A Friend in Need is a Friend Indeed: Theory and Evidence on the (Dis)Advantages of Informal Loans*

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Abstract

We study borrowers' choice between formal and informal credit in a setting with strategic default due to limited enforcement. Informal loans (e.g., from friends or relatives) can be enforced by the threat of severing social ties, which hurts both the borrower and the lender, while formal loans (e.g., from banks) are enforced by requiring collateral. Provided that social capital is sufficiently large, we show that the optimal informal loan features zero interest rate and requires no physical collateral. In contrast, formal loans charge positive interest and are collateral-based, making them *a priori* less attractive to borrowers. At the same time, physical collateral is divisible, unlike the social capital pledged in informal credit. Default on formal loans is thus less costly than default on informal loans. Therefore, borrowers choose formal credit for riskier (larger) loans while informal credit is used for small investments and projects with zero or low default risk. Empirical results using data on rural Thai households are consistent with the predicted pattern and terms of formal versus informal credit.

Keywords: Family loans, Informal credit, Social collateral
JEL Classification: D14, G21, O16, O17

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1 Introduction

Informal financing is the prevalent form of credit used by households and small firms in developing countries. A large fraction of these loans originates from family or friends.[1] One standard explanation for the abundance of informal credit is that it carries information or enforcement advantages that mitigate market imperfections originating from moral hazard, adverse selection, or limited commitment. In developing countries, the widespread inability of households to pledge collateral, as well as high transaction costs relative to the loan size (due to lack of credit history, financial illiteracy, lack of property titles, inefficient courts, etc.) cause many of the poor to be rationed out of formal credit markets.[2] This often leaves informal credit, primarily based on social capital, as their only option.[3]

The above argument implicitly presumes a shadow cost of using informal loans – if borrowers have choice, they prefer to use the formal credit market but are unable to do so because of the above-mentioned market imperfections. This presumption seems to be broadly consistent with the evidence, both across countries and over time. The fraction of informal credit in total lending is generally smaller in countries with a larger financial sectors and shrinks as the formal banking sector develops.[4]

In our data, Figure 1 illustrates how the use of informal credit evolved around the time of the 1998 Thai financial crisis for a panel of 872 rural households observed between 1997 and 2001.[5] Prior to the 1998 financial crisis, informal loans from neighbours or relatives made up roughly 21 percent of all household loans in the sample. This number rose to 31 percent during the crisis, then gradually reverted back to its pre-crisis level. This is consistent with the idea that many households used family and neighbours as a "lender of last resort" at a time when obtaining credit from other sources was harder.

Yet, the existing literature offers little systematic guidance as to why households are reluctant to borrow from friends and family if alternative sources are available.[6] One possible explanation could be that banks have a comparative advantage in lending (e.g., expertise, risk diversification, etc.) but this seems implausible for small sums of money. Turning to friends and relatives appears the preferable option in many circumstances as they are often better informed about the personal circumstances of the borrower and may not have to incur monitoring or enforcement costs. This is the 'peer monitoring' argument of

[1] Paulson and Townsend (2004), for example, report that about 30% of households in their 1997 Thailand survey have outstanding loans from other households while only 3% have loans from commercial banks. Banerjee and Duflo (2007) document that of all outstanding loans of households in Udaipur, India, 23% are from a relative, 37% from a shopkeeper and only 6% from formal sources. The latter number is also very similar in 12 other developing countries on which they report.

[2] See Ghosh et al. (2000) for a review of the theoretical literature on credit rationing in developing countries.

[3] The spread of microfinance in recent years provides another source of credit to poor households also based on social collateral.

[4] Detailed and reliable data on interpersonal informal loans in developed countries are scarce, which may partly be due to negative tax implications of monetary transfers between households (in the US, for example, loans will subject to a tax if the interest that is charged is deemed "too low". The US National Association of Realtors (2012) reports that 9% of home buyers received an intra-family loan to help with their downpayments in 2011.

[5] The data are part of the Townsend Thai Project, a very detailed dataset based on micro surveys of Thai households. See http://cier.uchicago.edu/ for details.

[6] A notable exception is Lee and Persson (2013) discussed below.

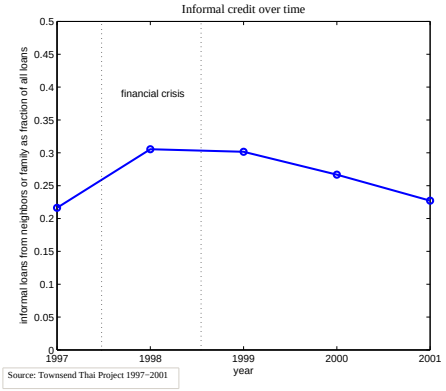

Figure 1: Informal Loans in Thailand.

Stiglitz (1990). For small loans, risk aversion or liquidity constraints are also less likely to be a problem. The question thus arises, if relatives and friends can do everything a bank can, (e.g., charge interest or require collateral) but, in addition, can rely on social capital as a means of enforcing compliance, why use formal credit at all?

This puzzle is more pronounced in light of the fact that loans from family or friends often have very favourable terms. For example, in a survey of financial management practices among the poor, Collins et al. (2010, ch. 2) report that family loans are most frequently interest free. Similarly, according to the 2004 survey on informal finance conducted by the Global Entrepreneurship Monitor (GEM), between 60 and 85 percent of investors were relatives or friends of the entrepreneur they financed and the majority were willing to accept low or negative returns (Bygrave and Quill, 2006). These regularities are also echoed in the Townsend Thai data we use, in which the median interest rate for loans from relatives is zero. [7]

To sum up, the logic that informal loans based on social capital pose fewer contracting problems, together with the evidence that such loans have more favourable terms, leads to the conclusion that borrowers should always prefer informal over formal credit sources, unless the former have insufficient funds. If informal loans are a viable option, why do many households use formal credit? Put differently, why are formal, market-based loans the preferred choice in developed countries where most people rely on banks when they need to borrow even relatively small amounts?

Our paper answers these questions by highlighting the costs and benefits of formal and informal credit from the borrower's perspective and by pointing out an inherent disadvantage of informal finance. We build a model which delivers as results the stylized facts discussed above - more favorable loan terms for informal credit, yet preference for formal loans under broad conditions. Throughout the exposition, we use the term *informal credit* to refer to loans that rely on personal relationships and use social sanctions

[7] see Figure 3 in Section 2 below.

as means of contract enforcement. The primary example we have in mind is money borrowed from family, neighbours, or friends, although other similar sources such as credit cooperatives, rotating savings and credit associations, or some agricultural credit associations may also fit this description. We use the term *formal credit*, in contrast, to refer to loans for which personal or social relationships between the lender and borrower are absent and/or not used to enforce repayment.

The main trade-off between formal and informal credit in our model is as follows. Informal credit uses 'social collateral' measured by the value of the friendship or kinship ties between the borrower and the lender. The social collateral serves as a substitute for the physical collateral required by formal lenders and the threat of losing it enables informal borrowers to commit not to behave opportunistically (default strategically). Using the social collateral is always feasible and allows for favourable loan terms (low or zero interest rate and no physical collateral). At first sight, this makes informal credit very attractive, especially for poor households who lack collateralizable assets and for small loans. Using a social collateral comes at a cost, however. Unlike physical assets, the social capital embedded in a relationship is *indivisible*: if a borrower defaults on an informal loan, the relationship is severed or severely damaged and the social collateral is lost in its entirety, with *both parties* incurring a utility loss. The social capital could be also (partially) lost if an informal lender refuses a loan when asked. These cost are incurred whenever there is a positive endogenous probability of default which in our setting is more likely for more leveraged borrowers. In contrast, in formal loans the physical collateral can be adjusted with the loan size and can (at least partially) compensate the lender in case of default. Overall, this implies that informal credit can in fact be more 'expensive' than formal credit and sub-optimal to use, even in the face of more favourable loan terms.

We show that even though informal lenders are able to use the exact same loan terms as formal lenders (require collateral, charge interest), they can choose to refrain from doing so and instead rely solely on the value of the social relationship as means of contract enforcement. Indeed, we prove that if the social capital between a lender and a borrower is sufficiently large, the optimal informal loan does not require physical collateral and charges zero interest. Intuitively, for large social capital values informal borrowers never default strategically and hence informal lenders always find it optimal to lend when asked, knowing that they will not be approached if the risk of involuntary default (project failure) is too high.

In contrast, formal loans always have a collateral requirement and, as long as there is a positive probability of default, demand a strictly positive interest rate. The comparative disadvantage of formal loans in terms of direct monetary costs notwithstanding, the potential loss of social capital associated with informal lending prompts borrowers to choose formal over informal credit when the ratio of the loan size to borrower's wealth (the LTW ratio) is relatively high, which corresponds to a higher probability of default in the model.

Our theory offers several empirically testable implications that we take to the Thai data. First, informal loans have 'better' terms (lower interest and collateral) than formal loans. Second, there is *negative*

(or U-shaped), relationship between the riskiness of a loan (measured by the ratio of the loan size to borrower's wealth) and the likelihood of observing informal credit. The reason is as follows: if the risk of equilibrium default is negligible, then informal credit is always preferred due to its favourable terms. As the risk of default increases, however, informal credit becomes relatively more costly because of the value of the social capital that is lost upon default, and thus borrowers prefer formal loans, ceteris paribus. This conclusion could be reversed only if the default risk becomes so high (for large LTW ratios) that access to formal credit is denied (because the possibility of strategic default prevents the lender from breaking even at any interest rate), leaving informal credit as the borrower's only remaining option.

The patterns we find in the data from the 1997 Survey of Thai households (part of the Townsend Thai Project) are consistent with the model predictions. We document that the majority of informal loans carry zero interest and collateral. Moreover, riskier loans are *less* likely to be informal: using the ratio of the loan size to borrower's wealth as a measure of how likely it is that the loan cannot be repaid in case of default, we find that *higher-risk loans are associated with a lower incidence of informal credit* than lower-risk loans. This at first glance counterintuitive finding is consistent with the cost of social capital we identify. We also find evidence that for very risky loans, some borrowers resort to informal loans again. These results are shown to be robust to alternative definitions of formal and informal loans, selection bias in borrowing, and the possible endogeneity of loan size.

Related literature

Our paper contributes to a relatively small but growing literature on the coexistence of formal and informal credit. The work that is probably the closest to ours is Lee and Persson (2013) who offer an alternative and complementary explanation of the downside of informal finance. Among several key differences, while we model informal loans as contracts in which compliance is enforced by the threat of severing social ties, Lee and Persson assume two-sided altruism – the borrower's utility directly enters the lender's utility and vice versa. While some of the implications regarding reduced agency costs and lower interest rates in informal credit arrangements are similar, the implied cost of using informal credit is different. Specifically, unlike ours, Lee and Person's altruism-based model emphasizes the role of risk taking: informal credit directly amplifies the borrowers' aversion to failure, thereby undermining entrepreneurs' willingness to take risk and potentially limiting investment and firm size.

Gine (2011) develops a model of limited enforcement and fixed costs of accessing formal credit to capture a trade-off between informal and formal loans. He estimates the model structurally using data from Thailand and concludes that the limited ability of banks to enforce contracts, as opposed to fixed costs, leads to the observed diversity of lenders.[8] This finding is consistent with our assumption of limited enforcement as the key friction in the credit market. Jain (1999) proposes a model in which the

[8] See also Madestam (2014) who, unlike us, models formal lenders (banks) as having a monitoring disadvantage relative to informal lenders (moneylenders) and shows that formal and informal sources can be substitutes or complements depending on banks' market power.

formal sector's superior ability in deposit mobilization (economies of scale and scope, security of deposit insurance, etc.) is traded off against an informational advantage that informal lenders possess about their borrowers.[9]

More generally, our paper contributes and draws upon the literature on social capital and the interdependence between economic development and the development of (financial) institutions. The theoretical foundations of sustaining cooperative outcomes in informal settings are two-fold. First, repeated interactions among members of a social network improve enforcement (Hoff and Stiglitz, 1994; Besley and Coate, 1995). In this respect, our paper relates to Anderson and Francois (2008) who emphasize that the social collateral destroyed when default occurs represents a loss not only to the borrower but also to other members of her social group. Second, informal lenders' better access to local information can allow them to write contracts that are more state-contingent than formal contracts (Bond and Townsend, 1996; Bose, 1997; Kochar, 1997; Guirkinger, 2008 among others). Similar insights underlie the attempts to improve lending to the poor by exploiting information sharing or peer enforcement in joint-liability lending programs (see Ghatak and Guinnane, 1999 or Morduch, 1999 for a discussion). Udry (1994) models informal loans between risk-averse agents as reciprocal and state-contingent and shows that low interest rates may be observed after a borrower suffers an adverse shock, with higher rates otherwise. In contrast, our explanation for the more favorable terms of informal loans does not rely on risk aversion or information advantages and we also model the co-existence of informal and formal loans with different interest and collateral terms. The literature on social capital (see Woolcock and Naryan, 2000 for a survey) identifies a downside of transactions based on social ties, as the lack of such ties to outsiders can stifle the extent to which production can move beyond the kin group. Our focus here differs, since we highlight how the possibility of losing the value of a social link in a risky environment makes borrowers substitute informal with formal credit arrangements. Finally, given that we model informal lending as embedded in a pre-existing social relationship, our paper also relates to the literature on interlinking (e.g., Braverman and Stiglitz, 1982).

We proceed as follows. In Section 2, we describe the data we use and highlight the key empirical regularities that a model should account for. In Section 3 we describe the model and characterize the optimal informal and formal loan contracts. The costs and benefits of informal vs. formal credit are compared and the choice of credit source is analyzed in Section 4. Section 5 presents the empirical analysis. Section 6 concludes. All proofs are in the Appendix.

[9]The empirical work on the choice of formal versus informal finance generally highlights the factors mentioned in the first paragraph of this paper. For example, in a study of Peruvian farmers, Guirkinger (2008) finds that households resort to informal loans either when they are excluded from the formal sector or face lower transaction costs. Using data from Vietnam, Barslund and Tarp (2008) find that the demand for formal credit is positively associated with household wealth while informal credit is positively associated with bad credit history and the number of dependents.

