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Finance for the Poor

Gharad Bryan

June 12, 2012

My dissertation consists of three parts, each of which explores a different aspect of a simple question: how should financial contracts be structured so the poor to make the best of the opportunities that are available to them?

The first part of the dissertation considers the role of ambiguity aversion (that is aversion to unknown probabilities) in explaining low adoption of profitable technologies in developing countries. I provide a formal model of technology adoption with ambiguity when insurance is available, and show that ambiguity lowers adoption. The model is used to derive comparative statics that are tested using data from Malawi and Kenya. The model is supported in the data.

The second part considers the impact of ambiguity on mutual insurance. Again I use a model to derive testable implication of ambiguity on the relationship between village and individual level consumption and income and test the implication using data from Thailand and India. The model cannot be rejected.

The final part considers a consumer credit experiment undertaken in South Africa. The work is joint with Dean Karlan and Jonathan Zinman. The experiment aimed to disentangle the ability of peers to screen and enforce loans and was based on a novel referrals program. Our results shown considerable loan enforcement, but we find no evidence of peer screening.

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My dissertation consists of three parts, each of which explores a different aspect of a simple question: how should financial contracts be structured so the poor to make the best of the opportunities that are available to them?

1 Technology Adoption with Ambiguity and Insurance

The first part of the dissertation considers the relationship between technology adoption, insurance and ambiguity. A key part of economic development is the gradual adoption of new and more productive technologies. Existing evidence, both at the macro and micro level, suggests that developing countries use inferior technologies (Caselli 2005 and Foster and Rosenzweig 2010). Understanding what constrains the adoption process and what can be done to encourage it is, therefore, an important part of development research and policy. Traditional theory implies that, if insurance is available, all technologies with a positive expected value will be adopted, and if information asymmetries limit the amount of insurance, finding a way to provide insurance will increase adoption.[1] Neither of these propositions finds unequivocal support in the data: in some situations adoption of profitable technologies seems to be stubbornly low (e.g. Duflo et al. 2008) and providing insurance does not necessarily increase adoption (e.g. Giné and Yang 2009 and Giné et al. 2008).

These negative results suggests the need for alternative theories, and in this paper I develop an idea that has a long pedigree: uncertainty or ambiguity may hinder innovation (e.g. Knight 1921 and Bewley 1989). In particular, I propose and test a model in which ambiguity aversion limits the adoption of novel technologies, even when insurance is available. The model formalises a simple mechanism: a decision maker is unable to form a single probabilistic belief, instead she forms a set of beliefs and behaves in accordance with the utility minimising belief.[2] This set of beliefs can simultaneously contain probabilities that imply a new technology is unacceptably risky, and beliefs that imply any insurance contract is risk increasing.[3] If this is the case, the decision maker will not

[1] Credit also plays a role, but is not the subject of this paper.

[2] Throughout the paper abstract decision makers are described as "she" but farmers are described as "he" consistent with the empirical reality.

[3] This requires that I restrict the set of insurance contracts that are available. In particular, I exclude contracts that condition directly on income. Details are given in the body of the paper.

adopt the technology and will not benefit from insurance. Intuitively, the decision maker worries that the new technology is too risky and cannot work out whether an insurance contract will reduce that risk.

I test the theory using data from two randomised controlled trials, one that provided rainfall insurance to farmers in Malawi (Giné and Yang 2009) and another that provided limited liability credit to farmers in Kenya (Ashraf et al. 2009). Both experiments were conducted with the aim of encouraging the adoption of a new crop type, and the impact of insurance on adoption can be seen as a natural measure of the value of insurance. Both data sets contain experimental measures of individual farmer's ambiguity and risk aversion, which allows me to test comparative statics implied by the theory. The theory has four key predictions: the value of insurance or limited liability will be lower for those that are ambiguity averse, because they cannot determine whether insurance is risk decreasing; the difference in insurance values between the ambiguity averse and ambiguity neutral will increase with risk aversion, because the ambiguity averse are concerned that the insurance is risk increasing; the difference in limited liability values between the ambiguity averse and ambiguity neutral will decrease with risk aversion, because the ambiguity averse perceive limited liability as insurance rather than a transfer; and the difference in behaviour between the ambiguity averse and ambiguity neutral will decrease as they gain experience with crops similar to the new one, because this reduces ambiguity. These comparative statics all find support in the data.

