Interest-Free Loans between Villagers

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I. Introduction

Credit in less developed countries is extended through both formal and informal channels. Banks, credit cooperatives, and government agencies supply formal credit. These loans are typically court enforced, almost exclusively for investment purposes, and carry a positive rate of interest for a fixed repayment period. Informal credit is a remarkably diverse category and includes loans from relatives, friends, community members, moneylenders, rotating savings and credit associations, and informal intermediaries, as well as tied credit and pawning. Although informal credit may be court enforced, it is more likely to be self-enforcing, especially in more remote areas. These loans can be at either positive or zero rates of interest, can be used for consumption or investment purposes, and often carry flexible repayment periods and terms.

This paper has three purposes: first, to describe a cross-sectional sample of informal loan contracts among households in different low-income rural villages, emphasizing the similarities and differences among positive–interest rate (PIR) and zero–interest rate (ZIR) loans; second, to provide an explanation for the choices borrowing households make between informal PIR and ZIR loans, an explanation that highlights the simple costs and benefits of these alternative arrangements; and third, to provide empirical support for our model's key predictions. As far as we know, this is the first paper to consider the PIR-ZIR choice explicitly.

In a related but largely descriptive literature (see, e.g., Dreze, Lanjouw, and Sharma 1998), the explanation for household choice between positive- and zero-interest informal sector loans is predicated on a segmented view of rural credit. Households borrow informally at zero interest from family and friends to finance consumption, perhaps in the context of reciprocal insurance arrangements or possibly out of altruism, and borrow at positive interest from

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moneylenders for investment purposes. Implicit here is the assumption that households do not borrow from each other at positive rates of interest. In numerous settings, however, including the one we examine in this paper—rural China in the 1930s—households borrow informally from each other at both positive and zero interest and do so to finance both consumption and investment.

Theoretical work on informal borrowing has not addressed the question of choice. Much of the current literature looks at this credit in the context of households' efforts to smooth their consumption through reciprocal insurance arrangements. Building on the earlier work of Kimball (1988) and Coate and Ravallion (1993), Ligon, Thomas, and Worrall (2002) construct repeated game models of mutual informal consumption insurance (see also Udry 1994; Kocherlakota 1996; Fafchamps 1999). In these models, the choice of loan contract terms, including both the rate of interest and repayment period, is not considered explicitly. In fact, for given current and past values of income, Fafchamps argues that the rate of interest is indeterminate on interhousehold loans that deliver the prescribed pattern of consumption; accordingly, households are indifferent concerning loan details. Our data, however, suggest otherwise.

One of the interesting implications of the model we develop is that many (but not all) observed features of households' zero-positive choice can be understood without appealing to enforcement problems. When court enforcement is absent, contracts are designed to ensure that each party has an incentive to fulfill its obligations. For any pair of contracting households, the enforcement constraints that their ZIR and PIR loan agreements must satisfy are basically the same.[1] As a result, enforcement problems are secondary when lenders and borrowers choose between these two types of informal loans. We therefore abstract from enforcement problems throughout most of the paper to model the zero-positive choice as one that involves a straightforward comparison of loan sizes and costs.

The benefit of a loan of given size for a borrower is the same whether the loan entails explicit interest or not. The key difference lies on the cost side. With a PIR loan, the borrower is required to pay principal and interest. With a ZIR loan, the borrower repays the principal but then has to provide an additional benefit to the lender in the future. This additional benefit is critical; without it, the lender will always prefer a PIR loan. We are entirely agnostic

[1] In either case, the agreement is structured so that for each party promising to undertake some time- or event-contingent action, the discounted sum of future benefits of continuing the relationship exceeds the current cost of compliance.

concerning the exact form that this future benefit takes. A ZIR loan could require that the borrower supply, on request, land, labor, or draft animal services or even a loan to the former lender; the exchange may be a one-time transaction or the beginning of a long-term reciprocal relationship with the lender. We refer to these generically as ZIR loan options.

The positive-zero loan choice in our model will depend on the parties' current borrowing needs and lending costs, their future trading needs and costs, the cost of verifying that the borrower is in a position to comply with the terms of a ZIR option, and the alternative future market opportunities of the current lender. Since an option will be less attractive in villages with more active or developed markets for the same goods or services covered by the option (as the lender can always "go to the market"), the model predicts that households will be less inclined to negotiate interest-free loans in villages with more developed markets. The model also predicts that interest-free loans will generally be smaller than PIR loans; that communities with more developed markets will have lower rates of interest; that in-kind loans are more likely to be ZIR loans; and that moneylenders will exclusively use PIR loans. Empirical confirmation is provided for each of these predictions.

In this paper, we hypothesize that ZIR loan agreements entail some future obligation on the part of the borrower to the lender, over and beyond the repayment of the loan principal. We model this option to encompass a broad range of possible contingent transfers. At the outset, it is important to acknowledge that the subset of ZIR loan agreements in our data do not explicitly prescribe future obligations for the borrower. Thus, some of the evidence we offer must be indirect. Of course, our situation in this respect is not unique; other theoretical and empirical analyses of informal credit hinge on credible promises concerning future actions or payments without providing direct evidence for such promises. Setting aside the possibility of entirely altruistic lenders (for which we also have no direct evidence, and which is inconsistent with our empirical findings), rationality and opportunity costs tell us that some future obligation on the part of the borrower must be part of a lender's cost-benefit calculus.

II. Informal Credit

The data we analyze were the product of an intensive household-level survey that was carried out in 1936 by the Japanese installed government of what is now northeast China (Guowuyuan shiyebu linshi chanye diaochaju 1936). Every household in 22 geographically and economically separate villages drawn from the current-day provinces of Liaoning, Jilin, and Heilongjiang was enumerated; village populations ranged from 24 to 91 households. Altogether,

TABLE 1
SELECTED HOUSEHOLD CHARACTERISTICS, 1935

	Mean	% > 0
Farm output	201.6	82.7
Agricultural sidelines	9.9	34.7
Agricultural wage income	14.5	43.6
Farm rental income	23.4	14.8
Other agricultural income	1.2	4.8
Agricultural revenue	250.7	95.3
Family business income	23.0	22.2
Nonagricultural wage income	17.3	26.2
Other nonagricultural income	3.7	14.5
Nonagricultural revenue	44.0	51.8
Subtotal: total revenue	294.7	99.5
Subtotal: total expenses	66.4	77.1
Net income (revenue − expenses)	228.2	98.6
Household size	6.3	
Per capita net income	33.8	
Land cultivated (mu)	45.6	79.7
Land owned (mu)	45.0	60.6
Land rented in (mu)	16.5	39.0

Source. Benjamin and Brandt (1997, 467).
Note. Monetary values are reported in yuan. A mu is equal to one-sixth of an acre.

1,095 households were investigated. The survey covers the period from January through December of 1935 and includes data on family demographics, farm output, input use, physical and financial assets, incomes, and expenditures. Agriculture, broadly defined to include the value of crop output, animal husbandry, farm wages, and land rental, was the source of more than 85% of gross revenue in these villages, with 95% of households reporting positive income from agriculture. Table 1 provides summary data for these households.

