Assumption 1 *Consider a group of n agents insuring each other:*

(a) If a set of k agents with high income realizations renege on their transfers, each of them has to pay a penalty $0 < P < \bar{P}$.

(b) The kP penalties are collected by the $n - k$ agents who suffered a loss and distributed equally among them.

(c) The capital stock of the group of size n is divided equally among all members. The deviating sub-group saves if saving is both stable and preferable to not saving. The deviating sub-group does not save if not saving is both stable and preferable to saving.

(d) *From the next period onwards, the deviating sub-group is excluded from the existing arrangement of size n, but may continue risk-sharing in a smaller group following exclusion – provided this sub-group is itself stable to further deviations.*

Part (a) and (b) state that agents with a high income realization can be charged with a penalty, which is collected by the agents with a low income realization and is bounded above by $\bar{P}$. The monetary penalty thus lowers the benefit from deviation for those agents who are most likely to gain from it: agents who did not suffer a loss and are called upon to make a transfer to those who did.

We denote consumption in the case of deviation as

$$\hat{c}_k^h(t) = y - P + (1+r)\frac{A(t)}{n} - \hat{a}_k^h(t+1) \tag{2}$$

$$\hat{c}_k^l(t) = y - L + \frac{k}{n-k}P + (1+r)\frac{A(t)}{n} - \hat{a}_k^l(t+1) \tag{3}$$

where $\hat{a}_k^h(t+1)$ and $\hat{a}_k^h(t+1)$ are the savings levels of those with and without a loss in case the group collapses.

In line with the practices observed among insurance groups, penalties can be structured in two equivalent ways: as state-independent fines that are charged only in case the group collapses or as regular ex-ante transfers. In the latter case, we think of each period t as consisting of three dates, t_0, the ex-ante date before an agent knows whether he suffers a loss or not, t_1 when the state of nature is revealed, and t_2, the ex-post date when consumption takes place. The insurance contract is then structured as follows:

1. At t_0 each agents pays a positive ex-ante transfer $0 \leq P \leq \bar{P}$, which is identical across individuals, into the group savings fund.

2. At date t_1, agents learn whether they suffer a loss and the ex-ante transfers are distributed among those agents who do.

3. At date t_2, agents who do not suffer a loss make an ex-post transfer $\tau_k'(t)$ to agents who suffered a loss, and savings levels are chosen for both sets of agents.

4. If the enforcement constraints are satisfied at date t_2, the specified transfers, consumption and saving levels are implemented and the group continues to share risk in period $t+1$.

5. If the enforcement constraints are violated, no further transfers are made and the group collapses.

Consumption in an insurance contract with ex-ante transfers is therefore defined as

$$c_k^h(t) = y - P - \tau_k'(t) + (1+r)\frac{A(t)}{n} - a_k^h(t+1) \tag{4}$$

$$c_k^l(t) = y - L - P - \frac{k}{n-k}(\tau_k'(t) + P) + (1+r)\frac{A(t)}{n} - a_k^l(t+1) \tag{5}$$

Consumption in case the group collapses is the same as in equation (2) and (3).

If we define $\tau_k = P + \tau_k'$, then it is easy to see that consumption on and off the equilibrium path is the same regardless of whether we interpret P as a state-independent ex-post fine or as an ex-ante transfer. The two types of penalties can therefore be interpreted as substitutes.[16] In both cases, P serves to increase the cost of deviation for those who do not suffer a loss and requires groups to use a mechanism that is not self-enforcing: committing ex-ante transfers to those who suffer a loss or fining those who do not suffer a loss in case the group collapses.[17]

We posit that the maximum penalty $\bar{P}$ can be decomposed into a part related to a group's ability to enforce contracts and a part related to group members' income. Regarding the latter, introducing a bound is a natural assumption as credibility requires financial feasibility of the payment in all states of the world. Consequently, the maximal upper bound we could consider would be $y - L$ the income level when a loss is incurred. This would ensure that the penalty (be it ex-ante or ex-post) can always be paid regardless of an agent's eventual income draw and the level of savings accumulated by the group. It is therefore credible in every state of the world.

However, this payment may still be larger than what could ever be credibly enforced, so let us define

$$P = \zeta(y - L) \tag{6}$$

where $0 \leq \zeta \leq 1$, expresses the extent to which a maximal payment can be enforced. For example, agents may be wealthy enough to pay an ex-ante payment, but do not have enough trust that their ex-ante payments and savings can be kept safely by one of the group members. Alternatively, they can afford a fine ex-post, but don't

[16] The observational equivalence between ex-post fines and ex-ante transfers was noted both by Gauthier et al. (1997) and Ligon et al. (2000)

[17] This argument is related to work by Gauthier et al. (1997). The authors model fully self-enforcing ex-ante transfers in a two-player sub-game perfect non-stationary risk-sharing contract and show that they can be interpreted as a state-independent net penalty that is paid by the agent with the higher incentive to deviate ex-ante in case the contract is breached ex-post. In contrast, our model allows for a penalty that is levied on the agent with the highest incentive to deviate ex-post. Clearly, this has potentially greater benefits for contract enforceability because the incentive to deviate arising from ex-post asymmetries in agent's income realizations usually dwarves the incentive to deviate due to ex-ante asymmetries in expected payoffs. Moreover, since we are only examining symmetric and stationary contracts, it is not possible to make penalties conditional on incentives to deviate ex-ante.

trust that fines will actually be enforced against deviant members. Defined in this way, it is clear that the maximal P is not just related to the ability to make a financial transfer but also to the overall social cohesion of the group including the social pressure it can bring to bear on group members ex-ante (or ex-post) to act in the interests of the group. Similarly, we could think of ζ as a parameter expressing a direct link between social cohesion and a group's ability to agree on credible formal rules. In either case, the more a group can make use of these mechanisms, the more robust it will be with respect to deviations.

While the introduction of an upper limit $\bar{P}$ provides an exogenous limit to the use of penalties, part (b) of Assumption 1 provides an endogenous limit. On the one hand, the fact that penalties (either in the form of ex-ante transfer or fines) are collected by those who suffer a loss in the current period implies that at least some smoothing is achieved even when the group collapses. On the other hand, if the penalty becomes too large, the recipients themselves may actually find it in their interest to bring about the collapse of the group.

Part (c) of Assumption 1 tells us how assets are distributed in case of deviation and how deviating subgroups decide whether to save or not.

The assumption that assets are shared equally has two purposes: First, suppose instead that we treat savings the same as fines, i.e. rather than sharing them equally, they are channeled to those members who suffered a loss in the current period. This would be problematic because savings can accumulate over time and become much larger than fines, which are bounded by current income and enforcement ability. Hence, such a rule would imply that there is an asset level for which those who suffered a loss would for sure find it in their interest to bring about the collapse of the group.

Second, the assumption that assets are shared equally in case of deviation – which appears reasonable among possible alternatives – is made for computational tractability. It implies that the state space grows linearly with group size rather than exponentially, as would be the case for a non-stationary model that keeps track of individual savings levels. This will allow us to compute the model for a large number of parameters and group sizes, which is necessary in order to be able to generalize from the simulation results.

Finally, following the collapse of the insurance groups, deviating subgroups have to decide whether they will save or not (and if so, how much). To make this decision, the relevant deviation payoffs need to be compared. Most generally, the out-of-equilibrium payoff for an individual with a high income realization in a group of size n considering deviating with a group of size m can be written as

$$u(y - P - \psi + (1+r)\frac{A(t)}{n} - \hat{a}_k^h(t+1)) + \beta V(\hat{A}(t+1), m). \tag{7}$$

where $V(\hat{a}(t+1), m)$ is the lifetime expected utility of continuing in a risk-sharing group of size m with total assets of $\hat{A}(t+1)$.

This comprises three special cases. If n invested in the savings technology and m continues to save, the deviation payoff is:

$$u(y - P + (1+r)\frac{A(t)}{n} - \hat{a}_k^h(t+1)) + \beta V_{\text{saving}}(\hat{A}(t+1), m). \tag{8}$$

If n did not invest in the savings technology, but m does, then the deviation payoff is:

$$u(y - P - \psi) + \beta V_{\text{saving}}(0, m). \tag{9}$$

Finally, if m decides not to save, then $\hat{a}_k^h(t+1) = \hat{A}(t+1) = 0$ and the deviation payoff becomes:

$$u(y - P + (1+r)\frac{A(t)}{n}) + \beta V_{\text{not saving}}(0, m). \tag{10}$$

Comparing (8) and (9) highlights the strategic cost of investing in the savings technology – or the strategic benefit from not investing in it – in a second-best environment. When a group of size n invests in the savings technology, it immediately makes it available to all of its subgroups. If the group of size n does not invest in the savings technology, it becomes available to deviating subgroups with a one-period delay. This implies that deviation is more tempting if n has invested in the savings technology than if it has not.