The theory suggests a source of heterogeneity in the degree of technology adoption: while the usual theory implies that all projects with a positive expected value will be adopted, my theory suggests that the degree of adoption will also depend on the amount of ambiguity. Thus, while the theory can account for low adoption and no impact of insurance, it can also apply to cases in which adoption is high (even if requires a little learning: Besley and Case (1993) and Conley and Udry 2010) and where insurance does have an impact (e.g. Bryan et al. 2012 and Mobarak and Rosenzweig 2012). In developing the theory I try to describe the objects that would need to be measured to predict when insurance is valuable, and what kinds of technologies will be hard to adopt. My hope is that these measures can provide the basis of further research and policy that takes a "where works" approach to insurance and technology provision.

The results also have implications for several important theoretical literatures. The model can be interpreted as providing a foundation for a Knightian theory of innovation. Knight (1921) claimed that innovation was inherently uncertain, and that this uncertainty could not be insured. This, he argued, meant that innovation and entrepreneurship are the domain of those that are tolerant of uncertainty (see Kihlstrom and Laffont 1979 for an interpretation). Several authors (e.g. Bewley 1989) have linked Knight's notion of uncertainty to the more modern idea of ambiguity. In my model, only those that are ambiguity tolerant can reduce risk through insurance. As a consequence, technology adoption is limited to those that are ambiguity tolerant and can make use of insurance, or to those that are risk tolerant and unconcerned by risk. If the poor are more risk averse and/or more ambiguity averse, the theory implies the poor are less likely to innovate. The paper also evidences the practical relevance of decision models that depart from the

Subjective Expected Utility (SEU) framework and allow for ambiguity aversion. While an important theoretical topic (e.g. Gilboa and Schmeidler 1989; Klibanoff et al. 2005; Maccheroni et al. 2006 and Hansen and Sargent 2001), there has been little work directly testing the implications of these models.

2 Ambiguity and Mutual Insurance

The second part of my dissertation considers optimal mutual insurance arrangements when decision makers are ambiguity averse. The question is important because the impact of formal financial institutions will depend on existing mutual insurance arrangements. Ambiguity aversion provides a possible explanation for imperfect mutual insurance that does not rely on contractual difficulties and, therefore, is not interrupted by the provision of formal insurance. I model ambiguity aversion by assuming that households beliefs change in response to contracts they sign. In particular, beliefs are chosen to minimise the gain from choosing a particular contract.

A starting point for discussing imperfect mutual insurance or risk sharing is the Townsend (1994) finding that, after controlling for household fixed effects and village aggregate income, household consumption is correlated with household income. This finding is not consistent with Pareto optimal risk sharing when households have the same preferences and beliefs. I show that the correlation is, however, consistent with Pareto optimal risk sharing when households have identical ambiguity aversere preferences.

A simple example provides the main intuition. Consider an ambiguity averse household (the Jones's) contemplating a risk sharing contract. The contract will specify a set of states in which the Jones's make a transfer, and a set of states in which they receive a transfer. These transfers will move the household away from its endowment, and the Jones's will tend to believe that states in which they receive a transfer are relatively unlikely, while states in which they give a transfer are relatively likely. Relative to the optimal with fixed beliefs, the Jones's will be willing to accept a little less when receiving a transfer, in return for a little more when they are making a transfer. Hence, the optimal allocation lies closer to the endowment point than it would in the absence of ambiguity, implying that consumption will be correlated with income even after controlling for individual fixed effects and the aggregate endowment.

I formalize this intuition and ask whether the resulting theory has testable implications for panel data containing measures of household income and consumption. The full risk sharing test of Townsend (1994) uses the fact that households with the same beliefs will trade to the same point (after controlling for Pareto weights). With ambiguity averse preferences, not all households have the same effective beliefs and formulating a similar test requires that the researcher be able to infer beliefs from a data set that does not include all households or all states of the world. The motivational example suggests one approach. In the example, the set of households making transfers in a particular state assign similar probabilities to that state, as do the set of households receiving transfers. I show that if a symmetry condition is satisfied – roughly symmetry requires that all house-

holds believe that ambiguity and income are evenly distributed around their entitlement as given by their Pareto weight – then all households making (receiving) transfers in a particular state will have the same effective beliefs, implying that they trade to the same point. I also show that the differences in beliefs between giving and receiving households creates a wedge between their consumption levels, with those giving transfers consuming more than those receiving transfers. Symmetry then implies that households whose incomes fall inside this wedge do not trade, instead consuming their own income.