The unique feature of the survey is the detailed information on all credit, labor, and land agreements involving villagers.[2] With regard to credit, we have information on all credit contracts taken out in 1935, as well as those that were outstanding as of the beginning of 1935. Enumerators carefully recorded original contract terms, payments of both principal and interest in 1935, as well as the amount that was due as of the end of 1935. This amount reflected past payments as well as interest arrears. Especially important for our purposes, the survey clearly identifies loans as being either zero-interest or interest-bearing; ZIR loans are not the product of either missing information or recording error. PIR loans are entirely conventional, requiring payment of principal plus interest. In contrast, interest-free loans did not explicitly impose future obligations on the borrower other than the repayment of the principal. The lowest interest rate among informal PIR loans in our sample is 18% per

[2] See Brandt and Hosios (1996) for an analysis of labor contracts in these villages.

year, implying sharp differences in the explicit interest costs between the two loan types.

A. Credit Contracts

Altogether, 383 (117) households in the 22 villages borrowed (lent) informally, that is, from other households, during 1935; 57 households were identified as both borrowers and lenders.[3] For 1935, we have 671 informal credit arrangements between households undertaken in 1935, including 368 loans at zero interest and 303 loans at positive interest. In each case, the lender, the borrower, or both resided in one of the 22 surveyed villages; if both, they resided in the same village. Together, they represent 86.7% of the 774 informal loans received during 1935 in the surveyed villages and 77.8% of the aggregate nominal value of all informal loans.[4] These two kinds of informal loans are the focus of this paper.

The remaining 103 informal loans include 61 pawns and 42 land mortgages. Pawns, which were obtained from shops located outside the surveyed village, typically in the county seat, were significantly smaller in size than other informal loans and represent only 1.7% of the total value of informal credit extended in 1935. Land mortgages, on the other hand, were considerably larger on average and made up 20.5% of the total value. Unlike conventional PIR loans and pawns, interest on mortgages was only implicit as "land-use rights" were ceded to the lender in lieu of interest payments.

We do not examine pawns or land mortgages in this paper for several reasons. First, these loans are not really loans, but are asset sales with buyback provisions. Second, given that our aim is to explain the choice between ZIR and PIR loans, these "loans" are not especially interesting for our purposes because they do not take an interest-free form. Finally, when enforcement is problematic for land mortgages and pawns, it is the lender's reputation for returning the asset after repayment that is important. In contrast, with conventional informal loans, it is the borrower's reputation for repayment that matters.

Table 2 provides summary information for both ZIR and PIR loans on the seasonality of the loans, relationship and residency of the parties, loan purpose,

[3] Including those households with outstanding loans as of the beginning of 1935, 585 (281) households out of a total of 1,095 in our sampled villages were involved in informal credit market transactions as borrowers (lenders).

[4] There were also 202 formal loans recorded in the survey in which the lender was either a local financial institution or an agent of the government. Over 95% of these loans were in only four villages, with a majority of them in-kind, subsidized grain relief loans. Three of the villages experienced a severe harvest shock in 1935.

TABLE 2
BREAKDOWN OF LOANS BY TYPE AND ATTRIBUTES, 1935

	Loan Type		
	Zero Interest	Positive Interest	*t*-Test
Number of loans	363	300	
Seasonality:			
January–March	32.5	38.7	1.66
April–June	20.7	21.3	.21
July–September	13.2	8.7	1.86
October–December	33.6	31.3	1.62
Enforcement:			
Written (%)	1.4	10.3	5.16
Third party (%)	2.8	12.7	4.99
Collateral (%)	1.4	4.3	2.33
Security (%)*	4.5	21.1	6.58
Relationship:			
Same clan (%)	5.6	2.0	2.32
Related (%)	47.1	49.3	.57
Same village (%)	16.3	11.7	1.68
Fixed duration (%)	25.3	51.3	7.14
In-kind loan (%)	33.9	7.7	8.53
Average size (yuan)†	6.28	11.37	4.65
Purpose (%):‡			
Consumption	62.0	58.7	.87
Investment	33.1	38.0	1.32
Other	5.0	3.3	1.30

* Loans that either are written, use a third party, or entail collateral.
† Loan size is expressed in "real" yuan by deflating nominal yuan by the local price of grain (the numeraire).
‡ A consumption loan includes loans for consumption purposes, emergencies, and ceremonies; investment includes fixed and current investment, as well as education expenses; and other includes loan repayment, taxes, rents, and other miscellaneous uses.

loan duration, the use of security provisions, loan form (i.e., cash or in-kind), and loan size. We also report *t*-tests for differences in these variables between the two loan types. Among households that are related, we distinguish between those that are related through kinship, that is, male lineage in the village, and through other family ties. For residency, we identify those contracts in which borrowers and lenders live in the same village. Security provisions are broadly defined to include the use of a written (as opposed to a verbal) contract, the presence of a third-party guarantor (usually a well-established individual in the community), or the use of collateral. For each loan, we also know if the terms included a well-defined repayment period, constituting a fixed-duration loan; if not, the loan is said to be open-ended. These are ex ante labels that are determined at the time the loan is negotiated, and so an open-ended loan cannot be attributed to missing data or ex post contract renego-

TABLE 3
OCCUPATIONAL DISTRIBUTION FOR BORROWERS AND LENDERS BY LOAN TYPE

	Zero-Interest Loans		Positive-Interest Loans		*t*-Tests†	
Occupation*	Lender	Borrower	Lender	Borrower	Lender	Borrower
Landlord	7.1	3.7	8.0	2.2	−.41	1.12
Farmer	56.3	69.1	56.5	64.1	−.03	1.40
Wage labor	10.2	12.9	9.3	7.7	.37	2.21
Commerce	14.9	.6	12.0	.3	1.07	.41
Professional	7.2	5.8	7.7	5.3	−.25	.25
Moneylender	0	0	1.0	.0	−1.91	NA
Unknown	4.1	.3	5.7	.0	−.92	.90

* Wage laborer primarily includes farm laborers but also some individuals hiring out in nonagricultural activity. Professional includes teachers, doctors, etc.
† The *t*-tests are for differences in the probability of ZIR and PIR loans by occupational type.

tiation.[5] Table 3 provides additional information on the occupations of the borrower and lender, along with the result of *t*-tests for differences between ZIR and PIR loans by occupational types.

In a number of key respects, ZIR and PIR loans appear very similar; we do not observe any obvious segmentation based on loan purpose, the residency or relationship between the parties, seasonality, or lender type. First, the uses to which these loans were put are nearly identical, with two-thirds of both kinds of loans being used for consumption purposes. Second, contracting with households that are relatives is as likely for PIR loans as it is for ZIR loans. ZIR loans are slightly more likely to be between villagers and households tied by kinship, but more generally, having a lender and borrower who are related or live in the same village is not synonymous with negotiating a ZIR loan. Third, the seasonality of the two loan types is very similar. In general, a majority of loans are taken out during the end or beginning of the year. The only small difference we observe is that PIR loans are slightly more likely during the period between January and March, and ZIR loans are more likely between July and September, or the period leading up to the fall harvest. Fourth, as reported in table 3, the distribution of occupational types among lenders and borrowers for the two types of loans is also similar. Most lenders were farmers or were working in agriculture as hired hands, as were almost all of the borrowers. Moneylenders were the source of only 1% of all loans. Landlords were more prominent but nearly as inclined to lend at zero interest than at positive interest (7.1% vs. 7.9%). They were more likely to borrow at positive interest, but the difference is not statistically insignificant. In

[5] The original Japanese surveys we use clearly identify and distinguish this loan category. Open-ended loans between households have been observed elsewhere (Platteau and Abraham 1987; Udry 1990; Platteau 1991; Townsend 1995).

contrast, wage laborers were significantly more likely to borrow at zero-interest rates.