Out of the above options (8) – (10), the deviating subgroup chooses that which is both stable and preferable. To understand how stability is determined in our model, we now turn to the long-run effect of being excluded from an insurance arrangement in case of deviation as detailed in part d) of the Assumption.

We follow the definition of stability derived in Bernheim et al. (1987), Bernheim and Ray (1989) and Genicot and Ray (2003): a group of size n is considered stable if there is no subgroup that can credibly deviate from the arrangement. A credible deviation requires that the subgroup in which insurance is continued is better off after deviation and that the subgroup itself is stable with respect to further deviations.

We begin with an individual household and define the expected discounted lifetime value starting with per capita assets $A(t) = a(t)$ as

$$V(A(t), 1) = \sum_{k=0}^{1} p(k, n)\left[\frac{k}{n}u(c_k^h(t)) + \frac{n-k}{n}u(c_k^l(t)) + \beta V(A(t+1), 1)\right]. \tag{11}$$

Since there are no possible deviations, stability of an individual is guaranteed, which is indicated by an asterisk superscript, $V^*(A(t), 1)$.

This definition of a stable payoff is now extended to an arrangement of size n. Recursively having defined sets of stable payoffs for arrangements of size $m = 1, ..., n-1$, $\mathbf{V}^*(m)$, consider a group of size n. The expected utility for agent i of being in an arrangement of size n for beginning of period total assets $A(t)$ is

$$V(A(t), n) = \sum_{k=0}^{n} p(k, n) \left[\frac{k}{n} u(c_k^h(t)) + \frac{n-k}{n} u(c_k^l(t)) + \beta V(A(t+1), n) \right] \tag{12}$$

where it is understood that $A(t) = 0 \forall t$, if the group does not engage in savings. Such an arrangement will be stable if no stable subgroup of size $m \leq n-1$ can credibly deviate from it.

Even though we look for symmetric and stationary equilibria, both agents with high income and those who suffered a loss may be tempted to deviate from the insurance group. This is the case because agents who suffered a loss collect state-independent penalties from those who did not suffer a loss in case the group collapses. If these penalties become too large, then those who suffer a loss may find it in their interest to bring about the collapse of the group themselves and exclude agents with a high income realization in order to collect the penalties.[18]

This results in the following definition of stability

Definition 1 *An arrangement of size n is stable if, and only if, for every possible beginning of period capital $A(t)$ and state k in period t, the following inequality constraints are satisfied*

$$\begin{aligned}
&(1) \quad V^*(A(t), n) \geq V^*(\hat{A}(t+1), m) \quad \forall \quad stable \quad m \\
&(2a) \quad u(c_k^h(t)) + \beta V^*(A(t+1), n) \geq \qquad\qquad\qquad\qquad (13) \\
&\qquad u(y - P - \psi + (1+r)\frac{A(t)}{n} - \hat{a}_k^h(t+1)) + \beta V^*(\hat{A}(t+1), m) \\
&\qquad \forall \quad stable \quad m \leq k \\
&(2b) \quad u(c_k^l(t)) + \beta V^*(A(t+1), n) \geq \qquad\qquad\qquad\qquad (14) \\
&\qquad u(y - L + \frac{k}{n-k}P - \psi + (1+r)\frac{A(t)}{n} - \hat{a}_k^l(t+1)) + \beta V^*(\hat{A}(t+1), m) \\
&\qquad \forall \quad stable \quad m \leq n-k.
\end{aligned}$$

(15)

[18] Note that this is the case, because we assume that penalties can only be conditional on the income realization of an agent, not on whether his actions brought about the collapse of the group. This seems sensible for two reasons: first, while it is easy to ascertain (certainly in the context of funeral insurance) whether an agent suffered a loss or not, it may be more controversial to decide whether an agent voluntarily left a group or whether others forced him to leave. Second, if penalties can be conditioned on the identity of the perpetrator, then the first-best outcome can be achieved trivially (provided the exogenous bound on the penalty does not bind).

This definition states that an arrangement is stable if at all times the individual prefers making the contractual transfers and savings to reneging on the contract and continuing insurance within a stable arrangement of size $m < n$.

Having defined the set of self-enforcing contracts, we can now compute the optimal constrained contract as the coalition-proof equilibrium of a stationary and symmetric risk-sharing game. This is done by solving the following dynamic maximization programme:

$$V^*(A(t), n) = \max_{a_k^h(t+1), a_k^l(t+1), \tau_k(t), P} \sum_{k=0}^{n} p(k,n) \left[\frac{k}{n} u(c_k^h(t)) + \frac{n-k}{n} u(c_k^l(t)) + \beta V^*(A(t+1), n) \right] \tag{16}$$

subject to the following constraints

$$\begin{aligned}
p(k,n)\frac{k}{n}\mu_k^h(t) \quad &: \quad u(c_k^h(t)) + \beta V^*(A(t+1), n) \geq u(\hat{c}_k^h(t)) + \beta V^*(\hat{A}(t+1), m) \\
&\qquad \forall \quad stable \quad m \leq k & (17) \\
p(k,n)\frac{n-k}{n}\mu_k^l(t) \quad &: \quad u(c_k^l(t)) + \beta V^*(A(t+1), n) \geq u(\hat{c}_k^l(t)) + \beta V^*(\hat{A}(t+1), m) \\
&\qquad \forall \quad stable \quad m \leq n-k & (18) \\
p(k,n)p(j,n)\frac{j}{n}\mu_j^h(t+1) \quad &: \quad u(c_j^h(t+1)) + \beta V^*(A(t+2), n) \geq u(\hat{c}_j^h(t+1)) + \beta V^*(\hat{A}(t+2), m) \\
&\qquad \forall \quad stable \quad m \leq j & (19) \\
p(k,n)p(j,n)\frac{n-j}{n}\mu_j^l(t+1) \quad &: \quad u(c_j^l(t+1)) + \beta V^*(A(t+2), n) \geq u(\hat{c}_j^l(t+1)) + \beta V^*(\hat{A}(t+2), m) \\
&\qquad \forall \quad stable \quad m \leq n-j & (20) \\
\nu(t) \quad &: \quad P \leq \overline{P} & (21) \\
\chi(t+1) \quad &: \quad A(t+1) \leq \overline{A} & (22)
\end{aligned}$$

where the Lagrange multipliers μ in each state and time period are scaled for convenience by the probability of this state occurring, and it is understood that $\hat{c}$ is defined according to equation (8) – (10) depending on whether the group under consideration and its deviating sub-groups save or not. The non-negativity constraints on savings and the penalty are omitted.

Analyzing the constrained-optimal contract shows that the model has the potential to match the empirical findings in the previous section. The results are summarized in Proposition 1 and Conjecture 2.

Proposition 1 *The constrained-optimal insurance contract with and without savings*

1. *If the first-best contract is not self-enforcing, insurance is imperfect.*

2. *Under second-best, the savings technology has an ambiguous effect on welfare.*

3. Under second-best, coalition-proofness can generate contract heterogeneity.

4. Under second-best, ex-ante transfers and ex-post state-independent fines are substitutes.

Proof of Proposition 1

1. The first-order condition for consumption in period t is given by:

$$(1 + \mu_k^h(t))u'(c_k^h(t)) = (1 + \mu_k^l(t))u'(c_k^l(t)) \tag{23}$$

and shows the standard results: if enforcement constraints are not binding, then full risk-sharing is achieved and the consumption of high and low draws is equalized. On the other hand, if enforcement constraints are binding for a group of agents, then their consumption is increased so that they are just indifferent between the risk-sharing contract and deviation from the group and risk-sharing is imperfect.

2. Given that savings appear both on the left and the right-hand side of the enforcement constraints, it is easy to see that the introduction of a savings technology can have an ambiguous effect on welfare following the logic in Ligon et al. (2000): first, suppose there is no savings technology and consider the case of individual deviations from a group of size n with individual but not aggregate uncertainty. Further, suppose that preferences are such that the first-best risk-sharing contract is sustainable, but some individuals are just indifferent between that and autarky. Now, if storage became available, this would leave first-best welfare unchanged, but make autarky more attractive. As a result the first-best contract would become unsustainable and welfare would be reduced.

In the case with coalitional deviations, the situation becomes even more complicated. On the one hand, making the first-best contract for the group of size n unsustainable reduces welfare, on the other hand, this may make larger groups sustainable, since the deviation payoff of the group of size n has now been reduced, which could have a positive effect on overall welfare. That being able to save has an ambiguous effect on welfare through its effect on deviation payoffs implies that there may be a strategic benefit to not invest in the savings technology – and therefore not to save.