2 Personal Loans in Rural Thailand

We use data from a socio-economic survey of 2880 rural households in Thailand, conducted in 1997 by the Townsend Thai Project.[10] The sample originates from four provinces located in two distinct regions of Thailand – the more developed Central region located near Bangkok, and the poorer, semi-arid Northeast region (see Figure 2). The dataset contains various socioeconomic and financial variables, including current and retrospective information on assets, savings, income, occupation, household demographics, entrepreneurial activities, and education. Most importantly for our purposes, the 1997 survey provides detailed information on the usage of a variety of formal and informal financial institutions such as commercial banks, agricultural banks, village lending institutions, moneylenders, as well as friends, neighbours and family.

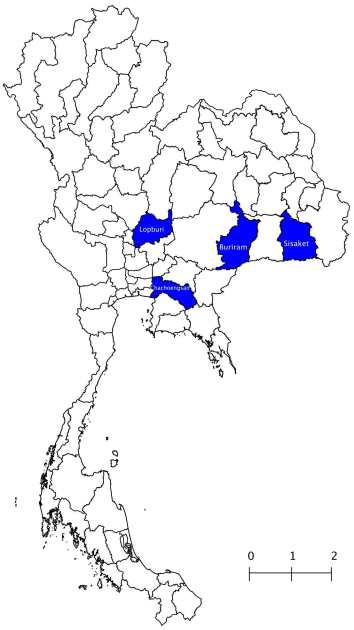

Figure 2: Surveyed Provinces in Thailand

Households were asked detailed questions about their borrowing and lending activities such as their total number of outstanding loans, the value of each loan, the date it was taken, the length of the loan period, the reason why the money was borrowed, and from whom it was borrowed. The last question has a

[10] The initial survey was fielded in May, prior to the economic/financial crisis which began with the devaluation of the Thai baht in July 1997. This survey was followed by a number of follow-up surveys in subsequent years that were conducted with a sub-sample of 1997 households and a less detailed survey questionnaire. For further details, including sample selection and the administration of the survey see the Townsend Thai Project website http://cier.uchicago.edu/about/.

Table 1: Loan Source

Source	Freq.	Percent
neighbor	272	7.94
relative	552	16.11
BAAC	1,185	34.58
Commercial Bank	106	3.09
Agricultural Cooperative	347	10.13
Village Fund	32	0.93
moneylender	338	9.86
store owner	141	4.11
other	454	13.25
Total	3,427	100.00

[a] **Note:** Category "Other" includes the following possible answers: Rice Bank, Landlord, Purchaser of Output, Supplier of Input, as well as the answer "other" (the latter has 344 observations). Some households hold multiple loans.

range of possible answers: a neighbour, a relative, the Bank for Agriculture and Agricultural Cooperatives (BAAC), a commercial bank, an agricultural cooperative, a village fund, a moneylender, a store owner or other business, a landlord, or other. Table 1 breaks down the loan sources into the respective categories. We see that borrowing from neighbours and family comprises about 25% of all loans in the sample. Borrowing from commercial banks, in contrast, is relatively rare (3% of all loans), reflecting the fact that a large fraction of households in this rural setting do not have access to commercial banks. Instead, they more often resort to moneylenders or the Bank for Agriculture and Agricultural Cooperatives (BAAC). The BAAC is a state-owned bank established to provide loans primarily for "agricultural infrastructure" (Ministry of Finance, Thailand, 2008). While most of the loans are extended to individuals, borrowers are often organized in groups with a joint liability clause. The interest rates on BAAC loans are typically 1–2 % lower than those of commercial banks.

Summary statistics of the data are provided in Table 7 in the Appendix. We computed household wealth using detailed (self-reported) information on the value of household assets, which include land and agricultural assets (animals, machinery, etc.), business assets, durable consumption goods, financial assets, and savings. The binary variable 'tenure' equals one if the household has resided in the village for more than six years and zero otherwise. The indicator variable 'bank' equals one if the household was a customer of a commercial bank. All other variables listed in the table are self-explanatory. To provide a point reference, the average annual income in Thailand in 1996 was 105,125 baht, or roughly $4,200 (Paulson and Townsend, 2004).

As mentioned in the introduction, the primary distinction we make between 'formal' and 'informal' credit is whether or not the loan is backed by physical collateral as opposed to social/relationship capital. In

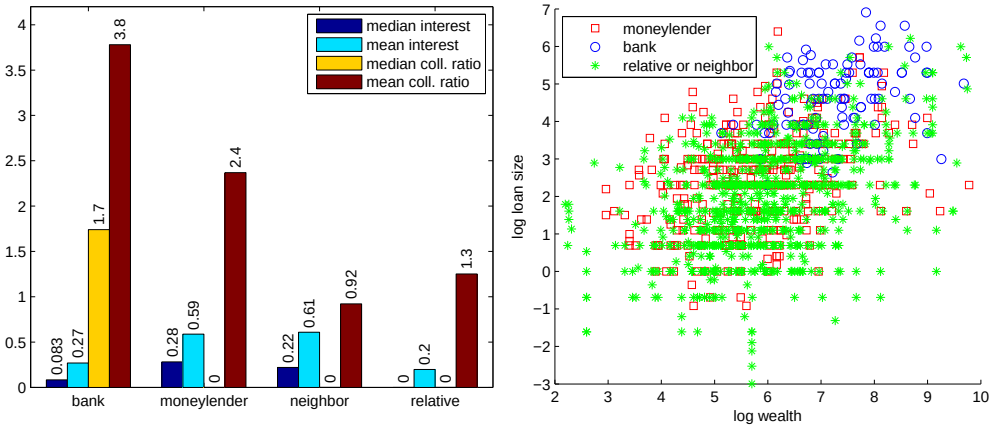

Figure 3: Variation in terms (a), and size of loan vs HH wealth (b), by type of credit

our baseline specification we define 'formal' credit as loans from commercial banks or moneylenders and 'informal' credit as loans from relatives or neighbors. Since the BAAC and Agricultural Cooperatives are hybrid institutions in terms this classification – they often requires collateral but may use social relations (via a joint liability clause) to secure repayment – we initially exclude those loans from the analysis, and instead restrict ourselves to commercial banks and moneylenders as *formal* credit, versus relatives and neighbours as *informal* credit. While moneylenders could be considered informal using an institutional-based definition, the dimension we focus on, whether or not the loan is secured by personal or social ties, leads us to group moneylenders with commercial banks. We drop the remaining households, but consider multiple robustness checks to our definitions of formal and informal credit, including adding BAAC loans to either category (see Section 5.3 below).

We first look at the terms of the different loan types in our sample. Although the survey did not directly ask about interest rates, we were able to manually compute those from the data using the loan period length, the total required repayment, and the initial loan size. Figure 3(a) shows the mean and median loan interest rates and ratios of collateral to loan size ('collateral ratio') for the four different loan sources we use: commercial banks, moneylenders, neighbours, and relatives. We see that in the majority of cases, informal credit (loans from relatives or neighbours) is significantly cheaper in monetary terms than formal credit (loans from commercial banks or moneylenders) – the median interest rate on loans from relatives is zero which is considerably lower than the median commercial bank interest rate (8%) or the median moneylender rate (28%). In addition, the majority of neighbours and relatives require no collateral, presumably using in its place social capital.

The fact that informal credit is cheaper than borrowing from a bank or a moneylender does not mean, however, that formal credit is non-existent in the data. Figure 3(b) plots household wealth against loan size , by type of loan. The Figure illustrates that while loans from relatives and neighbours can be found

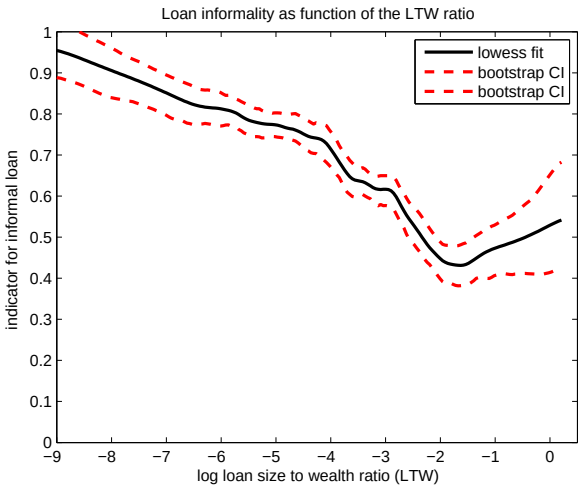

Figure 4: LTW ratio and type of credit

over the entire range of observed wealth and loan size, moneylender credit is also widespread. At the same time, only relatively large loans, taken out by relatively wealthy households, originate from commercial banks. One simple explanation is that access to banks is limited in our rural setting, and commercial banks require more collateral than moneylenders, which is a serious constraint for poorer borrowers. Figure 3(b) also shows that larger loans tend to be associated with formal credit, given household wealth. We will see in Section 5 that this pattern is very robust: the smaller a loan, the more likely it is that the lender is a relative or neighbour. This regularity points to a possible downside of informal lending, which may also explain why economic growth is associated with a decline in informal credit: the inter-personal credit market is incapable of meeting the rising loan needs associated with increased consumption and investment opportunities, possibly due to cash constraints or other endogenous bounds on informal loan size.[11] Yet, not all informal loans are small (the largest loans in the sample are informal) and there is a considerable number of small formal loans, suggesting that other factors play a role as well.

One such factor is risk. It is natural that the availability of different types of loans, and the households' choice among them, is related to the risk of default. Unfortunately, the data do not allow us to directly infer default risks; instead, we compute the borrower's loan-size-to-wealth (LTW) ratio as an indicator of the riskiness of a loan, with the interpretation that loans with large size relative to household assets are more risky than loans that are small relative to household assets.[12] The argument that informal

[11] See Section 4. for a more thorough discussion of this relationship

[12] The link between the LTW ratio and the risk of default arises endogenously in our model described in the next section. Note that the LTW ratio is akin to the loan-to-value (LTV) ratio, calculated as the mortgage amount divided by the appraised value of the property, which is frequently used by financial institutions to assess risk before approving a mortgage. In the U.S., the minimum LTV ratio requirement for a principal resident is often standardized and would be 65-85%, depending on the type of mortgage (fixed or variable rate) and number of units. See for example

credit arrangements have enforcement and informational advantages would suggest that riskier loans should be more likely to come from an informal source. This is not confirmed by the data. In fact, the exact opposite holds as Figure 4 shows: the relationship between loan informality and LTW ratio is negative over almost the entire range of the sample. The riskier a loan, the *less likely it is to come from a relative or neighbour*. Only for very high-risk loans is the relationship reversed (our model allows for this possibility).

3 Model

3.1 Basic Setting

The economy is populated by two types of agents: lenders and borrowers. Each borrower has an investment project financed by taking a loan at time $t = 0$. The projects can vary in size denoted by θ. A project requiring investment θ generates a stochastic return $y(\theta)$ at $t = 1$ which can take two possible values: $R\theta$ ('project success') with probability p, and 0 ('project failure') with probability $1 - p$, where $R > 1$ and $p \in (0, 1)$.

Each borrower is endowed with some amount of illiquid assets, $w > 0$ which may differ across borrowers. The assets are collateralizable but subject to risk. Specifically, at time $t = 1$ only fraction α of the agent's assets is available to compensate the lender, where α is a random variable with cdf $G(\alpha)$ and support $[\alpha_{\min}, 1]$ with $\alpha_{\min} \in (0, 1)$ and $E(\alpha) \in (\alpha_{\min}, 1)$. The cdf $G(\alpha)$ is assumed continuous on $[\alpha_{\min}, 1)$ but we allow it to have strictly positive mass at $\alpha = 1$, that is, a drop in the asset value may occur with cumulative probability less than one.[13]

The parameter α is important for our analysis as it ties the risk of default to the loan-size-to-wealth (LTW) ratio, $\frac{\theta}{w}$. A possible interpretation of α is that it captures expenses that the lender needs to incur in acquiring or storing the collateral. Alternatively, one can think of α as a shock to the $t = 1$ asset value – for example, a bad harvest, an accident lowering the resale value of a vehicle, or a drop in house or land prices. Alternatively, one could think of α as capturing expenses that the lender needs to incur in acquiring or storing the collateral. Importantly, the realization of α is unknown to both borrowers and lenders at $t = 0$ when the loan is taken but the value αw is observable by both at $t = 1$ when repayment is due. As will become clear below, the parameter α plays an important role for our analysis by tying borrowers' unobservable default risks to observable characteristics such as loan size θ and assets w.

Both lenders and borrowers are risk-neutral and, for simplicity, do not discount the future. We assume a limited enforcement setting in which the project return $y(\theta)$ is non-verifiable. This gives rise to the possibility of *strategic default* – a borrower may choose to default on her loan despite being able to pay

https://www.fanniemae.com/content/eligibility-information.

[13] For simplicity, we set the upper bound of α to 1 but our results easily generalize for an upper bound $\alpha_{\max} > 1$ as long as $E(\alpha) < 1$.

it back. In addition, as in most of the literature on rural credit, the borrowers have limited liability: if the project fails, $y(\theta) = 0$ and the borrower has insufficient funds to repay, then the borrower defaults involuntarily in which case the lender cannot punish her beyond seizing the posted collateral.

The main focus of our analysis is on the distinction and choice between informal and formal credit. Informal creditors could be relatives, friends, neighbours or members of the same ethnic group. The main characteristic of informal credit for our purposes is that the lender has a personal relationship with the borrower, which gives rise to *social capital*. We denote the non-pecuniary (friendship or kinship) value that either party derives from the relationship by $\gamma > 0$. Both parties lose this value in case of default. To capture the idea that friends or family typically have limited funds, we also assume that an informal lender has a maximum amount of $\bar{\theta} > 0$ available for lending. The analysis below is done for given γ and $\bar{\theta}$ but in practice borrowers and lenders can differ in these values. Informal credit arrangements are indicated with a subscript I. In formal credit arrangements, in contrast, the lender is a stranger to the borrower, that is, no personal relationship exists between them ($\gamma \equiv 0$). A prime example would be a loan from a commercial bank. We refer to any such creditors as formal and denote them by the subscript F.