ZIR and PIR loans are also alike in that the amount repaid on both types of loans does not appear to be state contingent.[6] Of those loans that are identified as being paid off during 1935, including some that were outstanding as of the beginning of 1935, all were repaid in full, including principal and accumulated interest (in the case of PIR loans). For the remaining unpaid loans, there is no record that any one of them was renegotiated; that is, there was no ex post adjustment in the amount owed presumably to reflect a change in a household's ability to repay. This is significant because the survey documents other cases of contract renegotiation; for example, it earmarks land rental agreements that were renegotiated following negative harvest shocks and details the new rental terms.

There are several notable differences between PIR and ZIR loans, however. First, PIR loans are much larger than ZIR loans. The average size of a PIR loan—expressed in terms of the local unit of grain—is nearly twice that of the average ZIR loan (11.37 vs. 6.28). To help put this in perspective, per capita income (also expressed in terms of grain) was 9.77. Second, the use of a security provision, especially a third-party guarantor or a written agreement, is also more common in the case of PIR loans; still, these provisions are limited to only a fifth of all contracts. Most contracts were verbal. Third, a ZIR loan was 50% more likely to be open-ended (74.7% vs. 48.7%). And fourth, a substantially larger fraction of interest-free loans are in-kind loans: 33.4% of interest-free loans are in-kind loans versus 7.6% for PIR loans.

We observe considerable heterogeneity in loan portfolios at both the household and village levels. Out of the 534 households that either had a loan outstanding as of the beginning of 1935 or borrowed in 1935, 288 or 53.9% had more than one loan; and out of these, 151 had both ZIR and PIR loans. In 1935, on the other hand, out of the 348 households borrowing informally (excluding pawns or land mortgages), 159 (132) borrowed exclusively at zero (positive) interest rates, and only 57 borrowed at both. At the village level, differences in loan type holdings are shown in figure 1, which graphs the percentage of informal loans in each village in 1935 that were at zero interest. The village average is around 50, with a considerable a number of villages (nine out of 22) having two-thirds or more of one type.

[6] Although the amount repaid on informal loans was not state contingent, the timing of the repayment was. We examine the issue of loan duration in a related paper (Brandt and Hosios 2008).

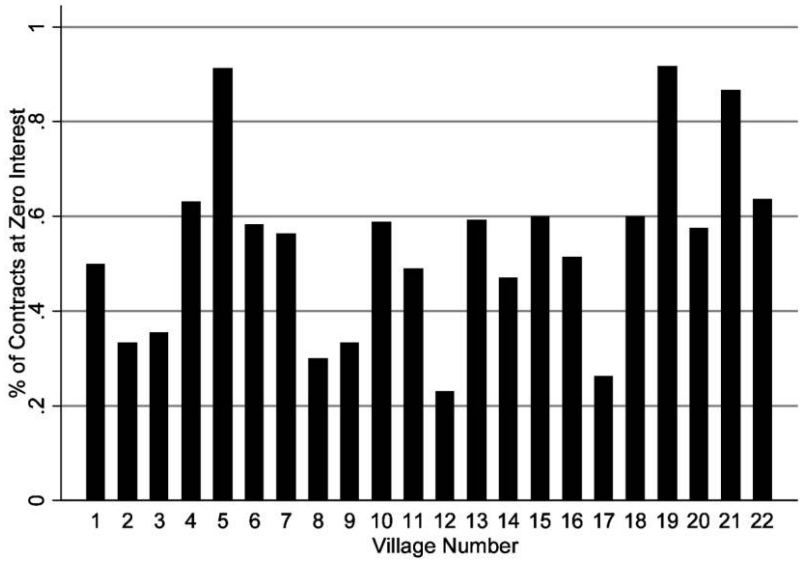

Figure 1. Percentage of zero-interest contracts by village

B. Village Market Development

Our analysis highlights the potential role of the level of market development in the local economy for the choice between PIR and ZIR loans. The 22 villages in our sample differ significantly in this regard, reflecting a host of factors, including when the village was first settled, transportation infrastructure, and proximity to urban centers. In our empirical analysis, we utilize several village-level variables to capture this heterogeneity, namely, the percentage of households in the village that were autarkic, the percentage of all farm output that was marketed, population density, and a dummy variable that equals one if the railroad ran through the county in which the village was located.

We define autarky in terms of a household's participation in local land rental and labor markets. A household is defined to be autarkic if it does not hire in (rent in) or hire out (rent out) labor (land). Slightly less than a sixth (15.9%) of the households in our sample were classified as autarkic. Nevertheless, among villages there is considerable heterogeneity, as the percentage of households in a village that were autarkic ranges from 0% to 57%.[7] Household participation in local product markets differed as well. On average, slightly less than a quarter (23.7%) of all farm output was sold; when villages are compared, however, the numbers range from 5.5% to 50.3%. Finally, two-

[7] To help put these numbers in perspective, almost a third of all land was rented and half of all households hired labor either in or out.

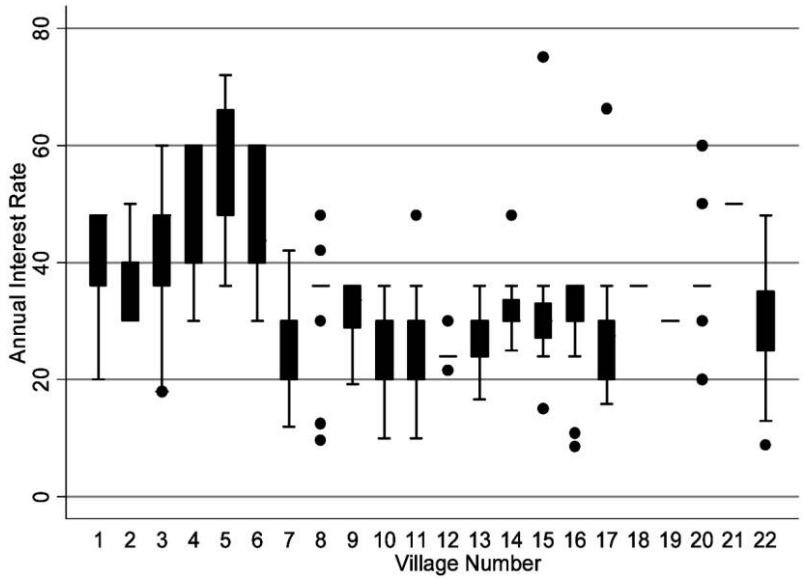

Figure 2. Box plot for interest rates

thirds of the surveyed villages benefited from being near a railroad that, in principle, offered wider access to regional product and factor markets.