3. That coalition-proofness can lead to contract heterogeneity arises from the fact that the coalition-proof insurance contract may fail to exist (see Genicot and Ray (2003)). This is the case because in the presence of coalitional deviations it is no longer sufficient to replicate the autarky allocation inside the insurance contract – which is in principle always possible by setting transfers to zero – to guarantee enforceability. The enforcement constraints may therefore be violated for some (or

all) asset levels.[19]

When a group that saves is not stable, stability of a group that does not save can arise in two ways: (1) the enforcement constraints hold for zero asset levels, but not for non-zero asset levels. That is, even after having invested in the savings technology, it is both optimal and self-enforcing not to use it. In this case, contract heterogeneity is driven wholly by coalition-proofness. (2) The group is stable with respect to deviations by sub-groups that do not have a savings technology available in the period of deviation and it is not stable with respect to deviations by sub-groups that do have a savings technology available in the period of deviation. In this case, contract heterogeneity is driven by the combination of coalition-proofness (an endogenous constraint) and the strategic benefit of not investing in the savings technology (an exogenous constraint).[20]

4. This follows directly from the discussion of Assumption 1.(a) and comparison of equations (2) and (3) with equations (4) and (5) . □

The mechanism by which contracts with and without savings coexist is sufficiently novel that it deserves some further explanation. There are two crucial differences between Ligon et al.'s (2000) setting and ours: (1) the latter only consider individual deviations and (2) the savings technology is costlessly and immediately available. In this case, it can never be optimal not to save when there is aggregate uncertainty, because the decision of a group not to save – as opposed to not invest in the savings technology – does not affect deviation payoffs of the individual. As a consequence, contract heterogeneity can only arise when there is no aggregate uncertainty and the first-best contract without savings is stable for some parameter values but not for others. By implication, in a given environment we would only expect to see one contract or the other.

In contrast, in our model we consider coalitional deviations and a savings technology that is available with a one period delay (and one could introduce even longer delays, which in the limit would be akin to comparing a world with and without savings). The latter implies that in our model a group can affect the deviation payoffs

[19] That the coalition-proof risk-sharing contract may not always exist is easy to see when comparing the enforcement constraints for individual and coalitional deviations for an individual that does not suffer a loss in a contract without savings. It is well known (for example Coate and Ravallion (1993)) that no matter how low the discount factor, the enforcement constraints are always guaranteed to hold (possibly with equality) in an individual deviations model. That is, $u(y - \tau_k) + \beta V^*(n) \geq u(y) + \beta V^*(1)$ and $\tau_k = 0$ if the enforcement constraint holds with equality. However, once we consider coalitional deviations, the expected utility that appears on the right-hand side of the enforcement constraint is $V^*(m) > V^*(1)$. Hence, there may not exist a $\tau_k \geq 0$ that satisfies the enforcement constraint.

[20] In principle, contract heterogeneity could also arise when both groups that save and those that do not save are stable for a given n, but the strategic benefit from not investing in the savings technology is so large that welfare in a group that does not save is sometimes higher. In our case, the strategic benefit from not investing in the savings technology is purposefully calibrated to be small enough that this (wholly exogenous) channel does not play a role.

of subgroups through its decision to invest or not to invest in the savings technology. More importantly though, even after having invested in the savings technology (or when the savings technology is freely and immediately available), coalition-proofness implies that it may be both optimal and self-enforcing not to save, simply because a group that saves may not be stable. In principle, it is therefore possible that we would see both contract types in a given environment.

Which of these mechanisms is most important and whether they lead to contract heterogeneity sufficiently frequently cannot be determined analytically, and we will therefore turn to simulations. In fact, as we discuss in the simulation section, we need both coalition-proofness and the delay in the availability of the savings technology to generate contract heterogeneity. Without coalition-proofness all groups are stable, and a group that saves is always preferred to a group that does not save. However, without some cost to saving that implies that deviation payoffs are higher when groups save than when they do not, a group that does not save never attains stability.

Having established that coalition-proofness can generate contract heterogeneity, can we predict where formal insurance contracts are likely to flourish? We conjecture that insurance contracts with savings are more likely to emerge where the ability to enforce contracts (parameterized here as ζ in the upper bound on the penalty $\overline{P} = \zeta(y - L)$) is higher and that this association comes about through a positive relationship between enforcement ability and the degree of insurance in equilibrium.

Conjecture 2 ***Enforcement ability, penalties and the prevalence of contracts with savings in the coalition-proof equilibrium***

1. *There is a positive relationship between enforcement ability and monetary penalties.*

2. *There is a positive relationship between enforcement ability and the degree of insurance (via monetary penalties) in each contract type.*

3. *Groups with higher enforcement ability select into contracts with savings, groups with lower enforcement ability select into contracts without savings.*

4. *The degree of insurance is higher in contracts with savings.*

5. *The degree of insurance is higher in contracts with higher monetary penalties.*

Part 1. of the conjecture hypothesizes that the assumption that enforcement ability limits the use of monetary penalties also holds in equilibrium. There are two reasons why this might not be the case: firstly, recall that the penalty is also bounded endogenously because those who receive it must not be tempted to bring about the collapse of the group. If this mechanism is sufficiently strong, it could weaken the relationship between ζ and P. Secondly, the set of stable sizes could change as enforcement ability increases in such a way that for the equilibrium configuration of stable sizes, penalties are actually smaller when enforcement ability is larger. Part 1. of the conjecture essentially states that neither of these effects will mask the positive correlation between P and $\bar{P} = \zeta(y - L)$ in equilibrium.

Part 2. of the conjecture hypothesizes that higher enforcement ability is linked with a higher degree of insurance – defined as the effect of own income on own consumption. Holding the set of stable group sizes constant, this would certainly be true because an increase in monetary penalties increases the cost of deviation making enforcement constraints less binding and allowing groups to come closer to first-best. In essence, the conjecture posits that this direct positive effect of a change in enforcement ability on the degree of insurance outweighs its indirect and more ambiguous effect on the set of stable sizes. Together with part 1. of the conjecture, this also implies a positive correlation between penalties and the degree of insurance.

Part 3. of the conjecture claims that there will be a positive relationship between enforcement ability and the prevalence of insurance groups with savings. This is the case because for groups that do not save, the marginal benefit over and above 'autarky payoffs' of increased insurance is larger than for groups that do save. Hence, the former attain stability already at low levels of enforcement ability, while the latter fail to exist unless there is some way of increasing the difference between equilibrium and out-of-equilibrium payoffs. This is precisely what happens as enforcement ability and therefore the use of financial penalties increases – at least if part 1. and 2. of the Conjecture are correct: with better enforcement, the cost of deviation increases and so does the likelihood that groups that save attain stability.

If part 1.-3. of the Conjecture are correct, then Part 4. and 5., the claim that insurance is better in insurance groups that save and better in insurance groups with higher enforcement ability follow: (1) For a given level of enforcement ability, contracts that save provide better insurance because they reduce the impact of a shock both by inter-household transfers and by intertemporal transfers. (2) For a given contract type, the degree of insurance will be higher the higher enforcement ability because the increased use of penalties makes enforcement constraints less binding, which will allow groups to get closer to first-best. Hence, the ability to enforce contracts reinforces the effect of contract type on the degree of insurance and vice versa.

What does this imply for welfare? While we can fairly confidently say that insurance groups that save will provide better insurance, the relationship between welfare and contract type is less clear-cut because the set of stable sizes may change in a way that counteracts the positive direct effect of changes in enforcement ability and switching into contracts with savings. Why might this be the case? All else equal, welfare from insurance is larger, the larger the risk pool, because this reduces aggregate variation. This also implies that when enforcement ability is low, the first group over and above individuals and pairs that attains stability tends to be large, because without penalties the only way to increase welfare from insurance is to increase group size. As enforcement ability increases, smaller intermediate group sizes attain stability and these in turn may destabilize the larger groups.

If groups that save tend to be smaller than groups that do not save, then they may only be able to offer the same (or a higher degree) of insurance than groups that do not save by building up assets and foregoing consumption. As a result welfare in groups that save could potentially be lower than in groups that do not save. So, while enforcement ability and switching into a contract that saves both have a positive effect on welfare for a given stable group size, their effect on the set of stable sizes and therefore the overall effect on welfare is less clear.

In sum, Proposition 1 and Conjecture 2 tell us that the model has the potential to match the empirical patterns documented in the previous section, namely, groups with savings provide more insurance than those without; both group types exist; and groups use a variety of punishment and enforcement mechanisms in equilibrium. Whether the model actually does generate the desired results cannot be determined analytically, however. Instead, we will confirm Proposition 1 and Conjecture 2 by simulating the model in the next section.