Empirically, these observations imply that, in any state, households with income sufficiently above (below) their entitlement point will share risk fully. Among these households consumption should not be correlated with income. For those households whose income falls in the "wedge" between these two consumption levels, consumption moves one for one with income. I propose a test for these properties using a non-linear least squares routine that allows for estimation of households fixed effects, village fixed effects and the "wedge" created by ambiguity. I implement the test on two panel data sets. The famous ICRISAT data from India which formed the basis for Townsend's (1994) paper and Townsend's Thai monthly survey data, a 10 year panel data set. I do not reject the model in either of these settings.

Overall, the results imply that ambiguity aversion is an empirically important constraint on trade and a source of misallocation. The findings also have several policy implications. With respect to index insurance, the results suggest that insurance contracts will be subject to low demand, particularly in settings where the production technology is not well known. Thus index insurance is not the panacea that proponents may have hoped and is particularly poorly suited to encouraging technology adoption, unless combined with policies aimed to encourage learning. The results also suggest a means for finding households that are hard to insure and imply it would be useful to study methods of overcoming ambiguity aversion among households. For example, short term subsidies of new technologies may allow for learning and make insurance more effective, and marketing methods that attempt to alter the status-quo may help generate demand among the ambiguity averse (see for example, Roca et al. 2006). With respect to risk sharing, the results imply that a finding of "imperfect risk sharing" – i.e. a failure of Townsend's (1994) test – is possible even in the absence of incentive problems within the community. This in turns implies that formal insurance need not crowd out informal insurance and improves the case for outside provision of formal finance.

3 Testing for Loan Screening and Enforcement in A Consumer Credit Field Experiment

The third part of my dissertation considers an experiment designed to measure elasticities relevant to the optimal design of micro-credit contracts and is joint work with Dean Karlan and Jonathan Zinman.

Economic theory assigns credit market failure a central role in explaining poverty and underdevelopment. Borrowing constraints reduce efficiency, increase inequality and can lead to poverty traps (Banerjee and Newman, 1993; Galor and Zeira, 1993). Credit

rationing also appears to be *empirically* important. Making use of experimental or quasi-experimental supply shocks, several recent papers estimate a large demand for additional credit – for consumers (Karlan and Zinman, 2009a), microenterprises (Banerjee et al., 2010; Karlan and Zinman, 2011) and small and medium enterprises (Banerjee and Duflo, 2004). These studies, coupled with a literature showing high returns to capital (e.g., De Mel et al. 2008), suggest that there may be important returns to relaxing borrowing constraints.

So, the goal is clear, but how does one relax borrowing constraints? Information asymmetries, including ex-ante selection and ex-post incentive and enforcement problems, are often invoked as the root causes of borrowing constraints in theory (Stiglitz and Weiss, 1981) and practice (Armendáriz et al. 2010). If this is indeed the case, contracts that alleviate asymmetric information problems provide one route to greater credit market efficiency. A widespread approach in this vein is based on the presumption that a borrower's peers can counter information asymmetries by providing information or enforcement that is unavailable to (or more costly for) the lender. The peer-intermediation approach has been fleshed out over several hundred years of lending practice and can be seen in a range of guises including credit cooperatives, credit unions, rotating savings and credit associations, and microlenders such as the Grameen Bank. The peer approach has also been analyzed over several decades of theoretical work on optimal mechanism design in the face of different asymmetric information problems (e.g., Varian 1990, Stiglitz 1990, Besley et al. 1993, Banerjee et al. 1994, Besley and Coate 1995, Ghatak 1999, Ghatak and Guinnane 1999, Rai and Sjöström 2004, Bond and Rai 2008 and Attanasio et al. 2011).

Empirical work on peer contracting mechanisms has lagged behind theory and practice. Empirical work could play an important role by showing whether and how peer mechanisms actually alleviate asymmetric information problems. Such results would have implications for theory, by helping to identify which models are most descriptive, and hence most useful for policy analysis. Empirical results could also inform practice, as lending institutions are actively wrestling with the mechanism design question of how to implement peer mechanisms on a large scale (e.g. Giné and Karlan 2010). But empirically identifying the different channels through which peer contracting might work– e.g., disentangling ex-ante screening from ex-post monitoring, enforcement, incentives, or insurance – is difficult. The few existing studies taking this line of inquiry have focused on symmetric mechanism designs in which individuals are jointly liable for each other, and have found mixed results. (See, e.g., Ferrara 2003, Ahlin and Townsend 2007, Karlan 2007, Gine et al. 2010, Fischer 2010 and Giné and Karlan 2010).