One other important dimension of these villages that may possibly be linked to the level of market development is the interest rate on informal PIR loans. On average, the mean village annual interest rate on loans taken out in 1935 was 36% per year, with a high (low) of 60% (24%). Simple ordinary least squares (OLS) regressions (not reported here) reveal that mean village interest rates were statistically significantly lower in both more commercialized and densely populated villages but higher in more autarkic villages. Figure 2 provides a box plot for interest rates on informal contracts in 1935 at the village level. Overall, roughly one-half of the dispersion in interest rates on PIR contracts can be attributed to differences between villages, with the other half arising because of differences in interest rates among households within the same village. Finally, figure 3 plots village mean interest rates calculated over PIR contracts against the percentage of informal loans that were zero interest in 1935. The relationship is clearly positive, and in Section VII.D we provide explanations for this connection.

III. The Basic Model

We consider a simple two-period model of a village populated by households that transact with each other over time. A household's utility in any period is the sum of its payoffs from the various transactions in which it participates

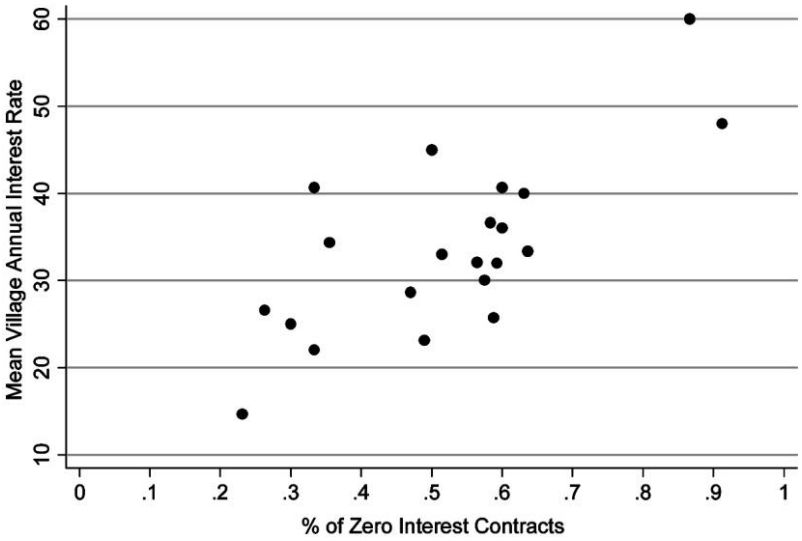

Figure 3. Interest rates and the percentage of zero-interest contracts

during that period. These include credit as well as noncredit transactions. A household's lifetime utility at the beginning of its first period is the expected discounted sum of its first- and second-period utilities.

With regard to credit, the same four events occur in each of the two periods: first, "nature" determines every household's lender-borrower status; second, households that wish to exchange credit are matched; third, matched households negotiate loan contracts and exchange credit; and fourth, households service their outstanding loans. We remain intentionally vague here about this matching process; it encompasses a range of situations, from those in which borrowers are randomly assigned to lenders to those in which borrowers seek out most-favored lenders.[8] The bargaining environment is also simple: the borrower in any matched pair makes a take-it-or-leave-it offer to the lender, and so the borrower extracts the entire surplus from their relationship. Unmatched households and matched households that fail to agree cannot reenter the matching process and, hence, can neither lend nor borrow during the remaining period.

When household h wants to borrow, its payoff from receiving a loan of size l is $F_h(l)$, an increasing, concave function of l, which satisfies $F_h(0) = 0$. The function $F_h(l)$ can represent either a utility function or a production function,

[8] The comparative static results below do not depend on how the loan parties are matched, i.e., whether the lender and borrower are randomly matched and negotiate a loan, or the borrower chooses among lenders by comparing her best PIR and ZIR loans across lenders. We adopt the simpler random matching perspective and confine all negotiations to specific borrower-lender pairs.

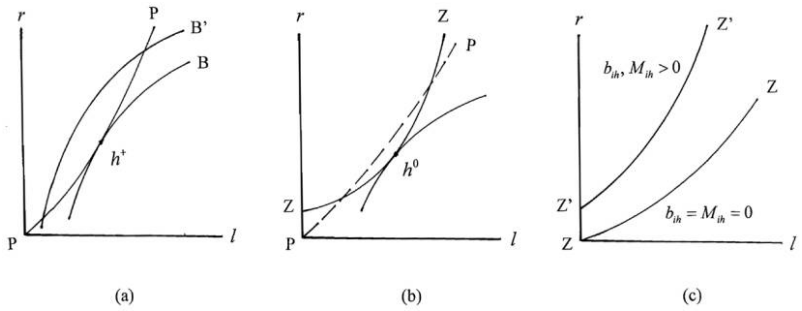

Figure 4

depending on whether the loan is for consumption or investment purposes. When household h wants to lend, its payoff from supplying a loan of size l is $-C_h(l)$. This loan cost function is a strictly increasing, convex function satisfying $C_h(0) = 0$ and $C_h'(0) > 1$; the latter inequality reflects the lender's opportunity cost of funds. These preferences are common knowledge.

IV. Loan Agreements

We examine a situation in which all contracts are perfectly enforceable. This is an expository device only. Enforcement problems arguably provide a compelling explanation for several features of village credit. Nevertheless, we are able to show that the basic ZIR-PIR choice involves a straightforward comparison of loan sizes and costs in which enforcement problems are secondary.[9]

A. Positive–Interest Rate Loans

A PIR loan contract has two components: the loan $l \geq 0$ supplied by the lender to the borrower and the amount $r \geq 0$ that the borrower promises to pay subsequently to the lender; r includes principal and interest. If lender i accepts borrower h's contract offer, $\{l, r\}$, they anticipate payoffs $-C_i(l) + r$ and $F_h(l) - r$, respectively; if i rejects h's offer, neither household exchanges credit in that period, and so they enjoy $C_i(0) = F_h(0) = 0$.

Household h's optimal PIR loan contract is located at point h^+ in figure 4*a*, where the parties' indifference curves are tangent to each other and the lender is indifferent between accepting and rejecting the contract.[10] In this figure, the borrower's utility is increasing in a southeast direction; the loan terms on the indifference curve labeled B are preferred by h to those on B'.

[9] The contract design problems that determine the optimal PIR and ZIR loan agreements are described in the appendix.

[10] The corresponding demand-supply diagram, with "price" dr/dl on the vertical axis, has a downward- (upward-) sloping demand (supply) curve because of decreasing (increasing) marginal loan benefit (cost).

The lender's utility increases in a northwest direction, and *PP* identifies the loan terms that provide lender i with a payoff of zero. The optimal contract at h^+satisfies $r > l$, and so a positive interest payment, $r - l$, is forthcoming; that is, *PP* lies above the 45° line through the origin, as $C_i' > 1$.

B. Zero–Interest Rate Loans

A ZIR loan can be modeled in many different ways, and the household survey that we draw on provides no guidance here (other than for the fact that ZIR and PIR loans are distinct). At a minimum, though, a ZIR loan *cannot* be a contract to lend and repay the same amount.[11] Instead, a ZIR loan is modeled as one for which the lender's return has two components: the repayment of principal during the initial loan period and, in lieu of interest, an option to tax the borrower in the future.[12] This future tax may take a variety of forms, including the provision of labor, land or draft animal services, a direct transfer in cash or in-kind, or a future loan (Platteau 1991). We let θ represent the size of this transfer.