4 The second-best contract for all stable group sizes

To conduct the simulations, we parameterize the model in Section 3 and calculate the set of equilibrium contracts and their associated welfare in a community of size 10, chosen to be sufficiently large but still computationally tractable. A community is characterized by its level of risk aversion, its rate of time preference, and its ability to enforce contracts. These parameters are common to all community members. Preferences are parameterized by a CRRA utility function

$$u(c) = \frac{1}{1-\rho} c^{1-\rho}, \tag{24}$$

where ρ is the coefficient of relative risk aversion. In each period, individual income is y with probability p and $y - L$ with probability $1 - p$. Aggregate income among a group $n \leq N$ agents follows a binomial distribution with the probability that k agents do not suffer a loss $p(k, n) = \frac{n!}{k!(n-k)!} p^k (1-p)^{n-k}$. Individuals therefore face idiosyncratic and aggregate income risk. The discount rate is β and returns to savings are given by $r = \frac{1}{\beta} - 1$. Per capita savings range from $[0, \overline{a}]$ and $\overline{a} = 1$. The cost of the savings technology is $\psi = 0$, so the only cost of investing in the savings technology for an insurance group is that it differentially affects the deviation payoffs of stable subgroups for one period. Variation in the community's ability to enforce contracts is introduced by varying the parameter ζ in the maximum penalty $\overline{P} = \zeta(y - L)$ that can be levied on deviators.[21]

We compute the set of equilibrium contracts on the following grid, $\beta = \{0.85, 0.87, 0.89, 0.91, 0.93\}$,$\rho = \{1.2, 1.4, 1.6, 1.8, 2.0\}$ and $\zeta = \{0, 0.25, 0, 50, 75, 1\}$ resulting in 125 different combinations of preferences and levels of enforcement ability.

To compute the set of equilibrium contracts, we proceed recursively by solving the dynamic programme defined in (16)-(22) for all groups $n = 1, ..., 10$ in a community. Each group choses the contract type which yields the highest welfare starting from an asset level of zero in the initial period. In making this choice, a group of size n takes as given the contracts chosen by its stable subgroups.

Given the assumptions on the savings technology, individuals will always save and we denote their payoff as $V^*(0,1) = V_{\text{savings}}(0,1)$. Next, we consider insurance groups. In a first-best world, these would like to save (because there is aggregate uncertainty), but, in a world of limited commitment and coalitional deviations, groups that save may not be stable, opening up the possibility that groups that do not save attain stability.

The per capita payoff for a stable group of size n is defined as $V^*(0,n) = \max\{V_{\text{not saving}}(0,n), V_{\text{saving}}(0,n)\}$ where it is understood that the payoff is simply set to $V^*(0,1)$ if the group is not stable. To compare the welfare of insurance with and without savings, we calculate the stable payoff $V^*(0,n)$ and record whether it involves saving or not for each $n = 1, ..., 10$ in each of the 125 different communities. We normalize this payoff by subtracting the minimum payoff $V_{\text{not saving}}(0,1)$, and scaling by the difference between the maximum payoff the community can achieve, $V^{\text{fb}}_{\text{saving}}(0,10)$, and the minimum.

$$\frac{V^*(0,n) - V_{\text{not saving}}(0,1)}{V^{\text{fb}}_{\text{saving}}(0,10) - V_{\text{not saving}}(0,1)} \times 100. \tag{25}$$

This gives a measure of the return to insurance in percentage terms.

Since the largest stable group will typically be smaller than the community and not all groups within a community will be stable, the question arises which group sizes will be observed and how the relevant payoff of being in a particular group can be calculated. Following Genicot and Ray (2003), the population is partitioned into stable groups in a way that maximizes the expected utility of an agent under the assumption that the probability of being in a group is proportional to the size of the group. Having found this optimal partition, we then calculate the welfare from insurance with savings by multiplying the probability of ending up in a group that saves (again proportional to its size) by the associated welfare for every combination

[21] We do not vary y and L, since income directly affects the payoff from insurance. Hence, there is a one-to-one relationship between ζ and the bound on the penalty $\overline{P}$.

of parameters. This number is then averaged over all parameterizations. The same is done to calculate welfare from insurance without savings.

Having calculated the set of stable contracts that include savings and those that do not, we can calculate the degree of insurance achieved by these contracts ex-post. In order to calculate the degree of insurance, we need to decide the initial asset level for Iddir that save. Since we do not observe this in the data, we choose the ergodic mean of capital as the initial level. We then randomly draw an income realization for each individual in the community of size $N = 10$ over $T = 5$ time periods and calculate log consumption based on the computed stable insurance contracts. We then calculate the degree of insurance for contracts with and without savings implementing a simple version of the estimation in Section 2.

$$\ln c_t^i \quad = \quad \alpha + \beta \mathsf{Loss}_{it} + \gamma \mathsf{Loss}_{it} \times \mathsf{Contract}_{it} + \delta \mathsf{C}_t^g + \varepsilon_{it} \tag{26}$$

where Loss_{it} is a dummy set equal to 1 if the individual has a low income realization, $\mathsf{Contract}_{it}$ is a dummy set equal to 1 if the contract includes savings and $\mathsf{C}_t^g = \frac{1}{|N_t^i|}\sum_{j \in N_t^i} \ln\left(\frac{c_t^j}{n_t^j}\right)$ is the average consumption of $|N_t^i|$ households i is connected to through membership in the insurance group. We include C_t^g in order to control for aggregate resources of all but agent i in the risk-sharing group. We bootstrap the procedure 100 times and record the average coefficients (and their standard errors).

Figure 1 summarizes the simulation results along various dimensions: coexistence of contracts; the relationship between enforcement ability, penalties and the degree of insurance; and welfare from different contract types.

In panel a) we show that the model indeed generates contract heterogeneity. We plot the percentage of people covered by the different contract types for each level of enforcement ability (averaging over time and risk preferences) and overall.[22] In total, 52.4% of agents select insurance contracts with savings and 47.6% do not. In line with our hypothesis that contracts with savings will become more prevalent as enforcement ability increases, we find a steady increase of insurance groups with savings from 21.2% for the lowest level of enforcement ability to 72% for the highest level of enforcement ability.

As posited in Proposition 1.3, contract heterogeneity is to a large extent driven by the requirement that groups are coalition-proof, which leads to instability of contracts: of the set of all possible group sizes, only 37% are stable. Similarly, the equilibrium average group size is 3.34 for groups that save and 6.91 for groups that do not save – both significantly smaller than the community of 10.

[22]In panel b) and c) in Figure 1, the overall averages are population weighted based on the number of people in each contract type at the different levels of enforcement ability shown in panel a).

The frequent non-existence of insurance contracts is a necessary condition for contract heterogeneity to emerge as it opens up the possibility for groups that do not save to attain stability when those that do save fail to exist. In fact it is not only necessary but also sufficient in the sense that the model generates contract heterogeneity without having to rely on variation in preferences across communities: for 23% of the different parameterizations, contracts with and without savings coexist in the same community (i.e. when preferences and enforcement ability are held constant).

In panel b) – d) we investigate what drives the positive correlation between enforcement ability and the prevalence of insurance contracts with savings.

In panel b), we plot the average penalty charged in both group types for each level of enforcement ability and overall. As predicted by Conjecture 2.1, we find that both sets of groups use monetary penalties, that the average penalty is about a third larger in groups that save and that enforcement ability and monetary penalties are positively correlated in equilibrium.

Panel c) and d) show that higher enforcement ability is linked with a greater degree of insurance via the use of monetary penalties. In panel c) we report the extent of insurance offered by the different contract types for each level of enforcement ability and overall. In particular, we estimate regression (26) and plot the regression coefficients β in the case of groups that do not save and $\beta + \gamma$ in the case of groups that do save.

Consistent with the empirical results in Section 2, insurance contracts with savings offer better insurance than those without overall and for all but the lowest level of enforcement ability. There is a steady increase in the degree of insurance in both contract types across the range of enforcement ability ranging from -22% (-21%) at the lowest level of enforcement ability to -4% (-6%) at the highest level of enforcement ability for contracts that save (contracts that do not save). Across all communities, the average effect of a shock on people in contracts without savings is -19%, while it is -9% for people in contracts with savings, a difference of 10 percentage points.

In panel d) we plot the degree of risk-sharing in each community and contract type and plot this against the amount of penalties charged. In line with Conjecture 2.2 and 2.5 and the results in panel b) and c), there is a positive relationship between the amount of penalties charged and the degree of insurance in each contract and overall.

Together panel b) through d) reveal the mechanism that drives the positive association between enforcement ability and the prevalence of contracts with savings: as enforcement ability increases, groups can sustain a higher degree of insurance and the higher the degree of insurance, the more likely a group that saves will be stable.