We designed a field experiment to test whether peers improve screening and/or enforcement under an individual liability mechanism.[4] This focus allows us to address the basic questions of whether peers have information about their friends and whether they can help to enforce loan repayment, without needing to address the strategic interactions among multiple borrowers. Specifically, we worked with Opportunity Finance South Africa (a member of the Opportunity International microfinance network) to test

[4]See also Klonner and Rai (2010), which finds in a non-experimental setting that co-signers improve repayment performance in "organized" (intermediated) rotating savings and credit associations

its Refer-A-Friend program, which offered an existing client (the referrer) a 100 Rand ($12) bonus for referring a "friend" (the referred, who could also be a family member, associate, etc.) who met particular criteria.

Opportunity first randomly divided referrers into one of two ex-ante incentives: referrers in the *ex-ante approval incentive* group were told that they would receive the bonus if the referred was approved for a loan. Referrers in the *ex-ante repayment incentive* group were told that they would receive the bonus if the referred repaid a loan on time. The ex-ante repayment incentive referrers had both an ex-ante incentive to refer applicants of good credit quality (both observable and unobservable to Opportunity), and an ex-post incentive to encourage repayment. Referrers in the ex-ante approval incentive group had only the ex-ante incentive to refer applicants of good *observable* credit quality.

Subsequently, Opportunity randomly surprised some referrers, whose referred applications had been approved, with an improvement to their bonus contract. [5] Half of the referrers with the ex-ante repayment incentive were given their bonuses as soon as the loan was approved, thus removing the enforcement incentive. Half of referrers given the ex-ante approval incentive were offered an additional bonus if the referred loan was repaid, thus creating an enforcement incentive. Thus, within each of the ex-ante groups half the referrers have an *ex-post repayment incentive* and half have an *ex-post approval incentive*.

The design thus produces four groups of referrers, each with a different combination of ex-ante and ex-post incentives (in the spirit of Karlan and Zinman 2009b), that, under certain assumptions detailed below, enable us to identify whether:

1. Opportunity induced referrers to *screen* on information unobservable to (or unused by) Opportunity. We estimate this by comparing repayment rates across ex-ante incentives holding the ex-post incentive fixed. We find no evidence that peer screening improved repayment.

2. Opportunity induced referrers to help *enforce* loan contracts. We estimate this by comparing repayment rates across ex-post incentives, holding the ex-ante incentive constant. We find that enforcement incentives do signficantly increase repayment: the small bonus (100 Rand is equal to about 2% of the average referrers gross monthly income and 3% of the average loan size), decreased default from around 20% to 10% in most specifications. The magnitude of improvement in repayment performance is far above and beyond what referrers and borrowers could accomplish with side-contracting, and the improvement in collections (and savings in collection costs) far exceeded the lender's outlays for bonuses.

We discuss the conditions under which our screening treatment allows us to identify whether referrers have information that is unobservable and useful to the lender. We lay out a model which identifies the key assumptions necessary for this interpretation and show that our 2×2 design, which allows us to estimate selection and enforcement in two different ways, allows us to identify whether peers have information even in a

[5] Lenders frequently contact borrowers with promotions in this market and our cooperating lender continued with the program after the experiment. We, therefore, feel that the arrangement would have felt natural to the borrower.

setting where the unobserved components of creditworthiness and responsiveness to incentives are correlated. This identification strategy is a key contribution of the paper and generates a test of the identification assumptions in two-stage experiments that aim to isolate selection effects (e.g., Karlan and Zinman 2009b, Cohen and Dupas 2010, Ashraf et al. 2010 and Beaman and Magruder 2009.)

Although our main focus is on testing whether peers have information and can enforce, our experiment also demonstrates the usefulness of a novel contract design. Referral bonuses proved profitable for this lender, and hence may be a useful complement to or substitute for other risk-sharing covenants like guarantors.[6]

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[6]Loans co-signed by third parties are common in many developed countries and help those new to the credit market to leverage the assets of their co-signers (often family members) in order to build credit. But in many developing country settings guarantees are less viable due to limited enforcement and/or limited wealth.

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