With a two-period model, ZIR loans will be negotiated during the first period so that their options can be exercised in the second. Exercising an option is assumed to preclude participation with other households by both parties. For the former lender, exercising the ZIR loan option represents an alternative to "going to the market" to purchase goods or services; for the former borrower, the option, if exercised, rules out acting as a supplier of the same goods or services. There is also a monitoring cost incurred by lender i, denoted b_{ih}, to confirm that borrower h is able to comply.[13]

Suppose that households h and i are matched in period 1 and that h wants to borrow. The expected present value of h's payoff from the ZIR loan $\{l, \theta\}$

[11] Since $-C_i(l) + l < 0$ for all i and $l > 0$, any loan satisfying $r = l$ is unacceptable to lenders.

[12] If we relax the assumption that the future option and current interest payment are mutually exclusive, the optimal loan contract will generally require both. Nevertheless, our formulation of the problem remains appealing, first, because almost half of the credit contracts in our data set are interest-free loans and, second, because the qualitative effects of the parties' attributes, relationship, and economic environment on the various contract terms are essentially the same whether or not an interest payment and an option are mutually exclusive.

[13] Our model highlights the impact of these monitoring costs on the terms of negotiated interest-free loans. We know, however, that lenders usually monitor borrowers who secure PIR loans as well. Introducing PIR loan monitoring is done straightforwardly, but if there is a need to monitor a PIR loan to ensure payment of principal and interest, it must also be necessary to monitor a borrower of a ZIR loan during its first period to ensure payment of the principal. Since the latter monitoring activity is common to the first periods of both types of loans, it can be shown that the net effect of higher monitoring costs on loan choice and size is due entirely to the monitoring that is specific to the ZIR loan options. To simplify, we chose to abstract entirely from any other monitoring since the model's important results are unchanged.

can be written as $F_h(l) - r$ as before, except that the cost to the borrower of this loan, r, now equals

$$r = l + a_{ih}\tilde{C}_h(\theta),$$

where l is the loan principal, $\tilde{C}'_h(\theta)$ is the second-period cost to h of transferring θ to i, and a_{ih} is the present discounted value of a future yuan multiplied by the joint probability that i needs the transfer and h is able to comply.

We can also express lender i's payoff from the ZIR loan directly in terms of $\{l, r\}$ rather than $\{l, \theta\}$, using the relationship between r and θ given above (see the appendix). Using this transformation, figure 4*b* depicts the locus of ZIR loans, labeled *ZZ*, which provide a payoff of zero for the lender. Household h's optimal ZIR loan contract is located at point h^0, where its indifference curve is tangent to *ZZ*. The choice between PIR and ZIR loans and the determination of their terms depend critically on the properties of *ZZ*. Figure 4*b* also includes the *PP* locus for comparison purposes.

The *ZZ* locus has two distinguishing features: first, *ZZ* generally intersects the positive r-axis; and second, *ZZ* must eventually become steeper than *PP* as l and hence θ increase. The curve *ZZ* generally intersects the positive r-axis because a strictly positive second-period ZIR option transfer, θ, is needed (even for arbitrarily small loans) to provide lender i with a second-period surplus relative to market exchange that is large enough to offset both the future cost of monitoring the former borrower and the current opportunity cost of the loan. In turn, the second-period surplus (relative to market participation) that is available to i is $\tilde{F}_i(\theta) - M_i$, where $\tilde{F}_i(\theta)$ denotes household i's benefit from receiving θ and M_i denotes i's expected payoff from participating on the demand side of the second-period market. We expect that M_i will be positively related to the overall level of market development of i's village.[14]

The curve *ZZ* must eventually become steeper than *PP* as l increases because i's second-period marginal benefit, $\tilde{F}'_i(\theta)$, declines as the transfer size increases, whereas h's second-period marginal cost, $\tilde{C}'_h(\theta)$, increases as the transfer size increases. As shown in the appendix, *ZZ*'s slope increases with $\tilde{C}'_h(\theta)/\tilde{F}'_i(\theta)$, the ratio of the second-period marginal cost to marginal benefit; indeed, for some services, such as those provided by labor or draft animals, we expect $\tilde{F}'_i(\theta)$ to go to zero for large values of θ.

[14] In the event that h is able to comply with the ZIR option, the terms of the contract must be such that i will always exercise the option rather than participate in the market. If not, the option is never exercised, which implies that the loan is equivalent to one in which $\theta = 0$, and a lender would always reject such a ZIR loan offer.

As borrower h's payoff is an increasing function of loan size and a decreasing function of loan payment, h will restrict its loan choices to the lower envelope of ZZ and PP. Hence, a necessary condition for borrowers to choose interest-free loans is that a portion of the ZZ locus lies below PP, as depicted at h^0 in figure 4*b*.

When monitoring costs are zero and there are no market opportunities, that is, $b_{ih} = M_i = 0$, the ZZ locus starts at the origin. This case plays a prominent role in the ensuing discussion and is depicted in figure 4*c*. When the monitoring cost rises, the offsetting future surplus needed to keep ZIR loans viable, $\tilde{F}_i(\theta) - M_i$, must also rise (see the appendix). Thus, $\tilde{F}_i(\theta)$ must increase, and so θ must increase as well. It follows that rising monitoring costs cause the entire ZZ locus to shift up in figure 4*c*. Importantly, since the initial transfer θ is an increasing function of loan size and since the benefit that i enjoys from θ exhibits diminishing returns, it follows that the increase in θ needed to offset higher monitoring costs also increases with loan size. As a result, higher monitoring costs cause the ZZ locus to shift upward and become steeper, at any value of l. Likewise, an improved market opportunity for i, which translates to a higher value of M_i and hence a lower second-period surplus, has identical effects on ZZ.

V. Contract Choice

For any given borrower-lender pair, the optimal loan contract is located at the tangency of the borrower's indifference curve with the lower envelope of the lender's PP and ZZ curves. We begin by highlighting five factors that influence the position of the ZZ locus and hence influence loan choice.

RESULT 1. An interest-free loan is more likely to be negotiated by a pair of households as (*a*) the borrower's expected future costs of supplying funds, labor, or land services fall; (*b*) the lender's corresponding future needs for funds, labor, or land services rise; (*c*) the lender's alternative future market opportunities deteriorate; (*d*) the lender's monitoring cost decreases; and (*e*) the joint probability that, in the future, the lender needs a transfer exactly when the borrower is able to comply increases.

Each of these factors causes the ZZ locus to shift down and hence increases the likelihood that an interest-free loan will be negotiated. For example, in figure 5*a*, when the ZZ locus shifts down from Z_1Z_1 to Z_2Z_2, borrower h replaces the PIR loan at h^+ with the ZIR loan at h^0, whereas borrower j's choice remains unchanged at j^+. Changing factors *a*–*e* in the opposite direction causes the ZZ locus to rise and hence increases the likelihood that a PIR loan will be negotiated.