The latter is the case because for groups that save, the marginal benefit over and above 'autarky payoffs' of increased insurance is smaller than for groups that do not save. Therefore, to be stable these groups have to – and of course can – offer a higher degree of insurance than groups that do not save. Conversely, since groups that save are always preferred when both group types are stable, we would expect to see more and more groups that save to exist in equilibrium as enforcement ability (and therefore the use of monetary penalties) increases.

The results in panel c) and d) also aid in interpreting the empirical estimates in Section 2. There we found that shocks are 17% better insured in insurance groups with savings than in those without and interpreted this as the causal effect of selecting a contract with savings. The model suggests a more subtle interpretation, however. Panel c) shows that the difference in the quality of insurance is not wholly driven by contract choice: conditional on the level of enforcement ability, the average difference between the two contract types is 5 percentage points, about half the overall effect estimated in the simulations.

To be sure, the model also confirms the placebo tests estimated in Section 2 by showing that the correlation between contract choice and the degree of insurance is not purely spurious. That is, it is not the case that those with higher enforcement ability are better at insuring each other and happen to be in contracts with savings. Instead, a higher ability to enforce contracts allows households to establish a more formal institution that can provide better insurance (the causal effect of contract choice), but it also has a direct positive effect on the degree of insurance regardless of the particular institutional form.

Finally, in panel e) and f), we explore the relationship between the degree of insurance and welfare in the two sets of groups both ex-post and in expectation. In panel e), we calculate for each community and group type discounted life-time utility (relative to first-best) starting from the long-run level of capital and plot it against the degree of insurance. Panel f) plots the degree of insurance against the expected utility starting from initial asset levels of zero in both group types (see equation (25)). This gives a measure of expected life-time utility at the point when households decide which type of group to form – the appropriate measure for welfare comparisons across contracts.

The two panels show that better insurance broadly corresponds to higher welfare – although there is a lot of variation. Ex-post, households in insurance groups that save are almost uniformly better off than households in insurance groups that do not save reaching an average of 96% of first-best welfare compared to 62%. The same is not true ex-ante though. While households in insurance groups that save reach the highest level of welfare overall and tend to perform better when enforcement ability is sufficiently high, on average welfare is higher in groups that do not save

(93% compared with 86%).

Insurance with savings is not necessarily linked with higher welfare ex-ante because groups that save tend to be smaller than groups that do not save. Why is this the case? When enforcement ability (and penalties are low), saving is usually only stable for very small groups. In order to overcome the threat posed by small groups that can save, groups that do not save need to be fairly large in order to be sufficiently attractive. In other words, the smallest stable group size for groups that do not save tends to be large. As enforcement ability increases and the degree of insurance a group can offer becomes higher, intermediate group sizes that save become stable. In turn, this prevents the formation of larger groups of either the saving or non-saving type.

Hence, we have two opposing forces at work: group size, which tends to be associated with higher welfare because it offers a larger risk pool and enforcement ability, which tends to be associated with higher welfare because it allows for a higher degree of insurance for each contract type (and group size) and because it tends to be associated with a contract that in principle can offer a higher degree of insurance. Ex-ante, the former outweighs the latter – at least on average. In particular, groups that save provide better insurance, but at the cost of lower consumption, because part of this insurance is financed by building up precautionary savings. Ex-post, groups that save have higher mean consumption and lower variance of consumption implying both higher welfare and better insurance in groups that save.

In summary, the model is able to replicate the main empirical findings that prompted the analysis: contracts with and without savings coexist, but contracts with savings provide better insurance coverage than those without. Moreover, the simulations show that the degree of insurance estimated in the data is informative about welfare even in a second-best world.

The model also identifies a mechanism that can generate these results: when groups are required to be coalition-proof, groups that save do not always exist allowing groups that do not save to attain stability (even though the latter would not be preferred if both group types were stable). In particular, groups that do not save are more likely to exist when enforcement ability is low because enforcement ability is positively associated with the degree of insurance and groups that save need to – and of course can – offer a higher degree of insurance in order to attain stability. This results in a positive correlation between enforcement ability and the prevalence of formal insurance groups with savings in equilibrium.

4.1 Discussion of results

The model and simulations show that our assumptions are indeed sufficient to match the empirical findings. We now use further simulations to examine to what extent they are necessary. We also discuss what the results imply with respect to the welfare effects of different policies, such as increasing access to savings, strengthening groups' ability to enforce contracts or improving the regulatory environment. To do this, we simulate the model, switching on and off different mechanisms one at a time.[23]

First, we examine the extent to which coalition-proofness and the strategic benefit to not investing in the savings technology are both necessary for the co-existence of contracts. Comparing the model for coalitional deviations with and without a delay in the availability of savings, we find that coalition-proofness alone cannot generate contract heterogeneity unless there is some wedge in the deviation payoffs between groups that save and those that do not save. That is to say, once a group has invested in the savings technology, there is no situation in which a group is stable for zero asset levels, but not stable for non-zero asset levels. On the other hand, examining the model with both coalitional deviations and the one period delay in the availability of savings in more detail, we find it is never the case that both contract types are stable, but the one without saving is preferred. Hence, the contract without savings is only chosen if the contract with savings is not stable. In that sense, coalition-proofness is necessary for achieving contract heterogeneity.

While coalition-proofness cannot generate contract heterogeneity in isolation, the strategic cost to savings cannot generate contract heterogeneity within communities, only across, and even then only in a stationary and symmetric setting. With only individual deviations, membership in groups that do not save is 36% (compared with 48% with coalitional deviations). This heterogeneity arises mainly because solving for stationary and symmetric equilibria implies that groups that save may not exist even in the individual deviations model as replicating the autarky allocation requires asymmetry in expected payoffs.[24] In a more general dynamic setting, all groups are stable to individual deviations, and we would see contract heterogeneity only if the strategic cost to saving was so large that not saving was preferable even when both contract types are stable. Given the small strategic cost to saving in our model, this only occurs in 4% of cases, however.[25]

Looking within communities, coalition-proofness is even more important in generating contract heterogeneity. Without coalitional deviations, only 0.8% of communities include groups that save and those that do not save simultaneously compared with 23% of communities with coalitional deviations. This is the case because with

[23]All simulation results are available from the authors on request.

[24]Comparing the model with and without coalitional deviations, we find that about 2/3 the nonexistence of contracts with savings is driven by coalition-proofness and 1/3 is driven by the restriction to stationarity and symmetry.

[25]Ideally, we would solve for the dynamic equilibrium of the model, but this is simply not computationally feasible. Hence, we focus instead on the stationary equilibrium and note that this slightly dampens the role played by coalitional deviations in generating contract heterogeneity compared to the more general dynamic setting.

individual deviations, the entire community is stable for the contract that does not include savings and therefore everyone in the community chooses the same contract. Hence, we conclude that the interaction of coalition-proofness and the strategic cost to saving drives 96% of contract heterogeneity within communities (0.8% versus 23% of communities with both types of contracts) and at least 25% of the contract heterogeneity across communities (36% versus 48% who choose contracts without savings).[26]

The simulations can also be used to examine the effect of different policies on welfare. Savings levels in developing countries tend to be low and it is often advocated that making individual saving products more easily available would improve welfare (Karlan and Ratan 2014). While this may be true at the individual level, making saving easier in the context of group insurance may be less beneficial. We can test this hypothesis by comparing our results both to a model where the savings technology is immediately available to all groups and a model where the savings technology is not available at all. Compared with our model expected welfare is lower in the former and higher in the latter. This suggests that if group savings are constrained by limited enforceability, then making savings more easily accessible will not necessarily lead to an increase in welfare.

Secondly, the model shows that efforts to strengthen groups' ability to enforce contracts would improve welfare, but would not be sufficient to achieve first-best outcomes. Even for the highest levels of enforcement ability, 28% of households choose not to engage in savings and welfare falls short of first-best. Hence, the model shows that informal enforcement mechanisms are imperfect substitutes for full contract enforceability.

Finally, we note that while we do not focus on preference heterogeneity as a mechanism, we do allow for it in the simulations. Indeed, we find that the prevalence of contracts with savings is sensibly related to both time and risk preferences (i.e. it is higher in communities with more patient and risk-averse agents). Similarly, the cost of capital could of course be determining contract selection, but since this parameter is not determined inside the model, we do not focus on it as a driver of contract heterogeneity.

4.2 Testable implications

The simulations suggest several ways in which the model assumptions and implications can be tested in the data. Firstly, if enforcement ability affects welfare via the use of penalties also in the coalition-proof equilibrium, then we would expect to

[26] 25% is a lower bound here calculated on the assumption that all the heterogeneity generated by the restriction to symmetric and stationary contracts would disappear in a more general dynamic setting with coalition-proofness.

see (i) a positive association between penalties and the degree of insurance and (ii) a positive association between penalties and enforcement ability. Secondly, if this mechanism implies that groups that save achieve stability only at higher levels of enforcement ability, then we should find (iii) a positive association between enforcement ability and selection into contracts that save; and penalties and selection into contracts that save.