The key defining characteristic in our model that qualitatively distinguishes formal from informal credit is that the former is associated with the relationship value $\gamma > 0$. The assumption that informal lenders have limited available funds $\bar{\theta}$ is used mostly when we take the model implications to the data. Let r_i, $i = I, F$ denote the required gross repayment (principal plus interest). Similarly, denote by c_i, $i = I, F$ the required physical collateral, expressed in terms of borrower's assets seized by the lender if the borrower defaults, that is, declares that she cannot pay back r_i. In line with the literature, we also assume that there is a (possibly small) transaction cost of using formal credit, $\lambda\theta$ where $\lambda > 0$.[14] This cost could be interpreted as arising from the need to show proof of title, filling out various forms, etc. A reduction in this cost can be interpreted as financial sector development (we come back to this in Section 4).

Assume also that both formal and informal lenders are willing to lend any feasible amount θ as long as they recover their opportunity cost of funds, which is normalized to one. [15] This assumption helps us maintain the comparability of formal and informal loans, and is satisfied, for example, if the market for either credit type is perfectly competitive. In general, of course, the market structure and bargaining power of borrowers and lenders may differ between formal and informal lenders. The borrowers' outside option, if they do not invest, is normalized to zero.

The sequence of events is illustrated in Figure 5. First, the borrowers learn their investment requirement

[14] Assuming that the cost is proportional to the loan size is not essential but helps with analytical simplification. If, instead, access to formal credit is subject to a fixed cost, λ, then only loans above a certain minimum size could be formal. All other results remain unchanged.

[15] In other words, borrowers receive all of the surplus – the loan terms (r_i, c_i),$i = I, F$ maximize the borrower's expected payoff subject to participation and incentive constraints.

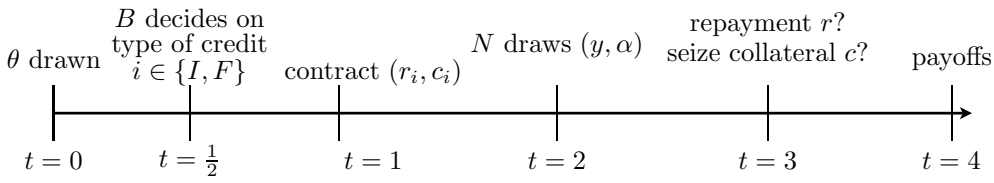

Figure 5: Sequence of Events

θ and decide whether to seek formal or informal credit, although only one of these sources may be available in equilibrium. Second, the terms of the loan contract (r_i, c_i) are determined. Next, nature chooses the value of α and whether the investment project succeeds or fails. The value of α is then observed by both parties. The project outcome is observed only by the borrower. Finally, the borrower decides whether to default or repay, the contract terms are executed, and payoffs are realized.

In what follows, we assume

Assumption.

$$\textit{(i) } pR > 1 + \lambda \textit{ and (ii) } p > 1/2 \tag{A1}$$

and

$$\gamma > \frac{p(R-1)}{1-p}\bar{\theta} \tag{A2}$$

As will become clear below, A1(i) implies that all investment projects are socially efficient and that borrowers would be always willing to take a formal loan in equilibrium. A1(ii) assumes that the probability of success p is sufficiently high which helps simplify the analysis by focusing on the relevant cases. Assumption A2 posits that the social value γ is sufficiently large so that people who borrow from informal lenders always have an incentive to repay – they never default strategically. Alternatively, we could assume away strategic default in informal credit upfront, for example by referring to superior enforcement ability or information availability between the parties, as is common in the literature. We discuss A2 further in Section 3.2.1.

The repay or default decision

The key difference between formal and informal credit is the absence or presence of social capital, otherwise they are treated symmetrically. Call

$$\gamma_i \equiv \begin{cases} \gamma > 0 \text{ if } i = I \\ 0 \text{ if } i = F \end{cases}$$

To understand the trade-off borrowers face between repaying r_i or defaulting, recall that the decision to default is made after observing α. Repaying costs r_i to the borrower. Defaulting costs

$$\delta(\alpha, \gamma_i) \equiv \gamma_i + \min\{c_i, \alpha w\},\ i = I, F \tag{1}$$

Since lending is socially efficient by A1 and the borrower receives the entire surplus, the interest rate will be such that repayment is always feasible when the borrower's project succeeds ($R\theta$ is large enough). When the project fails, the borrower has only αw in resources and repayment is a feasible choice only if $r_i \leq \alpha w$. We have

Lemma 1 (Borrower's repayment decision)**.** *a) The borrower defaults involuntarily and loses $\delta(\alpha, \gamma_i)$ if $r_i > \alpha w$ and $y(\theta) = 0$ (project failure).*

b) Otherwise, if $r_i \leq \alpha w$ or $y(\theta) = R\theta$ or both, the borrower optimally repays r_i whenever $r_i \leq \delta(\alpha, \gamma_i)$ or strategically defaults and loses $\delta(\alpha, \gamma_i)$ for $r_i > \delta(\alpha, \gamma_i)$.

For future reference, note that the lender's payoff equals r_i if the borrower repays and

$$v(\alpha, \gamma_i) \equiv \min\{c_i, \alpha w\} - \gamma_i \tag{2}$$

if the borrower defaults. Note from (1) and (2) that both the lender and the borrower lose the value γ_i upon default.

Finally, we impose without loss of generality a 'no strategic default' incentive constraint, which requires the loan terms (r_i, c_i) to be such that the borrower does not default strategically *all the time* (for all α). Focusing on the more natural situation where default occurs with probability less than one helps us to streamline the exposition without qualitatively changing the results.[16]

$$r_i \leq \gamma_i + \min\{c_i, w\} = \delta(1, \gamma_i) \tag{IC}$$

Contract Terms

As mentioned above, the assumption that the entire surplus is captured by the borrowers allows to derive the loan terms (r_i, c_i) by maximizing the borrower's expected payoff, U_B^i. There are four constraints to consider:

- the incentive constraint (IC) ensuring that strategic default does not occur for all α
- the borrower's participation constraint,
$$U_B^i \geq 0 \tag{PC$_B$}$$
- the lender's participation constraint,
$$U_L^i \geq \bar{u}_L^i(\theta, \gamma_i) \tag{PC$_L$}$$

[16] This constraint is always slack for informal loans. For formal loans, we otherwise may have contracts with $c_F > r_F$ in which there is default in every state of the world and the lender collects either αw or c_F. These contracts, however, give the same expected payoffs to the borrower and the lender as the contracts we study, and do not expand the set of parameters for which formal loans are feasible.

where U_L^i is the lender's expected payoff and $\bar{u}_L^i(\theta, \gamma_i)$ is her opportunity cost. In general, the latter depends on θ as lenders can put their funds to alternative uses. We also allow the cost to depend on the social capital γ_i, as for informal lenders it is plausible to think that they may suffer a utility loss from refusing to lend to a friend or relative. Recall that the opportunity cost of capital is unity. We assume the following functional form $\bar{u}_L^i(\theta, \gamma_i) = \theta - \kappa\gamma_i$ where $\kappa \in [0, 1]$ measures the part of the social capital that is lost when a loan is refused (e.g., think of lending to a parent or child). Since $\kappa > 0$ implies that surplus is being destroyed by not lending, borrowers could in principle demand excessively generous loan terms. To avoid this issue, we also impose

- non-negativity constraints on interest and collateral

$$r_i \geq \theta \text{ and } c_i \geq 0. \tag{NN}$$

Social capital γ_i, when positive, enters the contracting problem in four distinct places. It enters the incentive constraint (IC), it affects the borrowers' and the lenders' payoffs upon default, and it may also affect an informal lender's outside option, $\bar{u}_L^i$. In Section 3.2.1 and Appendix B we discuss allowing the social value γ to differ across these four distinct instances, including the case $\kappa = 0$ which makes the opportunity cost of lending the same for formal and informal lenders, $\bar{u}_L^F = \bar{u}_L^I$.

3.2 Informal Credit

Informal credit allows the borrower and lender to use the threat of terminating their social relationship and the associated utility loss of $\gamma > 0$ for each party as a means of ensuring repayment beyond what can be achieved by physical collateral. For simplicity and ease of exposition, we motivate the social value γ using a simple coordination ('handshake') game in which the lender and borrower 'confirm' or 'reject' their friendship after the project return is realized and the contract terms (r_I, c_I) executed.

Borrower \ Lender	confirm	reject
confirm	γ, γ	-1,0
reject	0,-1	0,0

A natural way to interpret the above game is as a reduced form of repeated interaction under limited commitment, for example, as in Coate and Ravallion (1993), Kocherlakota (1996), Fafchamps (1999) or Boot and Thakor (1994).[17] We assume that the Nash equilibrium (confirm, confirm) is played whenever the loan is repaid and the Nash equilibrium (reject, reject) is played otherwise. An isomorphic game is played when a borrower asks an informal lender for a loan. In that game there is an equilibrium in

[17] In Coate and Ravaillion (1993) and Kocherlakota (1996), agents share risk ('cooperate') on the equilibrium path by making transfers to each other depending on their incomes. Cooperation is supported by the threat of punishment with perpetual autarky if an agent reneges on the agreement. Similarly, Fafchamps shows that contingent credit can arise as an equilibrium in a long-term risk-sharing arrangement, while Boot and Thakor provide conditions under which long-term credit relationships can achieve the first-best in a repeated moral hazard problem without risk sharing motive.

which, if the lender refuses to give an informal loan when asked, he loses (a fraction of) the friendship value, $\kappa\gamma$ where $\kappa \in (0, 1]$. The interpretation is that the informal lender may suffer a utility loss from the refusal (e.g., parent and child). We discuss this assumption further in Section 3.2.1 and show what would change if the informal lender suffers no such utility loss.

From Lemma 1, it is clear that, if the social collateral γ is sufficiently large so that $r_I < \delta(\alpha, \gamma)$, $\forall\alpha$, the borrower would always prefer to repay r_I whenever feasible, that is, if $r_I \leq \alpha w$ or if $r_I > \alpha w$ and the project succeeds.[18] There would be no strategic default because of the large social capital γ at stake. A borrower would only default (involuntarily) if her project fails *and* $r_I > \alpha w$ in which case the borrower loses $\delta(\alpha, \gamma) = \gamma + \min\{c_I, \alpha w\}$ and the lender's payoff is $v(\alpha, \gamma) = \min\{c_I, \alpha w\} - \gamma$ from (2). In Section 3.2.1 we show that our results do not change if the lender does not lose γ in case of involuntary default by the borrower ("forgiveness").

We start the analysis by assuming that the parameter $\kappa \in [0, 1]$ in the r.h.s. of the lender's participation constraint is sufficiently close to or equal to 1, that is, the lender loses a large enough part of the social capital if he refuses to extend a loan. We discuss relaxing this assumption in Section 3.2.1. [19]

Lemma 2. *Suppose Assumptions A1 and A2 hold and $\kappa \in [0, 1]$ is sufficiently large. Then, whenever a (θ, w)-type borrower is willing to take an informal loan, the loan features zero interest and no collateral, $r_I^* = \theta$ and $c_I^* = 0$.*

Intuitively, for sufficiently large social value γ, an informal lender would never find it optimal to refuse to lend if asked and lose a friendship knowing that, for the same reason, the borrower has an incentive to repay whenever feasible. The assumption that the lender would lose social capital if he refused to make a loan when asked ($\kappa > 0$) matters for this result as it relaxes the lender's participation constraint. It also ensures that the lender offers the loan at favourable terms. Requiring the borrower to post collateral, $c_I > 0$, is sub-optimal since it is not necessary to prevent strategic default (the value of social capital suffices by A2) and doing so is costly to the borrower whenever there is positive probability of default.[20] Note also that it is possible for an informal lender to incur a monetary loss on an informal loan – the desire to preserve the relationship makes it worthwhile to lend to a friend or relative even with risk of non-payment.[21] The zero interest rate and collateral should not be taken literally - this result does

[18] Since $\delta(\alpha_{\min}, \gamma) > \gamma$, it is sufficient to ensure that $\gamma > r_I$ holds for the optimal r_I, which we will show is guaranteed by Assumption A2.

[19] The field experiment results of Jakiela and Ozier (2015) could be viewed as indirect evidence in support of the idea that refusing to help with money when asked by a relative is costly. The authors document that a large number of women in their Kenyan village sample are willing to forego a significant amount of money to hide their experiment payout from relatives.

[20] Even if the social capital did not suffice to prevent strategic default (A2 did not hold), it is immediate that the physical collateral that would be necessary to incentivize borrowers to repay whenever they have sufficient funds would be smaller for informal than for formal loans whenever $\gamma_I > 0$. Moreover, while borrowers with zero probability of involuntary default are formally indifferent to physical collateral requirements, even an ϵ cost of posting collateral wouldl render $c_i = 0$ strictly preferable.

[21] Alternatively, instead of losing social value when refusing to make a loan, one can think of the lender *receiving* social value when an informal loan is made (pleasure of helping out). In this case nothing changes since γ is added to the l.h.s. of (PC_L) while the r.h.s. becomes the opportunity cost θ.

depend on assuming that social capital is large and that lenders only require to break even. The robust implication is that, holding other things equal between formal and informal lenders, the presence of social capital allows for lower interest and collateral in informal loans.

We next show that, given γ, whether a borrower would benefit from using an informal loan depends on the value of the loan size to wealth (LTW) ratio.