The magnitude of a borrower's credit needs, represented by the marginal

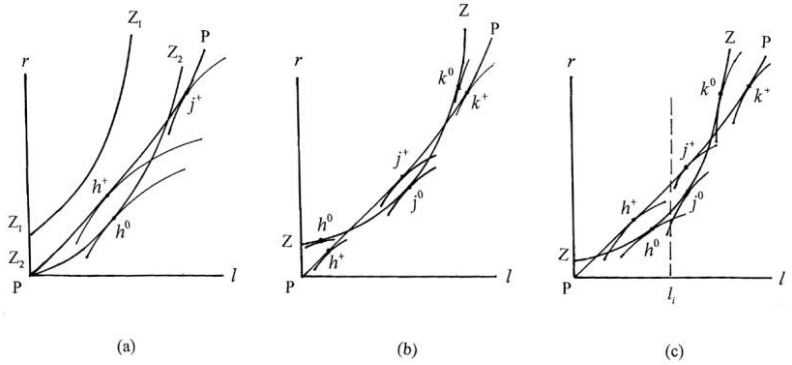

Figure 5

benefit $F_b'(l)$, generally has an ambiguous effect on loan choice. This arises because borrowers prefer small as well as large PIR loans to ZIR loans, but for different reasons. Borrowers with very modest credit needs (e.g., borrower h in fig. 5*b*) prefer PIR loans because of the relatively large and fixed implicit interest cost of ZIR loans that is required to offset information costs and lost market opportunities. In contrast, borrowers with significant credit needs (e.g., borrower k in fig. 5*b*) prefer PIR loans because the large future transfer required as part of the ZIR loan is inefficient.[15] Note, however, that the ambiguous effect of a borrower's demand for credit on loan type is attenuated when the ZZ locus is shifted down, since this causes the range of smaller PIR loans to contract.

RESULT 2. A borrower's credit needs generally have an uncertain effect on the likelihood of negotiating a ZIR loan. Nevertheless, an increase in the borrower's demand for credit is more likely to result in the choice of a positive-interest loan when markets are less developed and monitoring costs are low.

Loan size. We begin by describing the distribution of PIR and ZIR loan sizes among different borrowers.

RESULT 3. PIR loans will tend to be larger than interest-free loans where lenders have limited market opportunities and modest monitoring costs.

PIR loans are generally larger than ZIR loans because of a simple selection effect, as revealed by the lower envelope of terms acceptable to lenders in figure 5*a* for the case of Z_2Z_2. The problem with ZIR loans is that the marginal future benefit for the lender of the services supplied by the borrower per their ZIR loan agreement declines faster than the marginal benefit of equivalent interest payments. This makes ZIR loans especially unattractive for larger

[15] The marginal cost of the transfer to the former borrower, which is increasing in θ, exceeds the marginal benefit to the former lender, which is decreasing in θ.

loans.[16] Ranking ZIR and PIR loans by size becomes more difficult, however, where lenders have better market opportunities or monitoring costs are higher. In figure 5*b*, for example, relatively small PIR loans dominate ZIR loans for borrowers with modest credit needs. This "reversal" (in comparison to fig. 5*a*) arises because strictly positive, though implicit, zero interest charges are required to compensate the lender for forgoing market exchange and bearing monitoring costs.

Result 3 is concerned with the distribution of PIR and ZIR loan sizes among different borrowers. The analysis at the level of an individual borrower follows from figure 5*c* and involves a comparison of the optimal PIR and ZIR loans that would be chosen by a particular borrower. In figure 5*c*, l_i identifies the loan size at which the slopes of *PP* and *ZZ* (or the marginal costs of the two types of loans) are equal. It follows from figure 4*c* that l_i decreases as the lender *i*'s market opportunities improve and/or monitoring costs rise.

Recall that the slope of borrower *h*'s indifference curve, $F_h'(l)$, reflects the marginal benefit of a loan. Thus, households with greater credit needs (steeper indifference curves) will negotiate larger PIR and ZIR loans, given *PP* and *ZZ*. In figure 5*c*, for example, compare households *h*, *j*, and *k*: among PIR loans, k^+ is larger than j^+, which is larger than h^+; and among ZIR loans, k^0 is larger than j^0, which is larger than h^0. This figure also shows that for a given borrower, if its optimal ZIR loan is larger (smaller) than l_i, then its optimal PIR loan is even larger (smaller).

Result 4. (*a*) For any given loan type, households with greater credit needs will negotiate larger loans; (*b*) borrowers do not necessarily prefer the loan type that allows them to negotiate the larger loan; and (*c*) for any given borrower, its optimal PIR loan is likely to be larger than its optimal interest-free loan when either its credit needs are relatively substantial (exceeding l_i) or lenders have either ample market opportunities or significant monitoring costs (which decrease l_i).

Borrowers *j* and *k* in figure 5*c* nicely illustrate the difference between results 3 and 4*b*; the PIR loan k^+ is larger than the ZIR loan j^0 (result 3), and yet *j* could have chosen the larger PIR at j^+ over j^0 but didn't (result 4*b*).

VI. Contract Choice among Households

We wish to analyze the household choice between PIR and ZIR loans and the effect of this choice on loan size. There are two potential econometric issues: first, selection effects related to potential differences between borrowing

[16] For example, if the lender needs help harvesting a crop during a 1-month period, the incremental benefit of more than 1 month of the borrower's labor services will be small.

and nonborrowing households and, second, identification of the causal effect of loan type on loan size. Both are difficult to deal with, and for similar reasons.

Correction for selection requires variables that influence informal loan access but do not affect either loan type or loan size. Identifying the causal effect of loan type on loan size is hampered because the variables capturing market development and potential monitoring costs—key potential determinants of contract choice—may also be influencing loan size through other channels. For example, the monitoring variables may help relax certain kinds of enforcement constraints and thus allow larger loans of either type. Since it is difficult, ex ante, to isolate variables that influence loan size only through their effect on loan choice, we limit our estimation to a probit model for loan type and a reduced-form equation for loan size in the same set of variables. In interpreting these reduced-form results, the reader should also keep in mind the potential influence of selection on the estimates.

There are three sets of explanatory variables: those capturing market development in the borrower's village, those measuring potential monitoring costs between the parties, and a vector of household attributes. We use several variables to reflect the local level of market development including % of HH Autarkic, which is the percentage of households in the village that do not participate in either local labor or land rental markets; Commercialization, which is the percentage of farm output produced in the village that is sold; and RR, which is a dummy variable that is equal to one if a railroad runs through the county in which the borrower's village is located. We also include Pop. Density, which is village population density, in order to capture the potential pool of other households with which either the borrower or the lender might interact. Finally, we include a measure of the shock to agriculture in the village in the year of the survey, Village Harvest Shock, which is the percentage of land in the village that experienced a reduction in output of 50% or more compared to a "normal" year.

The ability of the lender to monitor the borrower will depend on their relationship as well as how near they live to each other. Among households that are related, we distinguish between those households that are related through kinship, that is, male lineage, in the village (Same Clan) and through other family ties (Related). For residency, we identify those contracts in which borrowers and lenders live in the same village (Same Village).