The simulations also motivate a reexamination of the 'causal' effect of being in a formal contract. Because enforcement ability affects welfare both directly and through its effect on contract choice, the unconditional difference in the quality of insurance between groups that save and those that do not, conflates these two effects. In what follows, we therefore reestimate the effect of contract choice on the extent of insurance controlling for observed enforcement mechanisms of the group.

5 Testing the model

The first testable implication of the model is that penalties for noncompliance should be positively related to the degree of insurance in each contract and overall. This also provides an indirect test of whether groups operate in a second-best world, for otherwise punishment mechanisms would not matter.

As noted in section 2, insurance groups that do not save mainly employ ex-post fines to deal with deviant behavior, while insurance groups that do save charge their members up-front premia. We have shown in the modeling section, that both these mechanisms can be interpreted as penalties in case of noncompliance levied on agents with a high income realization, i.e. those who most often have an incentive to deviate.

Consequently, we test our hypothesis as follows: we repeat the empirical analysis from Section 2, but now include interactions of the shock variable with the amount of penalties. The penalty variable is defined as the (logged) sum of ex-ante transfers and fines.[27]

To test whether penalties lead to better insurance in each group type and overall, we estimate the following regression separately for households in groups that save, for households in groups that do not save and finally for the entire sample:

$$\ln\left(\frac{c_t^i}{n_t^i}\right) = \beta \mathsf{death}_{it} + \delta(\mathsf{death}_{it} \times \mathsf{penalty}_{it}) + \eta X_{it} + \lambda_i + \lambda_t + \lambda_{vt} + \varepsilon_{it} \quad (27)$$

[27]Note that our hypothesis refers to the penalties the group's rules stipulate that a member should pay in case of deviation, not the fines actually paid in any particular period. It is the former measure – elicited from the survey of funeral insurance groups and matched to the household data – that we use in the analysis. As seen in Table 1, groups that do not save mainly use ex-post fines whereas groups that save mainly use ex-ante transfers.

The model and simulations show that groups that save obtain better insurance partly because these groups have stronger enforcement mechanisms in place. Conversely, for the same level of penalties charged, groups that save obtain better insurance because they employ a superior contract type. To disentangle these two effects, we estimate a second specification, which controls separately for the effects of penalties and contract choice:

$$\begin{aligned}\ln\left(\frac{c_t^i}{n_t^i}\right) &= \beta \mathsf{death}_{it} + \gamma(\mathsf{death}_{it} \times \mathsf{contract}_{it}) + \delta(\mathsf{death}_{it} \times \mathsf{penalty}_{it}) \\ &+ \eta X_{it} + \lambda_i + \lambda_t + \lambda_{vt} + \varepsilon_{it} \qquad (28)\end{aligned}$$

In both regression (27) and (28), we again control for Iddir fixed effects by subtracting group consumption from the dependent variable.

The regression results are reported in Table 3. Column (1)-(3) give the results from estimating equation (27), column (4) contains the results for equation (28). In each of the three samples, the (negative) effect of a shock is reduced, the more penalties the group charges: If a group that saves does not charge penalties, consumption is reduced by 12% following a death while the effect is basically zero for the median level of (log) penalties – though the difference is not significantly different. If a group that does not save charges no penalties, a death reduces consumption by 32%. If the group charges penalties, this effect is reduced significantly and the impact of a death at the median penalty level is halved to 16% (as can be seen from the last row of Table 2).

When considering the whole sample in column (3), the effects are very similar. On average, a death shock reduces consumption by 11% in groups that do not charge penalties, but this effect is completely (though not significantly) reversed at the median level of penalties. Taken together, this shows that observed penalties and welfare – as measured by the quality of insurance – are indeed positively correlated in equilibrium and that ex-ante transfers and fines can be considered substitutes in the enforcement of insurance contracts.

Finally, column (4) shows separately how contract type and enforcement mechanisms contribute to the quality of insurance. Suffering a death in a group that does not save and does not employ penalties leads to 29% loss in consumption. This is reduced significantly by almost 13% if the group charges the median penalty level and by a (significant) further 18% if the group also uses savings.

Hence, both contract choice and enforcement mechanisms play important parts in reducing the impact of a shock. Of course, the estimated coefficients may still suffer from omitted variable bias. Nevertheless the estimated correlations are consistent with the causal processes implied by the theory and simulations: groups that are better at enforcing contracts achieve a higher degree of insurance in a given contract and they find it easier to establish more formal and welfare-enhancing institutions for insuring funerals.

We now explore further how a group's ability to enforce and choose superior contracts is related. The model and simulations generated two hypotheses relating a group's underlying ability to enforce contracts to observed punishment mechanisms on the one hand and selection into insurance with savings on the other. Since the regression specifications for these tests are very similar, we discuss them together here.

In the model, we suggested that a group's ability to enforce contracts via monetary penalties is related to its social cohesion – which in principle can be measured – and found this to be true also in the coalition-proof equilibrium. There is indeed a large literature suggesting that the ability of a group to coordinate on Pareto superior outcomes that may not be self-enforcing is related to social cohesion or social capital (cf. Durlauf and Fafchamps (2005) and Attanasio et al. (2009), p.4)[28] The two hypotheses above present a direct test of this claim, namely whether social capital is linked to superior outcomes via better enforcement mechanisms and more sophisticated contracts.

A consensus is emerging, which types of variables make for good measures of social capital: (i) groups and networks (for example asking how many people can you rely on in times of need), (ii) trust (for example, generally speaking would you say that most people can be trusted, (iii) collective action (e.g. have you attended a local community event), (iv) social inclusion (are there any services that your household has been denied from using), (v) information and communication (e.g. availability of radio, newspaper etc.).[29] In the context of rural Ethiopia, the prevalence of informal networks (i) and trust in other people (ii) seem the most appropriate measures of social capital, while (iii)-(v) seem less salient, as communications as well public service delivery remain relatively limited.

In what follows, we therefore test the two remaining hypotheses by regressing both observed punishment mechanisms in each group type and overall and the likelihood of engaging in insurance with savings on two measures of social capital: a measure of trust, based on a simple question of whether others in the community were trusted (on a scale of one to five, one being the lowest) averaged at the group level; and a measure of the strength of informal networks, which records the percentage of people in a households informal network (defined by common membership

[28]Attanasio et al. (2009) et al. show that social capital is positively related to contributions in a public good game. Similarly, Karlan (2005) finds that individuals identified as 'trustworthy' in experimental games are more likely to repay their loans to a Peruvian group-lending microfinance program. At the macro level, Knack and Keefer (1997) find a positive correlation between social capital and economic growth.

[29]These are the five dimensions of social capital highlighted by the World Bank in their Social Capital measurement tool.

in informal labour sharing and credit arrangements) that are also a member of the same Iddir. Intuitively, if this proportion is high, then the household will share Iddir membership with a number of other households who they know well and can rely on in times of need.

In addition to the social capital variables, a member's reliability may also be an important determinant of how easily contracts can be enforced and – by extension – whether groups can select insurance contracts that include savings (Anderson et al. 2009). Households with stronger ties in the community, stronger ties in the group, and less mobility are more likely to make reliable members of insurance arrangements because they are more amenable to social and reputational pressure. Conversely, such members may also find it easier to enforce contract rules against others who do not comply. To proxy a member's reliability, we include a dummy for whether they were born in the village, whether the father was a member of the Iddir and whether they belong to a minority religion or ethnicity.

Furthermore, the ability to save and impose monetary fines could be related to the wealth of the group's members because poorer households may not have the liquidity to engage in group savings. We therefore include land and livestock holdings of the household as a proxy for wealth.

To account for differential preferences and environments, we include village, time and village-time fixed effects as well as a number of other household characteristics as explanatory variables. These include household size, age, sex and education levels of the household head. Aside from controlling for preferences, the level of education may in itself be positively correlated with selection into insurance groups that save, if these require more sophistication in terms of the day-to-day running of the group.

This results in the following regression specification for testing the relationship between social capital and punishment mechanisms:

$$\mathsf{penalty}_{it} = \alpha + \beta\mathsf{social\ capital}_{it} + \gamma X_{it} + \lambda_t + \lambda_v + \lambda_{vt} + \varepsilon_{it} \tag{29}$$

We estimate regression (29) separately for penalties faced by households in groups that save, groups that do not save and finally for the entire sample. When we only consider groups that save, the penalty variable is defined as the logged ex-ante transfer. When we only consider groups that do not save, the penalty variable is defined as the logged ex-post fine. When we consider both, the penalty variable is defined as the sum of these two.