Proposition 1 (Informal Credit)**.** *Suppose the conditions for Lemma 1 hold and consider a (θ, w)-type borrower with $\theta \leq \bar{\theta}$. There exists a threshold loan size to wealth (LTW) ratio, $\hat{\alpha}_I \in (\alpha_{\min}, 1)$ such that:*[22]

a) if $\frac{\theta}{w} \in (0, \hat{\alpha}_I]$ (low LTW ratio / low default risk) the borrower is willing to use informal credit. For $\frac{\theta}{w} \in (\alpha_{\min}, \hat{\alpha}_I]$ default occurs with positive probability.

b) if $\frac{\theta}{w} > \hat{\alpha}_I$ (high LTW ratio / high default risk) the borrower optimally chooses not to use informal credit.

3.2.1 Discussion

The role of α and the LTW ratio.

Loans that are not too large relative to the borrower's wealth, namely those with $\frac{\theta}{w} \leq \alpha_{\min}$, are feasible and mutually beneficial to both parties since there is zero risk of default, $\pi(r_I^*/w) = 0$ – the borrower always has sufficient assets to repay. For borrowers with higher LTW ratios, $\frac{\theta}{w} > \alpha_{\min}$, default occurs in equilibrium and the social value is lost with positive probability. Importantly, the probability of default increases in the LTW ratio since it becomes more likely that an α is realized for which $\alpha < \frac{r_I^*}{w} = \frac{\theta}{w}$. In that case, the borrower weighs the risk of default and loss of social capital against the expected gain from borrowing and undertaking the project. The gain outweighs the loss for ratios $\frac{\theta}{w}$ below the threshold $\hat{\alpha}_I$. For higher LTW ratios, $\frac{\theta}{w} > \hat{\alpha}_I$, informal credit is available but undesirable to the borrower since the risk of losing the social capital is too high.

The role of social capital γ.

Lemma 2 and Proposition 1 show that informal credit is characterized by no collateral requirement and zero interest, as is largely true in the data, see Section 4. Our assumptions that γ is large (A2) and that the lender loses a sufficiently high utility value $\kappa\gamma$ if a loan is refused are important for this result – the relaxed participation constraint arising from the threat of losing the social capital is what makes the lender extend a loan with favorable conditions (we discuss what happens if we relax this below).

We proceed to discuss in detail each of the four instances of the social capital γ in the contracting problem and the role of Assumption A2 on the size of γ. First, γ appears in the borrower's payoff, U_B^I

[22] The threshold $\hat{\alpha}_I$ depends on the social capital γ and borrower's assets w (see the proof of Proposition 2 and Lemma 3 for more details).

(see the proof of Lemma 1 for the exact expression). Call this instance γ_1. It can be interpreted as the "shame", "loss of face", or similar cost to the borrower incurred if she is unable to repay the informal loan. As seen in the proof of Proposition 1, a sufficient condition for our results to hold as stated is,

$$\gamma_1 \geq \tfrac{p(R-1)}{1-p}\bar{\theta} \quad \text{(C0)}$$

which is guaranteed by Assumption A2. If, instead we set the shame cost γ_1 to zero or sufficiently low, holding all else constant, the borrower would be willing to take and the lender would be willing to provide informal credit for any LTW ratio θ/w as long as $\theta \leq \bar{\theta}$. Hence, our result that risky informal loans, those with $\frac{\theta}{w} > \hat{\alpha}_I$, are avoided by borrowers hinges on Assumption A2 applied to γ_1. Notice that nothing changes in the analysis if we assumed that, in case of involuntary default, the borrower transfers all her assets αw to the lender but both lose only $\gamma - \alpha w$ in social value.

Second, γ appears in the l.h.s. of the lender's participation constraint (PC_L) – call this instance γ_2. It can be interpreted as the lender's cost of being 'upset' for not being repaid if the borrower's project fails and the borrower has insufficient wealth. It is easy to see that nothing changes in our results if we allow lender 'forgiveness' if the borrower defaults involuntarily, that is, $\gamma_2 = 0$. The reason is that setting $\gamma_2 = 0$ (or any $\gamma_2 < \gamma$) *relaxes* the lender's participation constraint. If lenders are willing to make loans at $\gamma_2 = \gamma$ satisfying A2, they are still willing to do so for any $\gamma_2 \in [0, \gamma)$.

Third, the social capital γ appears in the incentive constraint (IC) – call this instance γ_3. It can be interpreted as a 'shame' or other similar cost to the borrower as a result of *strategically defaulting* on an informal loan. For Lemma 2 and Proposition 1 to hold, it is enough to ensure that no strategic default happens at $c_I = 0$. A sufficient condition is

$$\gamma_3 \geq \bar{\theta} \quad \text{(C1)}$$

Note that condition (C1) is weaker than that assumed in A2 when all γ instances were set equal. If this cost did not exist ($\gamma_3 = 0$), then physical collateral ($c_I^* > 0$) will be needed to support informal loans in a way similar to the formal credit case discussed below.

Fourth, the social value γ appears in the r.h.s. of the lender's participation constraint (PC_L) – call this term $\gamma_4 = \kappa\gamma$. It can be interpreted as a utility cost to the lender from *refusing to give a loan* to a friend or relative. One can imagine this cost to be high between close friends, parents and children, etc. Going back to the proof of Lemma 2, for its result to hold we need (PC_L) to be satisfied at $r_I = \theta$ and $c_I = 0$ for which a sufficient condition is[23]

$$\gamma_4 \geq (\gamma_2 + \bar{\theta})(1-p) \quad \text{(C2)}$$

[23] A tighter sufficient condition but depending on the endogenous threshold $\hat{\alpha}_I$ is

$$\gamma_3 \geq (\gamma_2 + \hat{\alpha}_I w)(1-p)G(\hat{\alpha}_I)$$

using that informal loans are optimally taken only for LTW ratios $\frac{\theta}{w} \leq \hat{\alpha}_I$.

We see from (C2) that the sufficient condition in A2 can be too strong. For example, if $\gamma_2 = 0$ (the forgiveness scenario discussed above) we only need the lender's loss of refusing a loan, γ_4 to satisfy $\gamma_4 \geq (1-p)\bar{\theta}$ which is strictly smaller and, depending on p, can be much smaller than the original social value γ (γ_1 here). Even if $\gamma_2 = \gamma_1 = \gamma$ (the lender and the borrower lose the whole friendship if default occurs), then for p large enough, we can still have $\gamma_4 < \gamma$ with all our previous results intact. A realistic scenario with large γ_4 and small/zero γ_2 could be taking a loan from one's parents – they may not be upset ($\gamma_2 = 0$) with a borrower who fails to repay for exogenous reasons, but on the other hand may have a high utility cost (γ_4) of refusing a loan when asked (high κ).

In the other extreme, when $\kappa = 0$ which implies $\gamma_4 = 0$, that is, the lender has no qualms about refusing a loan, the lender would still charge zero interest and require no collateral for riskless loans, those with $\frac{\theta}{w} \leq \alpha_{\min}$. However, for risky loans, with $\frac{\theta}{w} > \alpha_{\min}$, the lender would optimally require positive interest and collateral, the values for which can be solved from setting (PC_L) to equality (see Appendix B for details).

The threshold $\hat{\alpha}_I$

Lemma 3. *The threshold LTW ratio $\hat{\alpha}_I$ defined in Proposition 1 is decreasing in the social value γ and increasing in the project success probability p, the return R, and the borrower's wealth w.*

For larger social value γ informal loans become more costly to both parties due to the risk of default. This reduces the range of LTW ratios for which informal loans are desirable – a shift to safer loans. An implication is that more closely related people are *less likely* to lend to each other *ceteris paribus* (for given w, the feasible range of project sizes that can be supported by informal credit is smaller). However, borrower-lender pairs with low γ may be unable to support any informal loans with zero collateral. Here this scenario is ruled out by Assumption A2 but would arise if we relax it, as discussed above. In contrast, larger wealth w, or larger p and R support a wider range of loan sizes since either the risk of default is lower or borrowing is more profitable in expectation.

3.3 Formal Credit

The major difference between informal and formal credit is that formal credit lacks associated social capital, that is $\gamma_F = 0$. Noting that $\delta_F = \min\{c_F, \alpha w\}$ from (1), Lemma 1 implies that formal credit borrowers have a strict incentive to default unless a sufficiently large strictly positive amount of assets is pledged as collateral. Using (IC), to ensure that borrowers do not always strategically default, formal loans must satisfy

$$r_F \leq \min\{c_F, w\} \tag{3}$$

We therefore must have $c_F \geq r_F$. Even subject to (3), however, if $r_F > \alpha w$ a borrower would still find it optimal to default (strategically if the project succeeds and involuntarily otherwise) after a negative shock

to the value of her assets. This is so since the inequality $c_F \geq r_F$ from (3) implies $\delta(\alpha, 0) = \alpha w < r_F$ – the most the lender can seize is αw, which is less than the both the required repayment r_F and the collateral c_F. As result, strategic default cannot be avoided in formal loans and can occur with positive probability depending on the realization of α. This is an important difference with the informal credit case where all equilibrium default is involuntary.

In the remaining case, $r_F \leq \alpha w$ Lemma 1 implies that the borrower would always repay (either from cash flow or voluntary liquidation of assets), since $r_F \leq \delta_F$ always holds using that $r_F \leq c_F$ by (3). This is the same outcome as in the informal credit case, although here it is achieved in a different way, by the lender requiring strictly positive collateral, $c_F \geq r_F > 0$. Overall, these results imply that the lender obtains r_F if $\alpha \geq \frac{r_F}{w}$ and $\lambda \alpha w$ otherwise.

Lemma 4. *Formal loan contracts always feature a non-negative interest rate $r_F^* \geq \theta$ which is strictly positive if $\frac{\theta}{w} > \alpha_{\min}$, and positive collateral, $c_F^* > 0$.*

Note the differences with informal credit (Lemma 2). The lack of social capital at stake always necessitates a strictly positive collateral requirement since this is the only way to avoid default in all states. The interest rate equals the opportunity cost of funds only if there is zero default risk, that is, when $\frac{\theta}{w} \leq \alpha_{\min}$. Otherwise, formal loans have strictly positive interest. The formal loan terms r_F^* and c_F^* satisfy $c_F^* \geq r_F^*$ where r_F^* is such that the lender's participation constraint $U_L^F \geq \theta$ holds at equality. We show below that the borrower's participation constraint $U_B^F \geq 0$ is always satisfied under A1.

We next discuss the conditions on (θ, w) for which (PC_L) is satisfied and characterize the optimal formal loan. As in the case of informal credit, the loan-size-to-wealth (LTW) ratio $\frac{\theta}{w}$ is key for the results.

Proposition 2 (Formal Credit)**.** *Suppose Assumption A1(i) holds and consider a (θ, w) type borrower. Denoting $\hat{\alpha}_F = E(\alpha)$, the formal loan contracts satisfies:*

(a) if $\frac{\theta}{w} \leq \alpha_{\min}$ (zero default risk / low LTW ratio), the loan has positive collateral, $c_F^* \geq \theta$ and interest rate $r_F^* = \theta$.[24]

(b) if $\frac{\theta}{w} \in (\alpha_{\min}, \hat{\alpha}_F]$ (low default risk / intermediate LTW), the loan has positive collateral, $c_F^* \geq \theta$ and positive interest rate, $r_F^* > \theta$ where r_F^* solves $U_L^F = 0$.

(c) if $\frac{\theta}{w} > \hat{\alpha}_F$ (high default risk / high LTW ratio) no formal loans are feasible.

Intuitively, since formal loans require collateral ($c_F^* \geq r_F^* > \theta$), the lender faces only one type of risk, namely that the ex-post value of the borrower's assets, αw falls short of the contracted repayment r_F. Default by itself is otherwise irrelevant to the lender, unlike in informal credit. This implies that

[24] If there is zero default risk, the lending interest rate equals the opportunity cost of funds to the lender which can be positive (e.g., $1 + \rho > 0$) in which case we would have $r_F^* = (1 + \rho)\theta$. In contrast, in the informal credit case, for large enough γ and κ, riskless loans would be still made at zero nominal interest rate.

borrowers with projects with high default risk (high LTW ratio) are ineligible for formal loans since the lender cannot break even. For the same reason low-LTW projects (with $\frac{\theta}{w} \leq \alpha_{\min}$), for which there is zero default risk are charged lower and size-independent interest rate relative to riskier projects.

4 Choice between Formal and Informal Credit

Using Propositions 1 and 2, we now compare and contrast formal and informal loans. The advantage of informal loans is twofold. First, provided the social capital is large, informal lenders do not require the borrower to pay interest or to post physical collateral – informal loans are therefore cheaper than formal loans. The reason is that informal lenders do not need to be compensated for the risk of strategic default – they know that the borrower has an incentive to pay them back whenever feasible in order to preserve the friendship. If the risk of losing the social collateral is too high, the borrower would not ask for an informal loan in the first place. Second, because of the pledged social capital, informal credit can be extended to borrowers with low or no assets (though such borrowers would not necessarily wish to borrow). In contrast, formal lenders such as banks always require physical collateral to ensure repayment.

Borrowing from informal sources does comes with a cost, however. First, unlike physical collateral that can be freely adjusted, the relationship value γ which acts as social collateral to secure the loan is *indivisible* – the entire amount γ is pledged to support repayment, even though for small loans only a fraction may suffice (see the discussion in Section 3.2.1). This has broader implications (not modelled here) regarding which person from her set of friends a borrower would turn to, depending on the needed loan size. The second disadvantage is the loan size upper limit $\bar{\theta}$ – friends or relatives generally do not have unlimited loanable funds.

Comparing between the informal and formal loan contracts characterized in Propositions 1 and 2, we see that, when using informal credit, both the lender and the borrower share a common interest to avoid default since each of them stands to lose the social capital γ. Hence, both want to avoid risky loans, those with high LTW ratios, and such loans would not be taken from informal sources. In contrast, when using formal credit, the lender's and borrower's incentives regarding the risk of default are not aligned. The borrower does not mind riskier loans since her loss is capped at αw. The lender, however, cannot break even for high-LTW ratio loans. This is why the LTW upper bound $\hat{\alpha}_F$ in Proposition 2, above which loans are not given, is determined by the lender's participation constraint while the corresponding bound $\hat{\alpha}_I$ in Proposition 1 is determined by the borrower's participation constraint (loans with higher LTW ratio carry too much risk of losing γ).