To control for borrower household heterogeneity, we include variables capturing the household's demographic composition, land and draft animal holdings, as well as two variables reflecting potential credit demand shocks: a death in the family in the year of the survey and a measure of the household's farm harvest relative to a "normal" year. A death in the family may represent

both a potential loss of income and unexpected ceremonial expenses, which in the Chinese context were often very high. Our data indicate if there was a death in the past year but do not identify the family member who died. We also include three dummy variables to capture the seasonality of borrowing.

A. Loan Choice

We report probit estimates for the probability of choosing a ZIR loan in column 1 of table 4. Altogether, we have observations on 618 contracts.[17] We also report in column 2 probit estimates over a sample that excludes all contracts involving households from four villages that were beneficiaries of a government-subsidized loan program in 1935 implemented because of major harvest failures. The concern is that access to these programs may affect choice with respect to informal credit.[18] Estimation in the reduced sample is based on 491 contracts.

In general, our results are supportive of the predictions of our model relating to the determinants of loan contract choice and are robust to estimation over a restricted sample of villages and contracts. First, households that live in localities with higher levels of market development and access are less likely to negotiate ZIR loans. Each of the variables capturing market development is highly significant.[19] Households contracting in environments with higher degrees of commercialization in the product market, lower household autarky in the factor markets, and access to a railroad are much less likely to select ZIR contracts. Households living in higher-density areas are also less likely to select ZIR contracts.

Second, the ability of a lender to monitor a borrower directly (because they live near each other) or indirectly (because they are related) enhances the likelihood that the two parties negotiate a ZIR loan. This helps to lower the costs associated with exercising the zero-interest option at some point in the future. The coefficients on these relational variables suggest a clear ordering in terms of the strength of these effects, with the effect largest among households living in the same village and related by kinship (Same Clan), followed by nonrelatives living in the same village (Same Village) and, finally, relatives living in different villages (Relatives).

[17] The difference between the 671 contracts reported in Sec. II and the 618 we use here largely reflects that our estimation is limited to contracts involving borrowers who resided in one of the 22 surveyed villages. We do not have household-level attributes, e.g., household size, assets, or shocks, for borrowers living outside, and so we must exclude these contracts. We also lose a few observations because of missing information.

[18] This concern was raised by one of the referees.

[19] The positive sign on Autarky reflects the fact that it is inversely correlated with the level of market development.

TABLE 4
DETERMINANTS OF LOAN TYPE AND LOAN SIZE

	Loan Type (ZIR = 1)		Loan Size	
Variable	Probit (1)	Probit (2)	OLS (3)	OLS (4)
Season 1 (January–March)	−.148	−.350	−.996	−.910
	(.170)	(.188)	(1.253)	(1.711)
Season 2 (April–June)	−.051	−.138	−3.743	−2.965
	(.192)	(.206)	(1.213)	(1.900)
Season 3 (July–September)	.431	.256	−2.226	−2.034
	(.275)	(.307)	(1.584)	(2.038)
Household-level variables:				
HH Size	.012	.028	−.307	−.420
	(.013)	(.015)	(.155)	(.171)
Land Owned	−.001	−.001	.030	.030
	(.001)	(.001)	(.009)	(.011)
Draft Animal	−.038	−.038	.754	.914
	(.046)	(.053)	(.509)	(.576)
HH Harvest Shock	−.783	−.564	9.264	13.395
	(.864)	(1.467)	(3.69)	(7.765)
Death in Family	−.406	−.324	5.497	6.474
	(.236)	(.218)	(1.891)	(2.279)
Related	.207	.182	.375	.534
	(.140)	(.165)	(.660)	(.789)
Same Village	.424	.307	−3.536	−3.700
	(.229)	(.244)	(1.199)	(1.499)
Same Clan	1.039	1.154	−3.827	−3.680
	(.240)	(.244)	(1.705)	(2.032)
Village-level variables:				
RR	−.370	−.581	1.876	1.917
	(.177)	(.138)	(1.006)	(1.142)
Commercialization	−2.552	−2.031	13.083	10.826
	(.752)	(.620)	(4.03)	(3.466)
Pop. Density	−1.151	−2.404	.497	−2.687
	(.413)	(.662)	(1.859)	(6.704)
% HH Autarkic	.596	1.207	−2.873	−4.772
	(.297)	(.252)	(2.519)	(2.300)
Village Harvest Shock	1.483	−.192	−15.494	−9.429
	(1.093)	(2.958)	(5.458)	(17.034)
Observations	618	491	618	491
R^2	.096	.1173	.304	.3159

Note. Cluster-corrected standard errors are reported in parentheses. In addition to household size, we also include variables capturing the age and gender composition of the household but do not report the coefficients here. For the probits, Stata reports a "pseudo R^2."

The likelihood of selecting a PIR loan is also weakly related to a number of variables capturing potential household demand for credit. Households with more land or draft animals are more likely to borrow at positive interest, as are those households experiencing either a death in the family or a larger harvest shock. The effect of the harvest shock is especially pronounced in the sample excluding villages with access to subsidized loan programs. Although

not reported, we also find consistent with the model (result 3) that the effect of these shocks on the likelihood of a ZIR loan is dampened in environments in which the level of market development is higher.

B. Loan Size

In columns 3 and 4 of table 4, we report the results of estimation of a reduced-form equation for loan size that includes the same set of variables that we used in the loan choice equation. Column 3 is for the full sample and column 4 is for the restricted sample. Two features of these results are noteworthy.

First, loan size is increasing in our two household shock measures, namely, a death in the family and a major harvest failure. From figure 4*a*, we know that this is true for both types of loans. The positive correlation between these shock measures and both the likelihood of selecting a PIR loan and loan size is consistent with result 3, which suggests that households with significant credit demands will access PIR loans as a way to borrow more than they otherwise could from their optimal ZIR loan (e.g., household k in fig. 5*c*).

Second, the monitoring-relational variables have either no effect (Related) or a negative effect (Same Village, Same Clan) on loan size. At first examination this seems puzzling: one might expect that lower monitoring costs help to relax certain lending constraints and lead to larger, not smaller, loans of both types. Recall, however, that these same variables are also increasing the likelihood of ZIR loans. Since within ZIR and PIR loans those between neighbors or relatives are not significantly larger, our results suggest that more important is the effect these variables have on loan choice and the fact that ZIR loans are typically smaller than PIR loans.

VII. Discussion

In this section, we examine four other implications of our model.

A. Friends, Relatives, and Moneylenders

The "stylized fact" in the literature that relatives and acquaintances are more likely to negotiate ZIR loans is explained here by the lower monitoring costs common to these relationships rather than by the parties' preferences or the length of their relationship. In contrast, moneylenders are likely to find the expected value of a ZIR loan option to be low since their monitoring costs are high and the future likelihood of needing the goods or services that most borrowers are readily able to provide is much lower. Thus, for the case of moneylenders, we expect ZZ to lie above PP and PIR loans to dominate; for example, with Z_1Z_1 in figure 5*a*, households choose $h^+$and j^+.

B. Incidence and Size of In-Kind Loans

PIR loans are one-fourth as likely to be in-kind as ZIR loans (7.7% vs. 33.9%). In both cases, the in-kind loan is also smaller; the average PIR (ZIR) cash loan is for 11.9 (7.3), whereas the average PIR (ZIR) in-kind loan is for 5.1 (4.3). Both observations are consistent with our model.