The regression results for the first hypothesis, whether observed punishment mechanisms are related to social capital are presented in Table 4, column (1)–column (3). Across the board, there is a positive (though not always significant) correlation between the social capital measures and observed punishment mechanisms. For groups that save, trust at the network level is positively and significantly related to the size of the ex-ante transfer levied by the insurance group. When considering the whole sample, the percentage of a household's informal network is significantly related to observed punishment mechanisms. When restricting the sample to households that are members of groups that do not save and considering fines, the relationship between the social capital measures and fines remains positive, but is not significant.

In terms of the other variables included, few significant predictors emerge. Monetary penalties are larger, the wealthier a member, but the measures related to a member's reliability are – if anything – negatively correlated with observed monetary penalties.[30]

Overall, the results support the model: social cohesion and observed punishment mechanisms are positively related in equilibrium both overall and in each set of groups.

We now turn to the final hypothesis, that social cohesion and selection into insurance groups with savings are positively related in equilibrium. In Table 5, we present the results from a probit analysis of contract selection at the household level. The left-hand side is set to 1 if the household is a member of an insurance group that saves and zero otherwise.[31]

The explanatory variables include the same list of variables as the regression for monetary penalties with one addition: since insurance groups with savings in principle offer better insurance, selection may also be driven by differing demand for insurance across households. In particular, we discussed in Section 4.1 that households that are more patient and risk-averse more often select into insurance groups that save. A lower cost of obtaining capital may also be associated with a higher demand for insurance that incorporates savings. Finally, the risk profile of the household and group members may also matter. On the one hand, the more shocks there are the more smoothing households may demand, on the other hand, liquidity constraints may then dictate that each shock is less well insured.

In additional specifications, we also examine directly the relationship between contract selection and the observed punishment mechanisms of the group, for which we predict a positive correlation, and provide further evidence that fines and ex-ante transfers are indeed substitutes.

This results in the following regression specification for testing the relationship between social capital and selecting into insurance groups that hold savings:

$$Pr(\mathsf{contract}_{it} = 1) \quad = \quad F(\beta \mathsf{social\ capital}_{it} + \gamma X_{it} + \lambda_t + \lambda_v + \lambda_{vt} + \varepsilon_{it}) \quad (30)$$

[30]This is in line with results by Anderson et al. (2009) who find that measures of members' reliability and formal punishment mechanisms are inversely related in the organization of urban Roscas in Kenya.

[31]For households that are members of more than one group, the dependent variable is set to 1 if more than 50 percent of the groups hold savings.

where F is the standard normal distribution function.

Table 5 offers the results from different variants of the probit analysis of contract selection. Across all specifications, the variables related to social capital (trustworthiness and overlap of informal network and Iddir) are positively and for the most part significantly correlated with contract selection. In addition, wealth is a positive and strongly significant predictor of contract selection. Variables related to a households demand for insurance correlate sensibly – though not significantly – with contract selection. More patient and risk-averse members with a lower cost of capital are more likely to select into insurance groups that save. Finally, variables related to a members reliability have a somewhat inconsistent pattern and are in any case – with the exception of belonging to a minority ethnicity – not significant. Taken together, these results provide strong evidence that social capital and liquidity constraints are positively correlated with selecting into an insurance contract with savings as predicted.

Finally – and consistent with both the descriptive statistics and simulations – in column (2), (3) and (4), we show that insurance with savings is more likely to be associated with the use of ex-ante transfer and less likely to be associated with the use of fines, but that the total sum of punishment mechanisms is larger in insurance groups that save.

6 Conclusion

This paper has explored theoretically and empirically contract choice in funeral insurance groups and discussed its consequences for welfare. We focused on two types of contracts found in rural Ethiopia: one with considerable savings at the level of the group and regular premium collection, and one without savings and direct payments to its members after they experienced a mortality shock.

We can show that both contracts may co-exist in a model in which groups may select into savings, but are constrained due to enforceability constraints that require coalition-proofness, as groups that save are more liable to group-deviations. Consistent with theoretical predictions and simulation results, we found that both contracts co-exist in the same villages and that contract choice is related to social cohesion. We can show theoretically and empirically that in equilibrium social cohesion allows stricter enforcement via penalties for deviations, and that the ability to levy these penalties improves welfare across groups. It also allows more entry into the formal contracts with savings, contributing to better predicted welfare. Social cohesion thus helps to overcome enforceability constraints, including via allowing more punishments for deviations, but not up to the first-best level of insurance.

This case of insurance groups in Ethiopia offers a striking insight of how more formal institutions may emerge, even when enforcement is limited. In this case, a group insurance scheme with savings, akin to a mutual society, offers superior insurance to more informal systems, but (group) enforceability issues limit the scale at which they can emerge. The result is that within the same community heterogeneity of funeral insurance systems emerges, even if with other factors equal, insurance with savings is superior in welfare. Our analysis also illustrates how social capital is no full substitute for enforcement, but can help these insurance institutions (both the formal and the informal ones) to function better as specific rules, in this case punishments for deviations, can become operational.

Even if the spread of more enforceable contract law to rural Ethiopia is still very limited, the richer, urban parts of this country are evolving towards stronger rule of law. It is striking that even there, the Iddir has continued to evolve as an important institution, operating increasingly with more formal, and indeed more enforceable rules (such as obligatory membership linked to professional bodies). The result is even more heterogeneity, with some very large, powerful Iddirs organised around professions, coexisting with many more informal grouping. Whether they will form the basis of large mutuals as have emerged in other countries remains to be seen, but as our analysis showed, the preliminary steps towards them do not need to wait for formal rules to emerge. In line with Greif and Kingston (2011), institutional arrangements have emerged as self-enforcing equilibria, which may not or may only later be formalised in rules and laws.

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7 Tables and Figures

Table 1: Characteristics of funeral insurance groups (mean and standard deviation).

	No Savings	Savings
Regular contribution to Iddir	0.27	2.35
(ETB/month equivalent)	(0.05)	(1.38)
Contributions at funeral	3.67	0.13
(ETB/month equivalent)	(1.94)	(0.08)
Payout in case of	143.69	277.00
member's/spouse death	(127.15)	(205.34)
Number of members	60	117
	(40.01)	(138.14)
Current funds of Iddir (ETB)	434.58	3488.08
	(771.39)	(5473.88)
Amount Iddir paid out in past 12 months (ETB)	564.13	1952.70
	(742.88)	(6047.63)
Severity of punishment (1=Lowest, 9=Highest)	6.75	7.70
	(.34)	(0.48)
Fines	3.212	0.32
	(.94)	(1.21)
Number of observations	41	37

Source: Funeral Insurance Survey. Severity of punishment is the answer to the question "What happens if someone does not pay their contribution?" and is coded as "1 = Nothing, 2=Exemption, 3=Delay, 4=Fine, 5=Paid by guarantor, 6=Excluded, 7=Fine and excluded, 8=Taken to local court, 9=Taken to government court"

Table 2: Testing the welfare effects of insurance with and without savings
Dependent variable: log real per capita consumption

	(1)	(2)	(3)	(4)	(5)	(6)
death	-.087	-.117				
	(.058)	(.064)*				
death × insurance w. savings	.131	.168				
	(.070)*	(.076)**				
Coeff1 + Coeff2	.044	.051				
	(.041)	(.044)				
illness			.079	.067		
			(.041)*	(.049)		
illness × insurance w. savings			-.024	-.007		
			(.048)	(.056)		
catastrophic death					-.142	-.194
					(.078)*	(.087)**
catastrophic death × insurance w. savings					-.009	.062
					(.106)	(.116)
Iddir fixed effects		YES		YES		YES
Obs.	1260	1260	1238	1238	1260	1260

Notes: Household fixed effects. Standard errors in parentheses (clustered at household level). Village-time dummies and individual preference shifters included, but not reported. * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Source: ERHS and Funeral Insurance Survey.