We next analyze formally the choice between formal and informal credit given a borrower's wealth and loan size, (w, θ) and the parameters p, R, γ. Assume that $\theta \leq \bar{\theta}$ – that is, informal credit is *a priori* feasible. The above discussion implies that borrowers with LTW ratios $\frac{\theta}{w} \leq \min\{\hat{\alpha}_I, \hat{\alpha}_F\}$ can

borrow from both formal and informal lenders. We characterize the optimal loan source choice for such borrowers.

Proposition 3 (Choice of loan source)**.** *Suppose Assumptions A1 and A2 hold and consider a* (θ, w) *type borrower with* $\theta \leq \bar{\theta}$*,*

(a) if $\frac{\theta}{w} \leq \alpha_{\min}$*, the borrower uses informal credit.*

(b) if $\frac{\theta}{w} \in (\alpha_{\min}, \min\{\hat{\alpha}_I, \hat{\alpha}_F\}]$*, the borrower uses informal credit for lower values of the LTW ratio in this interval and formal credit otherwise.*

(c) for $\frac{\theta}{w} \in (\min\{\hat{\alpha}_I, \hat{\alpha}_F\}, \max\{\hat{\alpha}_I, \hat{\alpha}_F\}]$*, if* $\hat{\alpha}_I > \hat{\alpha}_F$*, the borrower uses informal credit since formal credit is unavailable. If* $\hat{\alpha}_I \leq \hat{\alpha}_F$*, the borrower uses formal credit.*

(d) if $\frac{\theta}{w} > \max\{\hat{\alpha}_I, \hat{\alpha}_F\}$ *the borrower would not or cannot borrow from any credit source – either the risk of losing the social capital is too high or the lender cannot break even.*

Furthermore, if the transaction cost in formal lending is negligible $\lambda \to 0$*, borrowers weakly prefer using formal credit for any* $\frac{\theta}{w} \leq \hat{\alpha}_F$*, and strictly so for* $\frac{\theta}{w} > \alpha_{\min}$*.*

Intuitively, when the LTW ratio and hence the risk of losing the social capital γ is zero (part a), the borrower prefers informal credit since it offers more favorable terms – zero interest and collateral and no access cost. By continuity, this extends also to (θ, w) for which the default risk is small (part b), namely those with $\frac{\theta}{w} \leq \min\{\hat{\alpha}, \hat{\alpha}_F\}$ where $\hat{\alpha}w$ is the loan size at which the borrower is indifferent between using informal and formal credit, namely[25]

$$U_B^I(\theta, 0, \gamma) = U_B^F(r_F^*, c_F^*, 0).$$

In contrast, for higher values of the LTW ratio, above $\hat{\alpha}$, borrowers prefer formal loans despite their less favorable terms. In this case the expected cost of losing the social capital is smaller than the larger repayment required under project success or failure. In part (c), if $\hat{\alpha}_I > \hat{\alpha}_F$ informal loans are used when the LTW ratio θ/w is so large that the borrower's preferred choice of a formal loan is not feasible (the lender cannot break even due to insufficient collateral) but informal loans still generate positive expected payoff for the borrower.

The last part of Proposition 3 shows that, as the transaction cost of using formal credit goes to zero, which could be interpreted as a process of financial development, borrowers are always better off using formal credit as long as it is feasible. This model implication is consistent with the discussion in the introduction on why informal credit seems to be unpopular in developed countries despite its apparent advantages in terms of interest rate and collateral.

[25] Clearly, a larger bank access cost λ raises the threshold $\hat{\alpha}$ while we show that if $\lambda \to 0$ then formal loans are (weakly) preferred for any (θ, w) for which the lender can break even.

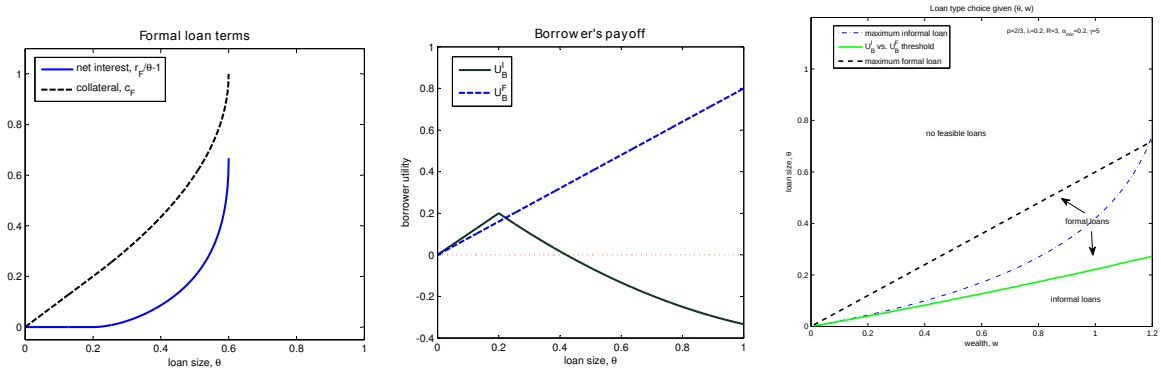

Figure 6: Terms of Contract and Choice of Loan Source

Numerical example

To visualize the theoretical results we offer a brief numerical example. Let $p = 2/3$, $R = 3$, $\lambda = .2$, $\bar{\theta} = 1$, $\alpha_{\min} = .2$, $\gamma = 5$ and α be uniformly distributed on $[\alpha_{\min}, 1]$. Normalize borrower's wealth to $w = 1$ so that loan size and the LTW ratio are the same. It is easy to verify that A1-A2 are satisfied for these parameter values. The net interest rate for formal loans, $\frac{r_F^*}{\theta} - 1$ increases monotonically in the LTW ratio (loan size) up to 66.7% for $\frac{\theta}{w} = \hat{\alpha}_F = .6$, as shown in the leftmost graph in Figure 6. The collateral requirement, $c_F = r_F$ also increases monotonically in the LTW ratio. The diagram in the middle plots the borrower's payoffs from using formal or informal credit. For the chosen parameters, $\hat{\alpha}_I = .42$, that is, informal loans are undesirable for loan size exceeding 42 percent of the borrower's wealth. Similarly, borrowers whose LTW ratio is above 60 percent do not have access to formal loans, since $\hat{\alpha}_F = .6$. Comparing the borrower's payoffs, U_B^I and U_B^F, we see that informal loans are optimal for borrowers with an LTW ratio $\frac{\theta}{w} \in (0, 0.22]$, while formal loans are optimal for riskier loans, with LTW ratios $\frac{\theta}{w} \in (0.22, .6]$. Loans with LTW ratios above .6 are not feasible, regardless of their source.

The rightmost panel of Figure 6 illustrates the choice of loan source in the loan size–wealth plane (w is now allowed to vary). Thinking in terms of borrowers who differ in some unobserved dimension such as γ, we see that *for a given loan size θ, borrowers with higher LTW ratios (lower wealth, w) are less likely to borrow from an informal source* than borrowers with lower LTW ratios (larger wealth, w).

5 Empirical Analysis

5.1 Testable Implications

There are three main predictions of our model which, as we showed in Section 2, are consistent with observed regularities in the data. In this section, we investigate these predictions in more detail, taking

advantage of the fact that our data contain various household characteristics that we can control for. In doing so, we view households as heterogenous in two key observables, the size of each loan they have, θ and their wealth, w. Since, in practice, households will generally also differ in unobservables, captured in the model by $\alpha_{\min}$, $G(\alpha)$, p and γ, the theoretical predictions translate into average differences in the loan terms between formal and informal credit, as well as a likelihood that we observe an informal versus a formal loan as a function of the loan size and the loan-to-wealth (LTW) ratio.

First, Propositions 1 and 2 imply that the interest rate on loans originating from neighbours and family should be lower on average, than the interest rate charged by formal lenders, holding loan size θ and household assets w fixed. Second, the collateral requirements on informal loans should be smaller than those on formal loans, ceteris paribus (compare Lemma 1 and 2).

The third testable implication concerns the effect of the LTW ratio (θ/w) on the observed choice between formal and informal credit. Specifically, we argued that informal credit is desirable for low LTW ratios, ceteris paribus (see Proposition 3, a and b). For larger LTW ratios, borrowers would optimally choose formal credit (Proposition 3b). Importantly, these results are not simply due to loan size. That is, holding loan size fixed, we should still observe formal credit for borrowers with low assets (lower LTW ratios) and informal credit for borrowers with more assets (higher LTW ratios). As the LTW ratio grows larger, Proposition 3(c) shows that one of two cases can occur. Either formal credit is still available and thus chosen (the case $\hat{\alpha}_I < \hat{\alpha}_F$); or, formal credit becomes unavailable (the case $\hat{\alpha}_F < \hat{\alpha}_I$). In the latter case, informal credit is used as long as $\theta \leq \bar{\theta}$. In sum, Proposition 3 predicts that either: (i) the relationship between loan informality and the LTW ratio is strictly decreasing – the case $\hat{\alpha}_F \geq \hat{\alpha}_I$; or (ii) the relationship between loan informality and the LTW ratio is U-shaped: initially informal loans become less attractive as the LTW ratio grows, but are used again for high values of the LTW ratio in the case $\hat{\alpha}_I > \hat{\alpha}_F$.

The same reasoning implies also that, as we hold borrower's wealth fixed, larger loans are less likely to be informal. We should therefore expect that loan informality, on average, decrease in the loan size θ. However, there can be various other reasons for why borrowers with larger credit requirements are more likely to use formal credit, ceteris paribus. One such reason may be that informal lenders are more limited in their funds than formal lenders.[26]

[26] To accommodate this possibility, the model allows for informal loans to be capped at $\bar{\theta}$, so all loans $\theta > \bar{\theta}$ are necessarily formal. While one could imagine borrowers tapping multiple informal sources if their credit requirements exceed $\bar{\theta}$, adding such loans will increase the risk of default and costly loss of social capital. In the data the fraction of households who took several informal loans within the same calendar year is below 10 percent.

5.2 Baseline results

5.2.1 Interest rate and collateral

We first test the model implications for the loan terms – the interest rate and collateral requirement. As already noted in Figure 3, loan terms are more favourable for informal loans. To test this prediction more formally, Table 2 reports the results of a tobit regression of the loans' interest rate and collateral on the loan source, controlling for various household characteristics including wealth, income, location, age, gender, marital status and education, as well as the loan size and intended use. All continuous variables (loan size, household wealth, income, interest, and collateral) have highly skewed distributions and are therefore log-transformed. Specifications (1) and (3) in the Table only use the dichotomous distinction between informal and formal loans, while columns (2) and (4) break the loan source down further by introducing dummy variables for moneylender, neighbour and relative, with commercial bank as the baseline. The results in Table 2 show that loan informality is associated with statistically significantly lower interest rate and collateral. The coefficient estimates indicate that the results for the interest rate are mainly caused by the loans from relatives. Larger loan size and/or wealth is expectedly associated with larger collateral.

Table 2: Tobit Regressions for Terms of Credit

dependent variable	interest		size of collateral	
	(1)	(2)	(3)	(4)
loan source (informal=1)	-0.40**		-494.2**	
	(-0.09)		(-76.7)	
loan size	0.00	0.02	176.5**	136.1**
	(0.03)	(0.04)	(26.9)	(26.2)
household wealth	-0.03	-0.04	83.7**	66.0*
	(0.04)	(0.04)	(29.4)	(29.6)
source=money lender		0.06		-351.2**
		(0.16)		(72.6)
source=neighbour		-0.00		-628.9**
		(-0.18)		(-102.6)
source=relative		-0.54**		-817.6**
		(-0.19)		(-100.2)
Observations	815	815	1,139	1,139
pseudo R^2	0.03	0.05	0.11	0.12

[a] **Note:** The baseline loan source for columns (2) and (4) is commercial bank. With the exception of indicator variables, all independent variables are logged. The regressions include fixed effects that account for location (tambon) and the intended use of the loan (consumption, real estate, investment, other). We also control for age, gender, marital status and education of the household head. The standard errors reported in parentheses are clustered at the household level. Superscripts ** and * indicate significance at 1% and 5%, respectively.

5.2.2 Loan Source and the Loan-size-to-wealth Ratio

We next study the relationship between the chosen loan source (formal versus informal), loan characteristics, and household characteristics. In doing so, we initially assume that the loan size is exogenously determined by the needs of the household.[27] In our baseline specification the dependent variable is the choice of loan source, $Lsource \in \{0, 1\}$, which equals one if the loan is informal, that is, originates from a neighbour or a relative, and zero if the loan is formal, that is, originates from a commercial bank or a moneylender. For the reasons explained in Section 2, our baseline regressions exclude BAAC loans from both loan source categories.[28] Altogether, formal credit, as defined, constitutes 36 percent of the sample.

The main regressor of interest is the (log-transformed) LTW ratio, but in the different specifications we also control for loan size and numerous household and loan characteristics. Specifically, we run the following two regressions:

$$Lsource_{kij} = \delta_j + \gamma_0 LTW_{ki} + \beta X_{ik} + u_{kij} \quad \text{(A)}$$
$$Lsource_{kij} = \delta_j + \gamma_1 Lsize_{ki} + \gamma_2 LTW_{ki} + \beta X_i + u_{kij} \quad \text{(B)}$$

where i refers to the household, j refers to the tambon (a local administrative unit at a subdistrict level)[29], and k to the loan (one household can have several loans in our sample). In specification (B), we additionally control for loan size because there may be other possible explanations for why smaller loans are more likely informal, which are logically distinct from the loan-size-to-wealth ratio effect we highlight. If that were the case, finding a negative relationship between the incidence of informal credit and the LTW ratio in specification (A) (as we do in the data) may be purely an artifact of loan size, instead of indicating that larger LTW ratios imply higher default risk thereby disadvantaging informal credit, which is the primary channel we model and seek to identify. Controlling for loan size means that residual variations in the LTW ratio, the third term in specification (B), correspond to variations in household wealth,[30] and a negative coefficient γ_2 would thus suggest that, for given loan size, wealthier (less risky in the model) households are more likely to seek informal credit that poorer households. Estimation is done by probit and the results are reported in Table 3.