Figure 1: Simulation results

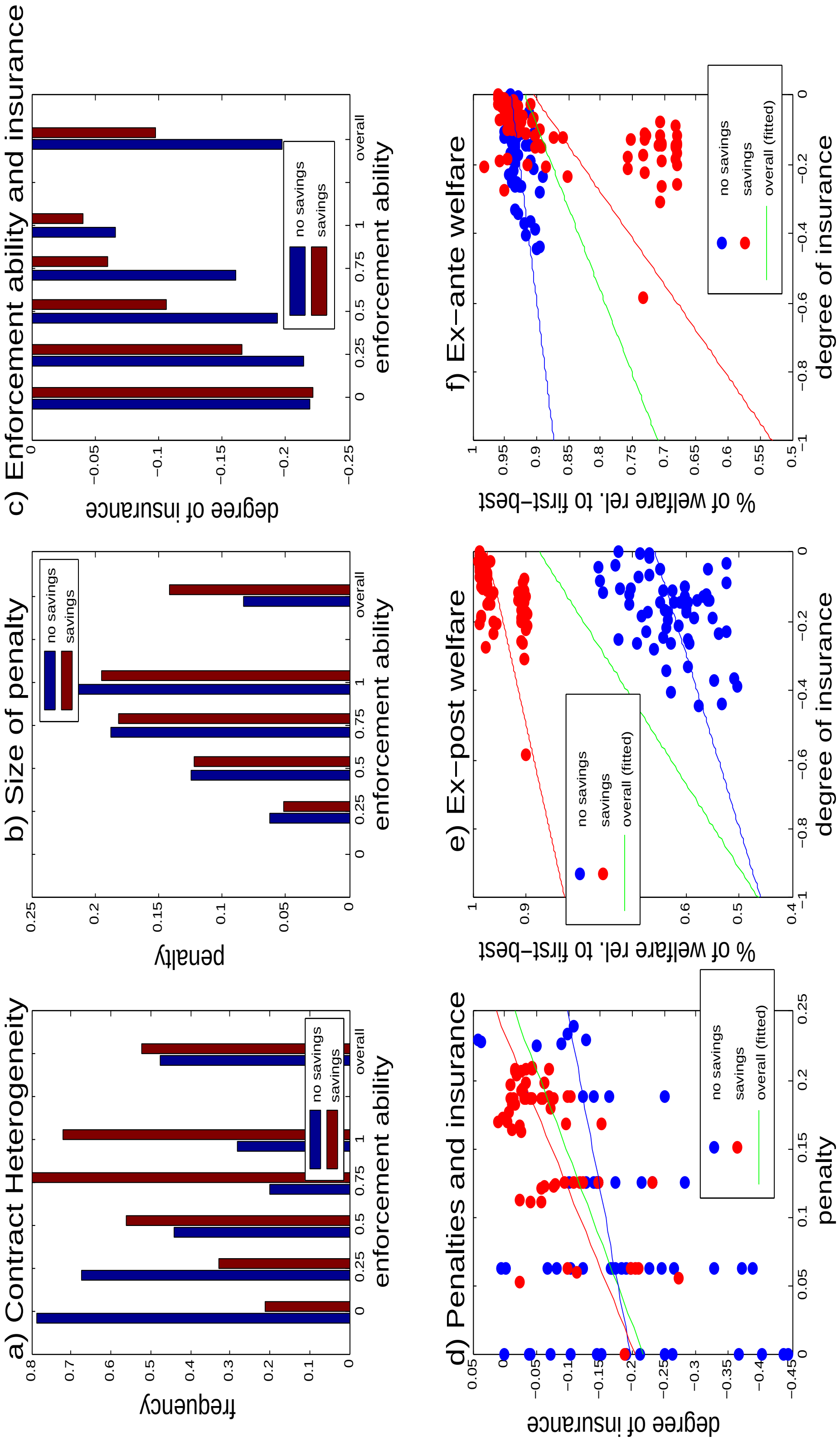

Table 3: Testing the model – Insurance, enforcement mechanisms and contract choice

Dep. var.: log real p. c. consumption (de-meaned)	(1)	(2)	(3)	(4)
death	-.117	-.324	-.105	-.289
	(.172)	(.159)**	(.097)	(.136)**
death × total penalty	.124	.136	.097	.127
	(.140)	(.078)*	(.075)	(.071)*
death × insurance w. savings				.182
				(.098)*
Linear Combinations				
death, median total penalty	.018	-.174	.0009	
	(.041)	(.101)*	(.035)	
Sample	ins. w. savings	ins. wo. savings	both	both
Obs.	774	236	1017	1011

Notes: Household fixed effects. Standard errors in parentheses (clustered at household level). Village-time dummies and individual preference shifters included, but not reported. * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Source: ERHS and Funeral Insurance Survey.

Table 4: Testing the Model – Correlates of enforcement mechanisms

	Ex-ante transfer (1)	Fine (2)	Sum of both (3)
Social capital			
Avg. measure of trustworthiness of others in network	.113	.165	.076
(1=Low, 5=High)	(.060)*	(.252)	(.066)
Proportion of informal network in same Iddir	.060	.217	.187
	(.052)	(.374)	(.085)**
Reliability			
Born in village†	-.050	-.736	-.093
	(.045)	(.338)**	(.059)
Father member of same Iddir†	-.043	.173	.016
	(.045)	(.194)	(.058)
Belonging to minority ethnicity†	.054	-.856	-.007
	(.053)	(.334)**	(.090)
Belonging to minority religion†	-.010	-.157	.107
	(.063)	(.178)	(.070)
Parents important in village life†	-.005	.223	-.040
	(.045)	(.221)	(.057)
Socio-economic characteristics			
Second land-owning quartile†	.050	-.141	-.009
	(.053)	(.183)	(.079)
Third land-owning quartile†	.087	-.095	.045
	(.047)*	(.325)	(.078)
Fourth land-owning quartile†	.042	.038	.033
	(.062)	(.307)	(.079)
Ln age of head	.003	.496	.120
	(.064)	(.325)	(.079)
Ln of household size	-.028	.516	-.018
	(.038)	(.262)**	(.045)
Head has schooling†	-.030	.733	.067
	(.042)	(.347)**	(.069)
Female-headed household†	-.006	.091	.050
	(.045)	(.230)	(.060)
Sample	ins. with savings	ins. wo. savings	both
Obs.	829	223	960

Notes: Standard errors in parentheses (clustered at household level). Village-time dummies included, but not reported. † indicates a dummy variable. * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Source: ERHS and Funeral Insurance Survey.

Table 5: Testing the Model – Correlates of contract selection

Dependent variable: Contract type (1=ins. with savings, 0=ins. without savings)

	(1)	(2)	(3)	(4)
Social capital				
Avg. measure of trustworthiness of others in network	.153	.101	.135	.135
(1=Low, 5=High)	(.046)***	(.045)**	(.047)***	(.046)***
Proportion of informal network in same Iddir	.094	.048	.001	-.015
	(.048)*	(.045)	(.042)	(.044)
Contract structure				
Ex-ante transfer (log)		.265		
		(.052)***		
Fine (log)			-.060	
			(.036)*	
Ex-ante transfer + fine (log)				.060
				(.030)**
Reliability				
Born in village†	-.024	-.035	-.033	-.036
	(.046)	(.044)	(.041)	(.042)
Father member of same Iddir†	.001	.008	-.019	-.017
	(.041)	(.037)	(.036)	(.036)
Belonging to minority ethnicity†	-.167	-.174	-.138	-.147
	(.068)**	(.059)***	(.057)**	(.057)**
Belonging to minority religion†	.030	-.005	-.083	-.071
	(.074)	(.055)	(.055)	(.050)
Parents important in village life†	-.010	-.009	.008	.019
	(.041)	(.039)	(.036)	(.037)
Demand for insurance				
No. of deaths in the past 5 years	-.013	-.010	-.011	-.011
	(.012)	(.010)	(.010)	(.010)
Avg. number of deaths in network in past 5 yrs	.003	.027	.023	.027
	(.049)	(.045)	(.059)	(.059)
Patience	.036	.037	.046	.042
	(.044)	(.037)	(.039)	(.036)
Risk aversion	.013	.010	.013	.016
	(.013)	(.013)	(.012)	(.013)
Cost of capital	-.030	-.031	-.055	-.055
	(.041)	(.040)	(.037)	(.036)
Socioeconomic characteristics				
Second land-owning quartile†	.042	.048	.077	.065
	(.040)	(.039)	(.030)***	(.028)***
Third land-owning quartile†	0.097	0.090	0.111	0.098
	(.044)**	(.043)**	(.036)***	(.036)***
Fourth land-owning quartile†	0.132	0.132	0.134	0.126
	(.053)**	(.050)**	(.041)***	(.041)***
Ln age of head	-.188	-.193	-.188	-.205
	(.062)***	(.062)***	(.055)***	(.057)***
Ln of household size	.005	-.010	-.028	-.024
	(.030)	(.027)	(.029)	(.028)
Head has schooling†	.012	.009	-.019	-.023
	(.041)	(.035)	(.038)	(.037)
Female-headed household†	-.035	-.030	-.051	-.052
	(.033)	(.030)	(.030)*	(.030)*
Obs.	1075	1066	913	904

Notes: Standard errors in parentheses (clustered at household level). Village-time dummies included, but not reported. † indicates a dummy variable. * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Source: ERHS and Funeral Insurance Survey.