Columns (1) and (2) in Table 3 are the most parsimonious specifications and include as controls only

[27] This is obviously a strong assumption, but could be justified if most loans are taken for a specific purpose, as our data indicate. A related issue is that some households may borrow from several sources to finance a single investment project (Kaboski and Townsend, 1999). In the Thai data, we observe the calendar dates at which each household took any given loan, as well as rough categories regarding the reported purpose of the loan. If we count loans that are taken for the same purpose within a year of each other as potentially being part of a larger loan that was split up (e.g., due to cash constraints on the lenders' side or the required collateral), we arrive at a fraction of roughly 17% of all informal credit loans and only 0.2 % of all formal credit loans. We deal with the possibility that loan size is endogenous in the robustness section below.

[28] See Section 5.3 on the robustness of the results with regard to the coding of the dependent variable including BAAC loans.

[29] There are 20 tambons in the data. On average, 226 households reside in a tambon.

[30] See the Appendix for an alternative to Table 3, which uses wealth instead of the LTW ratio (Table 8). The regressions with log loan size and log wealth in columns (2) and (4) in Table 8 are, of course, mathematically equivalent to those with log loan size and log LTW ratio in Table 3.

Table 3: Probit Regressions for Loan Source

dependent variable	loan source (informal=1)				
independent variable	(1)	(2)	(3)	(4)	(5)
loan size		-0.22***		-0.23***	
		(0.04)		(0.06)	
LTW ratio	-0.24***	-0.10*	-0.25***	-0.11*	-0.20***
	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)
tenure			-0.42	-0.38	-0.42
			(0.22)	(0.22)	(0.22)
bank access			-0.32**	-0.21	-0.32**
			(0.11)	(0.11)	(0.11)
BAAC member			-0.10	-0.02	-0.09
			(0.10)	(0.10)	(0.10)
income			-0.02	0.09	-0.02
			(0.04)	(0.05)	(0.04)
LTW ratio, 5th quintile					0.15*
					(0.07)
Observations	1139	1139	1138	1138	1138
pseudo R^2	0.13	0.15	0.14	0.16	0.15

[a] **Note:** The regressions include fixed effects that account for location (tambon) and intended loan usage. We also control for the following household characteristics: age, gender, marital status, education of the household head, and the total number of outstanding loans. With the exception of age, all continuous variables are in log form. The standard errors reported in parentheses are clustered at the household level. Superscripts ***, ** and * indicate significance at 0.1%,1% and 5%, respectively.

basic demographic characteristics of the household head, such as gender, education, marital status, and age, as well as fixed effects for location (tambon) and intended use of the loan.[31] The estimates reveal that the incidence of informal loans is significantly lower the larger is the loan-size-to-wealth ratio, *ceteris paribus*. This is true both with and without controlling for loan size (columns 1-2). These results are fully in line with the model's prediction that riskier loans, as measured by their LTW ratio, are less likely to be informal. The magnitude of the effects is large; for example, in column (1) one standard deviation change around the mean in the log of the LTW ratio decreases the probability of a loan being informal by 13 percentage points. Controlling for loan size (column 2), the estimated effect of one standard deviation change in the LTW ratio lowers the likelihood of informal credit by 5 percentage points (which corresponds to an increased likelihood of informal credit of 5 percent for one standard deviation increase in household wealth).

Columns (3) and (4) in Table 3 add four additional control variables, namely whether or not the household head has lived in the village longer than 6 years ('tenure'), whether (s)he has bank access, whether (s)he is

[31] We distinguish between four broad categories of loan use: investment, real estate, consumption, and other. The coefficients on age, education and the total number of outstanding loans are statically significant and have the expected signs. They are suppressed in the reported output for brevity of exposition. Full details are available from the authors.

a BAAC member, and household income. [32] In rural areas, access to commercial banks is often severely restricted and travel times to the nearest bank branch may be prohibitive while the government-funded BAAC may act as a backup credit source. Clearly, these factors may affect the choice of loan source and, since they are likely to be correlated with the loan size and borrower's wealth, omitting them could bias our estimates. We see, however, that the negative coefficients on both the LTW ratio and loan size are virtually unaffected and remain statistically significant.

Looking at the coefficients on the controls, column (3) indicates that access to a commercial bank increases the probability of formal loans holding the LTW ratio constant, as expected. Household income is not associated with the loan source choice when controlling for the LTW ratio, loan size, and household characteristics. The last column (5) investigates the possibility of a non-monotonic relationship between the LTW ratio and loan informality by adding as a regressor the top quintile of the LTW ratio in our sample. We see that the estimated effect is positive and significant at the 5% confidence level which is suggestive of a U-shaped relationship, as we saw in Figure 4.

5.3 Robustness

5.3.1 Selection

An important issue that we have neglected so far is that we may not observe loan-choice related characteristics of the households in our sample who decide not to take a loan. It is easy to imagine that, for instance, households who have an outstanding loan could have larger credit needs or be more trustworthy than households who do not have a loan. If the propensity to take a loan is correlated with unobserved characteristics that are also important in determining the chosen source of credit, then our baseline estimates in Table 3 would be biased, since selection into the sample could be correlated with the error term. To correct for this potential selection bias we use Heckman's (1979) sample selection correction method for probit models.[33] In the first stage, we estimate a selection equation as probit regression of the form,

$$s_{ij} = \delta_j + \alpha Z_i + e_{ij}, \;\; D_{ij} = 1 \Leftrightarrow s_{ij} \geq \bar{s}$$

where s^*_{ij} is the propensity to be included in the sample, $D_{ij} = 1$ if the household took out a loan and zero otherwise, Z_i is a vector of observable household characteristics, and e_{ij} is the error term. Along with the previously discussed controls, we include household savings and whether the household reports to be credit constrained as regressors in the selection equations. In the second stage, we correct for self-selection by incorporating a transformation of the predicted choice probabilities as an additional

[32] Note that having access to the BAAC or a commercial bank does not imply that the household has a loan with any of these institutions.

[33] We use a version of Heckman's sample selection model in which the second stage equation is also probit. The corresponding STATA command is 'heckprob'.

explanatory variable. The estimated model is

$$Pr\left\{y_{kij}=1|D_{ij}=1\right\}=\delta_j+\gamma M_{ki}+\beta X_i+\beta_\lambda\lambda(\alpha Z_i+\delta_j)+u_{kij},$$

where $\lambda(\cdot)$ is the inverse Mills ratio, evaluated at $\alpha Z_i+\delta_j$ and M_{ki} is either $Lsize_{ki}$ or ($Lsize_{ki}$, LTW_{ki}) corresponding to specifications (A) and (B) in Section 5.2.

The results from the Heckman-corrected regressions reported in Table 4 suggest that selection does not play an important role. Comparing columns (1) and (2) in Table 4 with the corresponding uncorrected estimates in columns (3) and (4) in Table 3, we see that the coefficients on the main variables of interest (the LTW ratio and loan size) remain very similar in magnitude and significance. Furthermore, the estimates of the correlation between the error terms in the regression equation and the selection equation show a relatively weak relationship and the corresponding Wald test is never statistically significant, suggesting that sample selection bias does not pose significant problem for the validity of our estimates.

The coefficient estimates in the selection equation (the columns with primes) have the expected signs. Controlling for other household characteristics, the propensity to have taken a loan increases in income and decreases in household savings. The indicator variable 'credit constrained' equals 1 if the respondent answered "yes" to the question whether additional funds would be useful to increase the profitability of the family business or farm. As expected, the estimated coefficient is strongly positive, that is, households who state that expanding would be profitable are more likely to borrow than those who do not.

5.3.2 Alternative definitions of formal and informal credit

We next examine the sensitivity of our results to alternative definitions of formal and informal credit. As explained earlier, we have so far excluded village-level organizations such as production credit groups (PCGs), rice and buffalo banks, poor and elderly funds, as well as agricultural lending institutions such as the Bank for Agriculture and Agricultural Cooperatives (BAAC) or agricultural cooperatives. The latter two in particular are common in rural Thailand and make up for almost 45 percent of all loans in our data. At the outset, one could think of these institutions as formal lenders; indeed, roughly 85 percent of BAAC loans and almost 95 percent of agricultural cooperative loans require collateral and virtually all carry a positive interest rate. For the village-based organizations the corresponding numbers are somewhat lower. While PCG loans require collateral in roughly 60% of all cases, the corresponding number for village fund and rice bank loans is only 30%. At the same time, however, loans from these institutions often rely on joint-liability or community monitoring for enforcement and thus they could be viewed as secured by social (rather than physical) capital. For example, about 50 percent of BAAC loans are reported as backed by multiple guarantors (group lending). As such, viewed through the lens of our model, they bear more resemblance to informal loans.

To examine whether our results are sensitive to variations in the definitions of formal vs. informal credit, we re-run the exact same specifications from Table 3 using three alternative definitions for informal

Table 4: Heckman Correction Probit Regressions for Loan Source

** dependent variable	Loan Source (1=informal)							
	(1)	(1')	(2)	(2')	(3)	(3')	(4)	(4')
loan size			-0.22***				-0.22***	
			(0.05)				(0.05)	
LTW ratio	-0.25***		-0.10*		-0.20***		-0.06	
	(0.04)		(0.04)		(0.04)		(0.05)	
tenure	-0.41	0.08	-0.35	0.08	-0.40	0.08	-0.35	0.08
	(0.21)	(0.15)	(0.21)	(0.15)	(0.22)	(0.15)	(0.21)	(0.15)
bank access	-0.32**	0.07	-0.21	0.07	-0.32**	0.07	-0.21	0.07
	(0.11)	(0.10)	(0.11)	(0.10)	(0.11)	(0.09)	(0.11)	(0.09)
BAAC member	-0.03	0.79***	-0.07	0.79***	-0.02	0.79***	0.08	0.79***
	(0.14)	(0.09)	(0.14)	(0.09)	(0.14)	(0.09)	(0.14)	(0.09)
income	-0.01	0.09*	0.09	0.09*	-0.02	0.09*	0.09	0.09*
	0.04	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)
savings		-0.20***		-0.19***		-0.20***		-0.20***
		(0.02)		(0.02)		(0.02)		(0.02)
credit constrained		0.33***		0.32***		0.32***		0.32***
		(0.08)		(0.08)		(0.08)		(0.08)
LTW ratio, 5th quintile					0.16*		0.15*	
					(0.07)		(0.07)	
Observations	1134	866	1134	866	1134	866	1135	866
corr. of error terms		0.21		0.27		0.22		0.30
		(0.26)		(0.25)		(0.27)		(0.25)
Wald test p-value		0.44		0.30		0.43		0.25

[a] **Note:** The columns denoted with primes are the selection equations. All regressions control for household characteristics (age, gender, marital status, and education of the head) and include tambon fixed effects. With the exception of age, all continuous variables are in log form. The loan source regressions also include intended loan usage, and control for the total number of outstanding loans. The selection regressions include occupation dummies (farmer, business owner) for the household head. The standard errors reported in parentheses are clustered at the household level. Superscripts ***, ** and * indicate significance at 0.1%,1% and 5%, respectively.

Table 5: Alternative classification of formal and informal credit

	baseline		wider formal		wider informal		narrower formal	
loan source	(1)	(1')	(2)	(2')	(3)	(3')	(4)	(4')
loan size		-0.23***		-0.28***		-0.11*		-1.06***
		(0.06)		(0.05)		(0.04)		(0.14)
LTW ratio	-0.25***	-0.11*	-0.23***	-0.06	-0.15***	-0.09*	-0.59***	0.09
	(0.04)	(0.05)	(0.03)	(0.04)	(0.03)	(0.04)	(0.08)	(0.12)
Observations	1138	1138	2308	2308	2621	2621	773	773
pseudo R-sq	0.14	0.16	0.28	0.30	0.13	0.14	0.58	0.69

[a] **Note:** The dependent variable is the loan source which equals 1 if the source is informal, and 0 otherwise (see the text for the categorization in different samples). All regressions control for location and intended loan usage, household demographics, and the co-variates specified in the baseline regressions (3) and (4) in Table 3. The standard errors reported in parentheses are clustered at the household level. Superscripts ***, ** and * indicate significance at 0.1%,1% and 5%, respectively.

and formal credit. Table 5 reports the corresponding estimates. For brevity we only report the main coefficients of interest, namely those on the loan size and the LTW ratio.

Columns (1) and (1') 5 replicate the estimates from the baseline regressions in Table 3, columns (3) and (4). In columns (2) and (2'), we widen our baseline definition of formal loans by also classifying as *formal* all loans from agricultural organizations (BAAC and agricultural cooperatives) or village-level institutions. This is the broadest definition of formal credit we consider. In columns (3) and (3'), we instead classify all these loans as *informal* which broadens our definition of informal credit relative to that used in Table 3.

The results in Table 5 show that the definition of formal vs. informal loans does matter for the coefficients' magnitude but not for their signs which remain consistent with the model implications. However, when using the broader definition of formal loans, the estimated coefficient on the LTW ratio when controlling for loan size is reduced in magnitude by a half and becomes statistically insignificant. When we instead broaden the definition of informal credit to include loans from the BAAC, agricultural cooperatives and village funds, in contrast, the measured effect of loan size becomes markedly smaller. Our theory provides an explanation for why the estimated effects of loan size on loan informality are smaller if village-level and agricultural institutions are classified as informal rather than formal and vice versa for the effect of the LTW ratio (compare columns (2)–(2') and (3)–(3')). First, those institutions presumably have more loanable funds than neighbours and relatives. In the terminology of the model the upper bound on the lender's resources $\bar{\theta}$ should thus be binding less often once those organizations are included among the informal loan sources. Second, since about half of the BCAA and agricultural cooperative loans still involve some kind of social collateral, we would expect the measured effect of the LTW ratio (increased risk of default) on the *relative desirability* of informal loans to be smaller.

Finally, columns (4) and (4') in Table 5 report results obtained when we define formal credit very

narrowly – as only consisting of loans given by commercial banks. This markedly reduces the fraction of formal loans in the sample, with the total number of observations on formal loans dropping to just over 100. The coefficient estimate on loan size increases significantly in absolute value compared to the baseline, while the estimated coefficient on the LTW ratio loses its statistical significance, possibly due to the significantly reduced sample size.

5.3.3 Loan size endogeneity

As a final robustness exercise we tackle the issue of potential loan size endogeneity. If informal lenders have limited funds, as we hypothesize, and if the credit needs of a household exceed this limit, then an alternative to taking a more expensive formal loan would be to split the needed amount into several smaller loans from multiple informal sources (e.g., relatives or friends). If this were a widespread practice, the causal link from loan size to the choice of credit source implied by the model would be reversed: rather than choosing to rely less often on informal sources for larger (riskier) loans, households would endogenously choose smaller loans once they have decided not to use (or are unable to use) the formal credit market. This possibility does not invalidate our theory *a priori* – allowing households to split up large loans in the model would not alter our conclusions qualitatively, except for increasing the range for which informal credit is feasible (the upper limit $\bar{\theta}$). For the empirical analysis, however, the assumed exogeneity of loan size is important, since otherwise the estimated coefficients on both explanatory variables of interest, loan size and the LTW ratio could be biased.

Fortunately, the Thai household survey contains a question which allows us to tackle the loan size endogeneity concern by using an exogenous proxy for loan size. Specifically, households were asked to imagine a hypothetical situation in which they need funds for an emergency and how they would get the needed amount. The possible answers included "selling assets" (land, equipment, livestock, car, etc.); "using savings"; or "taking out a loan", in which case the source had to be specified. The same questions were posed for two different hypothetical amounts, 2,000 Baht and 20,000 Baht. Neither amount is particularly high (both are below the median loan size in our sample) but, since everyone was confronted with the same numbers, these hypothetical loan amounts are clearly exogenous to any observed and unobserved household characteristics. If we reasonably assume that households answered the hypothetical question in a way that would correspond to their actual behaviour had they actually faced the same situation, we can use an indicator variable for the two hypothetical loan sizes as a regressor and the corresponding answer about the chosen loan source as the outcome variable. The results are reported in Table 6. For brevity we only report the estimates for the main explanatory variables of interest. The fixed effects specification in column (1) uses only $Lsize$ as the regressor since the other variables are at the household level. All other regressions include the full set of covariates from Table 3.

Table 6 shows that our baseline results continue to hold: in the model with household fixed effects, column (1), an exogenous increase in the hypothetical loan size has a statistically significantly negative

Table 6: Exogenous Loan Size Regressions

dependent variable	hypothetical loan source (informal =1)				
estimation method	fixed effects	random effects GLS		random effects logit	
	(1)	(2)	(3)	(4)	(5)
loan size	-0.01***		-0.01**		-0.05**
	(0.00)		(0.00)		(0.02)
LTW ratio		-0.05***	-0.02*	-0.49***	-0.22*
		(0.01)	(0.01)	(0.07)	(0.11)
Observations	2830	1,791	1,791	1,791	1,791
number of HHs	1,987	1,256	1,256	1,256	1,256

[a] **Note:** In specification (1), 1793 households were dropped because their answers did not vary with the size of the loan. The random effects regressions include fixed effects that account for location (tambon) and intended loan usage, and control for household characteristics. With the exception of age, all continuous variables are in log form. Superscripts ***, ** and * indicate significance at 0.1%,1% and 5%, respectively.

effect on the reported choice of informal credit, as we saw in the baseline results. Similarly, in the random effects models (columns (2)–(5)), the probability that a household reports relatives or neighbours as their preferred loan source decreases in the LTW ratio, with and without controlling for loan size.

6 Conclusions

We model borrowers' choice between formal (collateral based) and informal (social relationship based) credit in a setting with asymmetric information, risk, and strategic default. Our model delivers testable predictions which we show are consistent with data from rural Thai households. First, informal lenders charge lower interest rate and require less physical collateral than formal lenders. Second, the likelihood of observing informal loans decreases with the loan size to borrower's wealth ratio (the LTW ratio) which in our model measures risk of default, with and without controlling for loan size.

We study informal loans between agents who are in a relationship characterized by a sufficiently large and indivisible utility value that is lost to both parties in case of default. The presence of this 'social capital' is key in supporting repayment and for the absence of strategic default at zero collateral and interest rate in informal loans. Our assumption that the value of the social collateral is large makes our model better suited to more traditional settings, such as rural or immigrant-group environments, where the value of maintaining interpersonal links is high. This is also consistent with the observed prevalence of informal credit in such settings, as reviewed in the introduction.

Relaxing the indivisibility in the lost social capital upon default or relaxing the reciprocity of the loss would make informal contracts look more like formal. Allowing forgiveness by the lender in case of involuntary default does not change our results though. Unlike informal loans, formal loans can only

be supported by posting a strictly positive amount of (divisible) asset-based collateral which does not eliminate the possibility of strategic default and results in positive interest rates.

In the model, agents chose either an informal or formal loan, depending on the desired loan size and their wealth. Nothing in the analysis, however, prevents agents from having two projects requiring different loan size and hence borrowing from both an informal and formal source, backing the informal loan with the social collateral and the formal with their wealth. The analysis would change, however, if formal lenders could observe repayment on the informal loan as a signal of project success and ability to repay.

In addition to the optimal choice between formal and informal credit for a project of given size by a borrower of given wealth, our model has indirect implications for the types of investments that are likely to be financed via formal or informal loans. Importantly, if formal credit is unavailable, the utility loss from default may have negative consequences for the kinds of projects that are financed via informal loans – although we do not model the borrowers' project choice explicitly, it is possible to extend the analysis and show that projects based on informal credit involve less risk taking than in the absence of credit constraints. As a result, households or regions primarily relying on informal credit may experience slower or limited business growth.

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7 Appendix

Proof of Lemma 2:

Define the function $\pi(x) : \mathbb{R}_+ \to [0,1]$ as

$$\pi(x) \equiv \begin{cases} 0 \text{ if } x \leq \alpha_{\min} \\ G(x) \text{ if } x \in (\alpha_{\min}, 1] \\ 1 \text{ if } x > 1 \end{cases} \tag{4}$$

and note that $\int_0^\infty d\pi(\alpha) = 1$. The value $\pi(\frac{r_i}{w})$ equals the probability of involuntary default conditional on the realization of α and project failure, Prob$(r_i > \alpha w)$, that is, the probability that a borrower with wealth w is unable to repay r_i.

As discussed in the main text, an informal loan borrower always repays r_I unless $y(\theta) = 0$ *and* $r_I > \alpha w$ (involuntary default). This implies that r_I is repaid with probability $1 - (1-p)\pi(\frac{r_I}{w})$. In case of involuntary default the borrower and lender lose the social value γ (with probability $(1-p)\pi(\frac{r_I}{w})$) and the borrower transfers $\min\{c_I, \alpha w\}$ to the lender. Calling $\eta(r_I, c_I)$ the ex-ante expected cost to the borrower associated with the collateral requirement,

$$\eta(r_I, c_I) \equiv (1-p) \int_0^{r_I/w} \min\{c_I, \alpha w\} d\pi(\alpha), \tag{5}$$

we can write the $t = 0$ informal loan contracting problem for a borrower with project size $\theta \in (0, \bar{\theta}]$,

initial wealth $w > 0$, and social capital $\gamma > 0$ as

$$\max_{r_I,\, c_I} U_B^I = pR\theta - [1-(1-p)\pi(\tfrac{r_I}{w})]r_I - (1-p)\pi(\tfrac{r_I}{w})\gamma - \eta(r_I, c_I) \qquad (\text{OBJ}_B)$$

$$\text{s.t. } U_L^I = [1-(1-p)\pi(\tfrac{r_I}{w})]r_I - (1-p)\pi(\tfrac{r_I}{w})\gamma + \eta(r_I, c_I) \geq \theta - \kappa\gamma \qquad (\text{PC}_L)$$

$$U_B^I \geq 0 \qquad (\text{PC}_B)$$

$$r_I \leq \gamma + \min\{c_I, w\} \qquad (\text{IC}_I)$$

$$r_I \geq \theta \text{ and } c_I \geq 0. \qquad (\text{NN})$$

We first show that, given assumptions A1, A2 and given (NN), (PC_L) is always satisfied for κ sufficiently close to or equal to 1. Call $\pi \equiv \pi(r_I/w)$ and $\eta \equiv \eta(r_I, c_I)$. Then ($\text{PC}_L$) is:

$$[1-\pi(1-p)]r_I + \eta - \theta \geq \gamma[(1-p)\pi - \kappa] \qquad (6)$$

By (NN), $r_I \geq \theta$ and $\eta \geq 0$ and so the l.h.s. of (6) is larger or equal to $\theta[1-\pi(1-p)-1] = -\pi(1-p)\theta$. The latter is larger or equal to $\gamma[(1-p)\pi - \kappa]$ for any $\theta \in (0, \bar{\theta}]$ as long as $\kappa\gamma \geq \pi(1-p)(\gamma + \bar{\theta})$ which is satisfied for κ close to 1 since $\pi \leq 1$ and since $p > 1/2$ and $\gamma \geq \bar{\theta}$ by A1–A2.

From the objective function, observe that it is optimal to set r_I and c_I as low as possible given (NN), that is $r_I = \theta$ and $c_I = 0$, as long as all constraints are satisfied.[34] We already proved that (PC_L) holds for any r_I and c_I satisfying (NN) and κ sufficiently close to 1. In addition, Assumptions A1 and A2 imply $\gamma \geq \overline{\theta}$, that is, ($\text{IC}_I$) is also satisfied. Therefore, whenever informal loans are beneficial to the borrower, that is (PC_B) holds, they would feature zero interest and collateral.□

Proof of Proposition 1:

At $r_I^* = \theta$ and $c_I^* = 0$, (PC_B) can be written as,

$$(pR-1)\frac{\theta}{w} + (1-p)\pi(\frac{\theta}{w})(\frac{\theta}{w} - \frac{\gamma}{w}) \geq 0. \qquad (7)$$

There are three possible cases depending on the value of the LTW ratio, $\frac{\theta}{w}$.

1. Case I1 (low LTW ratio): $\frac{\theta}{w} \leq \alpha_{\min}$. Then $\pi(r_I/w) = \pi(\theta/w) = 0$ and hence (7) is satisfied for any such (θ, w) since $pR > 1$ by Assumption A1. No default occurs for such loans and the social value is never lost.

2. Case I2 (high LTW ratio): $\frac{\theta}{w} \geq 1$. Then $\pi(r_I/w) = \pi(\theta/w) = 1$ and hence (7) is violated for any such (θ, w) since $\gamma > \frac{p(R-1)\bar{\theta}}{1-p}$ by Assumption A2. Thus, no informal loans are taken for these (θ, w).

3. Case I3 (intermediate LTW ratio): $\alpha_{\min} < \frac{\theta}{w} < 1$. From cases I1 and I2 we know that, for given (θ, w), the borrower's participation constraint (PC_B) is satisfied when $\frac{\theta}{w}$ is sufficiently small and violated when

[34] It is obvious that the objective is strictly decreasing in c_I. To see that it is also strictly decreasing in r_I at $c_I = 0$, denote $M \equiv (1-(1-p)\pi(\frac{r_I}{w}))r_I + (1-p)\pi(\frac{r_I}{w})\gamma$. We have $\frac{\partial M}{\partial r_I} = 1-(1-p)\pi(\frac{r_I}{w}) + (1-p)\frac{1}{w}\pi'(\frac{r_I}{w})(\gamma - r_I) \geq 0$ since $\gamma \geq r_I$ from (IC_I).

$\frac{\theta}{w}$ is sufficiently large. Call $\hat{\alpha}_I \in (\alpha_{\min}, 1)$ the value of $\frac{\theta}{w}$ at which (7) holds with equality.[35] Informal loans thus satisfy (PC_B) for LTW ratios $\alpha_{\min} < \frac{\theta}{w} \leq \hat{\alpha}_I$. Note that the borrower may be unable to repay the required amount $r_I = \theta$ depending on the realization of α. Thus, such loans are risky and social capital is lost with positive probability.

Lemma A1: *A sufficient condition for uniqueness of the threshold $\hat{\alpha}_I$ in Proposition 1 is $G'' \leq 0$.*

Proof of Lemma A1: In case I3 where $\hat{\alpha}_I$ is relevant we have $\pi(\frac{\theta}{w}) = G(\frac{\theta}{w})$. Thus, the first derivative of the l.h.s. of (7) (multiplied by w) with respect to θ is,

$$pR - 1 + (1-p)G(\frac{\theta}{w}) + (1-p)G'(\frac{\theta}{w})\frac{1}{w}(\theta - \gamma)$$

which cannot be signed in general. The second derivative has the same sign as

$$2G' + G''\frac{1}{w}(\theta - \gamma)$$

If $G'' \leq 0$ (the cdf G is weakly concave, e.g. this is satisfied by G uniform), the above expression is positive since $\gamma > \theta$ for all $\theta \in [0, \bar{\theta}]$ by Assumption A1–A2. That is, the l.h.s. of (7), call it $\Phi(\theta)$, is a strictly convex function of θ over the entire interval $(\alpha_{\min} w, w)$. This implies that $\Phi(\theta)$ can cross the horizontal axis exactly once in this interval since it is continuous and since $\Phi(\alpha_{\min} w) > 0$ and $\Phi(w) < 0$. Hence, if $G'' \leq 0$, the threshold $\hat{\alpha}_I$ defined as the value $\theta/w \in (\alpha_{\min}, 1)$ such that $\Phi(\theta) = 0$, is unique.■

Proof of Lemma 3: Using the definition of $\hat{\alpha}_I$ and $\pi(.) = G(.)$ we have from (7),

$$(pR-1)\hat{\alpha}_I + (1-p)G(\hat{\alpha}_I)(\hat{\alpha}_I - \frac{\gamma}{w}) = 0 \tag{8}$$

By Assumption A1, $pR > 1$ and so for the above equality to hold it must be that $\hat{\alpha}_I < \frac{\gamma}{w}$, so we can write (8) as,

$$G(\hat{\alpha}_I) = \frac{(pR-1)\hat{\alpha}_I}{(1-p)(\frac{\gamma}{w} - \hat{\alpha}_I)} \tag{9}$$

The left and right hand sides of (9) can be viewed as functions of α on the interval $[\alpha_{\min}, 1]$ with equality holding when evaluated at $\alpha = \hat{\alpha}_I$. Both sides are strictly increasing in α. The l.h.s. equals 0 at $\alpha = \alpha_{\min}$ and 1 at $\alpha = 1$. The r.h.s. is positive at $\alpha = \alpha_{\min}$ and < 1 at $\alpha = 1$.[36] Hence, assuming $\hat{\alpha}_I$ is unique (see Lemma A1 above for sufficient condition), the r.h.s. of (9) as function of α crosses the l.h.s. from above at $\hat{\alpha}_I$. We thus obtain: (i) An increase in the social capital γ shifts the r.h.s. of (9) down, thus $\hat{\alpha}_I$ decreases in γ, ceteris paribus and (ii) An increase in the borrower's assets w, the project's return R, or the project's probability of success p shifts the r.h.s. of (9) up hence $\hat{\alpha}_I$ increases, ceteris paribus.□

[35] By continuity, this value always exists since at $\frac{\theta}{w} = \alpha_{\min}$ (Case I1) the l.h.s. of (7) is strictly positive, while at $\frac{\theta}{w} = 1$ (Case I2) it is negative and since the l.h.s. is a continuous function. See Lemma A1 for a sufficient condition for the uniqueness of $\hat{\alpha}_I$.

[36] The latter follows noting that at $\alpha = 1$ we have $w = \theta$ and using Assumption A2.

Proof of Lemma 4:

Given the discussion in the main text, the contracting problem between a formal lender and a (θ, w) type borrower can be written as:

$$\max_{r_F,\, c_F} \; U_B^F = pR\theta - \int_0^\infty \min\{\alpha w, r_F\} d\pi(\alpha) - \lambda\theta \tag{OBJ$_B$}$$

$$\text{s.t.} \;\; U_L^F = \int_0^\infty \min\{\alpha w, r_F\} d\pi(\alpha) \geq \theta \tag{PC$_L$}$$

$$U_B^F \geq 0 \tag{PC$_B$}$$

$$r_F \leq \min\{c_F, w\} \tag{IC$_F$}$$

$$r_F \geq \theta \text{ and } c_F \geq 0 \tag{NN}$$

Constraints (IC) and (NN) imply that formal loans always require positive collateral since $c_F \geq r_F \geq \theta > 0$. Evaluating the expected payoff of the lender U_L^F at zero interest ($r_F = \theta$), we obtain

$$\int_0^\infty \min\{\theta, \alpha w\} d\pi(\alpha) \leq \theta,$$

with equality only if $\theta \leq \alpha w$ for *all* $\alpha \in [\alpha_{\min}, 1]$, that is when $\frac{\theta}{w} \leq \alpha_{\min}$, and with strict inequality otherwise (if $\theta > \alpha w$ for some α). Since U_L^F is increasing in r_F, this implies that if $\frac{\theta}{w} > \alpha_{\min}$ a strictly positive interest, $r_F^* > \theta$, is needed for the lender to break even.□

Proof of Proposition 2

The optimal r_F^* is found by setting the lender's participation constraint (PC$_L$) to equality:

$$\int_0^\infty \min\{\alpha w, r_F\} d\pi(\alpha) = \theta \tag{10}$$

Consider the three possible cases depending on the value of the LTW ratio, $\frac{\theta}{w}$.

1. Case F1 (low LTW ratio): $\frac{\theta}{w} \leq \alpha_{\min}$. In this case $r_F^* = \theta$ solves (10) since $r_F^* \leq \alpha w$ for all α. The borrower always has sufficient funds and incentive to repay the loan and hence there is no risk for the lender and default in equilibrium.

2. Case F2 (high LTW ratio): $\frac{\theta}{w} > E(\alpha)$. We have,

$$\theta > wE(\alpha) \geq \int_0^\infty \min\{r_F^*, \alpha w\} d\pi(\alpha) = \theta$$

The second inequality holds since $\alpha w \geq \min\{r_F^*, \alpha w\}$ for all α and hence $wE(\alpha) = \int_0^\infty \alpha w d\pi(\alpha) \geq$

$\int_0^\infty \min\{r_F^*, \alpha w\} d\pi(\alpha)$ with equality only if $r_F^* \geq \alpha w$ for all α. Thus, for $\frac{\theta}{w} > E(\alpha)$ the lender's break-even constraint (PC_L) cannot be satisfied – no feasible r_F exists due to the possibility of strategic default.

3. Case F3 (intermediate LTW ratio): $\alpha_{\min} < \frac{\theta}{w} \leq E(\alpha)$.

It is easy to see that, for $\frac{\theta}{w} > \alpha_{\min}$, evaluating the l.h.s. of (10) at $r_F = \theta$ yields an amount strictly less than the r.h.s. θ. On the other hand, substituting $r_F = w$ in the l.h.s. of (10) yields $wE(\alpha)$ which is strictly larger than the r.h.s. θ for any $\frac{\theta}{w} < E(\alpha)$. This implies that, by continuity, for any $\frac{\theta}{w} \in (\alpha_{\min}, E(\alpha))$, there exists an $r_F^* \in (\theta, w)$ which solves (10) and which is strictly increasing in the loan size θ. From case F2, it is also immediate to verify that $r_F^* = w$ solves (10) for $\frac{\theta}{w} = E(\alpha)$.

The above results imply that the maximum LTW ratio value $\hat{\alpha}_F$, such that formal loans are feasible for $\frac{\theta}{w} \in (\frac{\alpha_{\min}}{\phi}, \hat{\alpha}_F]$ and not otherwise, equals $E(\alpha)$.■

Proof of Proposition 3:

(a) Since $\alpha_{\min} < \hat{\alpha}_F = E(\alpha)$, formal loans are feasible over the entire interval $\frac{\theta}{w} \in (0, \alpha_{\min}]$. If $\theta \leq \alpha_{\min} w$, Propositions 1 and 2 imply $r_F^* = r_I = \theta$ and $\pi(\frac{\theta}{w}) = 0$ since the risk of non-repayment is zero for both formal and informal lenders. The borrower's expected payoff from taking an informal loan loan is $U_B^I = (pR-1)\theta$ while her expected payoff from taking a formal loan is $U_B^F = (pR-1-\lambda)\theta$ which is strictly smaller – informal loans are strictly preferred because they avoid the cost λ.

(b) By Proposition 2 and its proof, for $\frac{\theta}{w} \in (\alpha_{\min}, \min\{\hat{\alpha}_I, \hat{\alpha}_F\}]$, the repayment r_F^* solves (10) and is strictly larger than θ while we have $r_I^* = \theta$ from Proposition 1. For such $\frac{\theta}{w}$ we have $\pi(\frac{r_I^*}{w}) = G(\frac{\theta}{w}) \in (0,1)$ and $\gamma > \theta$ by A2. The borrower's expected payoff from using informal credit is

$$U_B^I = (pR-1)\theta - (1-p)G(\frac{\theta}{w})(\gamma - \theta)$$

which she would compare to the expected payoff from using formal credit, $U_B^F = (pR-1-\lambda)\theta$. The optimal loan source choice in this case depends on the parameter values. Recall from the discussion above that: (i) $U_B^I > U_B^F$ at $\theta/w = \alpha_{\min}$, (ii) $U_B^I < 0$ at $\theta/w > \hat{\alpha}_I$, and (iii) $U_B^F > 0$ for any θ/w. Thus, informal loans are preferred for relatively small θ/w ratios while formal loans are chosen for larger θ/w ratios in the interval $(\alpha_{\min}, \min\{\hat{\alpha}_I, \hat{\alpha}_F\}]$.

(c) and (d) The results follow directly from the discussion above.

To prove the last statement, note that we showed above that $U_B^I \leq (pR-1)\theta$ with strict inequality if $\frac{\theta}{w} > \alpha_{\min}$ and $U_B^F = (pR-1-\lambda)\theta$. The result then follows directly by taking the limit as $\lambda \to 0$.■

Appendix B. No utility cost of refusing a loan ($\kappa = 0$)

Consider the case in which an informal lender's reservation utility is $\bar{u}_L = \theta$ – the same as that of a formal lender, that is he suffers no disutility from refusing to make a loan when asked. It is then clear from the proof of Lemma 2, that if $\pi(\frac{r_I}{w}) > 0$ (positive default probability), that the lender can no longer break even at $r_I = \theta$ – a positive interest must be charged. Hence, for $\frac{\theta}{w} > \alpha_{\min}$, the optimal informal loan terms (r_I^*, c_I^*) must satisfy the lender's break-even constraint,

$$[1-(1-p)\pi(\tfrac{r_I}{w})]r_I - (1-p)\pi(\tfrac{r_I}{w})\gamma + (1-p)\int_0^{r_I/w} \min\{c_I, \alpha w\} d\pi(\alpha) = \theta$$

Substituting into U_B^I, the borrower's expected payoff is:

$$(pR-1)\theta - 2\gamma(1-p)\pi(\frac{r_I}{w})$$

which is decreasing in r_I (strictly if $\pi(\frac{r_I}{w}) \in (0,1)$). Thus, to keep the interest rate as low as possible, it is optimal to choose r_I^* and $c_I^* \geq r_I^*$ where r_I^* solves:

$$[1-(1-p)\pi(\frac{r_I}{w})]r^I - (1-p)\pi(\frac{r_I}{w})\gamma + (1-p)\int_0^{r_I/w} \alpha w d\pi(\alpha) = \theta$$

This ensures that a defaulting borrower would always hand αw to the lender and the interest r_I would cover the rest of the lender's opportunity cost θ. Evaluating the l.h.s. at $r_I = \theta$ for $\frac{\theta}{w} > \alpha_{\min}$, the third term is smaller than $(1-p)\pi(\frac{\theta}{w})\theta$ since $\alpha w \leq \theta$ under the integral with strict inequality for $\alpha \in (\alpha_{\min}, \frac{\theta}{w}]$. This implies that he left hand side is smaller than θ. Informal loans thus would charge strictly positive interest and collateral for $\frac{\theta}{w} > \alpha_{\min}$.

Notice that it is unclear apriori how the resulting interest rate r_I^* compares to r_F^* in Proposition 2 since there are two opposing effects. On the one hand, given A2, informal loans are repaid in full more often as there is no strategic default. On the other hand, the lender needs to be compensated for the utility loss γ in case of default. If we set $\gamma = 0$ in the l.h.s. of (PC_L) (the 'forgiveness' scenario discussed in Section 3), then it is easy to see that the optimal informal credit interest rate r_I^* is strictly lower than the formal credit rate r_F^* for the same (θ, w) since only the former effect operates.

Table 7: Summary Statistics

Variable	Obs.	Median	Mean	St. Dev	Min	Max	Units
yearly household income	1,441	60.50	158.84	579.24	0.00	15,710.00	1,000 baht
wealth (assets)	1,444	488.55	1,027.78	1,810.86	9.00	21,166.30	1,000 baht
loan-to-wealth ratio (LTW)	1,444	0.04	0.08	0.16	0.00	3.54	
number of outstanding loans	1303	1	1.54	0.94	0.00	6	indicator variable
value of outstanding loans	1451	30	72.07	179.21	0.27	3,220	1,000 baht
age	1426	47	48.95	12.72	19	101	years
education	1426	3	3.44	1.81	1	11	categorical variable
gender (1=female)	1426	0	0.15	0.35	0	1	indicator variable
marital status (1=married)	1441	1	0.48	0.37	0	1	
collateral (1=yes)	1,449	1.00	0.63	0.48	0.00	1.00	indicator variable
interest	1,274	0.10	0.28	1.76	0.00	48.32	percent/100
tenure (1 = yes)	1,437	1.00	0.95	0.22	0.00	1.00	indicator variable
bank access (1=yes)	1,450	0.00	0.27	0.44	0.00	1.00	indicator variable

[a] **Note:** Observational units are households. Any personal demographics refer to the household head. A household's wealth was computed by adding up the (self-reported) value of all assets of the household as given in the data, including house and land holdings, durable assets (TV, car, etc.), agricultural assets (tractor, seeds), fishing assets (boat), animals, and business assets.

Table 8: Additional Probit Regressions for Loan Source

dependent variable	loan source (informal=1)			
independent variable	(1)	(2)	(3)	(4)
loan size	-0.29***	-0.32***	-0.31***	-0.33***
	(0.03)	(0.04)	(0.04)	(0.04)
wealth		0.10*		0.11*
		(0.04)		(0.05)
tenure			-0.33	-0.38
			(0.22)	(0.22)
bank access			-0.16	-0.21
			(0.11)	(0.11)
BAAC member			0.02	-0.02
			(0.10)	(0.10)
income			0.12*	0.09
			(0.05)	(0.05)
Observations	1143	1139	1142	1138
pseudo R^2	0.15	0.15	0.15	0.16

[a] **Note:** The regressions include fixed effects that account for location (tambon) and intended loan usage. We also control for the following household characteristics: age, gender, marital status, education of the household head, and the total number of outstanding loans. With the exception of age, all continuous variables are in log form. The standard errors reported in parentheses are clustered at the household level. Superscripts ***, ** and * indicate significance at 0.1%,1% and 5%, respectively.