First, in-kind loans, which were almost always in grain, tend to be relatively small because they are typically for consumption purposes. When there are transaction costs, a commodity transfer dominates cash of equal value as long as the household directly consumes the commodity; otherwise, they incur additional costs of converting the commodity transfer into cash or other goods through a sale in the market or exchange. Second, conditional on negotiating a small loan for consumption purposes, ZIR loans are likely to dominate PIR loans, at least with ZIR loan loci similar to Z_2Z_2 in figure 5*a*, that is, in villages with limited market opportunities. Third, loans between households living in the same village are much more likely to be in-kind than those between nonvillagers (48.3% vs. 16.2%). The extent to which in-kind loans are likely to be ZIR loans thus reflects limited market opportunities and low information costs.

C. Loan Duration and Security Provisions

Earlier, we identified two significant differences between PIR and ZIR loans: first, ZIR loans are more likely to be more open-ended (74.7% vs. 48.7%) and, second, PIR loans are more likely to have security provisions (21.1% vs. 4.5%). Both of these outcomes can be explained by extending the model in Section V. Here, we sketch the arguments.

In contrast to a fixed-duration loan, an open-ended loan has no agreed-upon length or final date. In our data, a fixed-duration loan is typically for a year. An appealing interpretation of an open-ended loan is that it is a loan with a state-contingent loan repayment date; the borrower is required to repay the loan as soon as he is able to do so. This makes the relationship between the parties and the informational environment once again central to the contracting. When a lender can easily monitor a borrower's ability to repay, an open-ended loan can be used: the lender will impose sanctions on the borrower as soon as he observes that the borrower is able, but not willing, to repay. A fixed-duration loan will be advantageous to loan parties in cases in which a lender cannot verify the borrower's ability to repay. The fixed duration provides the borrower with a window during which sanctions are suspended independent of the amount he owes.

Lower monitoring costs thus have two effects: as emphasized in this paper, households are more likely to negotiate ZIR loans, and as developed in Brandt

and Hosios (2008), households are more likely to negotiate open-ended loans. Since the circumstances in which ZIR loans are desirable are largely the same as those in which open-ended loans are preferred, the observation that ZIR loans are more likely to be more open-ended is not surprising.

The role played by security provisions can be best understood in the context of loans that are self-enforcing rather than court enforced. When third-party enforcement is absent, the amount that a borrower will voluntarily repay or supply (in the case of a loan option for goods or services) cannot exceed the present discounted value of maintaining a reputation for repaying loans or complying with requests to exercise loan options. These self-enforcing constraints impose borrower-specific upper bounds on a borrower's PIR and ZIR loan obligations. With a self-enforcing constraint modeled as an upper bound on r, figures 4 and 5 show that a given self-enforcing constraint will first limit the choice of larger PIR loans.

Suppose that security provisions relax self-enforcing constraints by imposing an additional cost on borrowers that choose not to meet their loan obligations. These provisions thereby allow larger loans to be negotiated and hence are more likely to be added to PIR loans since these loans are more attractive to borrowers who require larger loans. In other words, borrowers who introduce security provisions to relax self-enforcing constraints to induce lenders to supply larger loans are more likely to prefer larger PIR loans to ZIR loans. Thus, enforcement problems can account for the relatively larger portion of PIR loans with one or more security provisions.

D. Interest Rates and Market Development

Figure 3 depicts a positive relationship between the percentage of loans that are zero interest in a village and the average village rate of interest. Our model predicts such a positive relationship between these two variables, intermediated by the level of market development.

When households' market opportunities are limited, as represented by Z_2Z_2 in figure 5*a*, households with modest credit needs tend to negotiate smaller ZIR loans, whereas those with more substantial credit needs tend to negotiate larger PIR loans. Compare this to what happens with ZZ in figure 5*b*. In this case, some borrowers (such as h) who would have preferred smaller ZIR loans when facing Z_2Z_2 in figure 5*a* instead choose smaller PIR loans. Since PP is convex, negotiating smaller PIR loans that dominate ZIR loans lowers the average rate of interest (i.e., on PP, the rate of interest decreases as loan size decreases). Thus, in equilibrium, the average rate of interest will generally be lower in villages with greater market opportunities, where interest-free loans are less appealing.

An alternative (and potentially complementary) explanation for the positive relationship takes the rate of interest to be exogenous to the village, as would be the case if the geographical boundaries of the credit market extended beyond the village. Suppose that PIR loans are available nearby at a fixed rate of interest, $R > 0$, that is meant to capture the combined effect of a range of local market conditions. In this case, R is the opportunity cost of funds supplied by lender i, and so $C_i(l) = (1 + R)l$. The model then goes through as before, except that PP is a straight line, with slope $1 + R$, and ZZ remains convex. An increase in the local interest rate, R, will increase the proportion of ZIR loans by inducing borrowers to switch from small (large) PIR loans to larger (smaller) ZIR loans.

We included the 1934 mean village rate of interest on PIR loans in our choice equations in table 4 to capture the local opportunity cost of funds, along with a control for the distribution of potential borrowers, namely, land distribution. The coefficient on the lagged interest rate, our proxy for the local cost of funds, is negative and highly significant whereas the remaining coefficients are essentially unchanged.

VIII. Final Remarks

Interest-free loans among households in low-income, rural economies are common. Often used for consumption purposes, these loans are typically interpreted in the context of long-term reciprocal insurance or patronage relationships between households. Seen as a "non-market transaction par excellence" (Dreze et al. 1998, 542), their long-run decline and replacement by positive–interest rate loans have been interpreted as "a manifestation of the displacement of personalized relationships by market transactions."

In this paper, we argue that this interpretation of interest-free loans is by no means universal. Indeed, our sample of informal credit contracts for rural China for the 1930s suggests that in this particular setting, ZIR and PIR loans are more alike than different. They are both commonly found between neighbors and relatives and are used for consumption purposes. Moreover, repayment of neither loan type appears to be output contingent.

We hypothesize that the fundamental difference between the two types of loans is in how interest obligations were fulfilled. A PIR loan requires that the borrower pay the principal plus interest to the lender, whereas a ZIR loan requires that the borrower pay only the principal and, in lieu of interest, gives the lender an option to tax the borrower in the future at the lender's discretion. Exercising this option can be thought of as an alternative to going to the market to obtain the same set of services.

The zero-positive choice in our model depends critically on the parties' current borrowing needs and costs, their future trading needs and costs, the verification costs of the option, and the alternative future market opportunities of the lender. Empirically, we exploit heterogeneity across our sample of rural Chinese villages and households to identify the role of these factors in contract choice and, in turn, the effect of contract choice on loan size. We find that both market development and informational costs play significant roles in informal credit contract choice. PIR loans also appear to provide the borrower a mechanism to obtain larger loans from a given lender in some environments.

Finally, in this particular context, our findings suggest that one does not have to appeal to a breakdown of personalized relationships to explain the decline of informal interest-free lending. Other analyses suggest that PIR informal credit contracts are firmly embedded in these same personal relationships. Rather, increases in the level of market development by itself will tend to increase the preference for positive interest rates over their zero-interest counterparts.

Appendix

Contract Choice

In this appendix, we present the simplest possible version of our model in which there is only one market, the loan market. In this case, the ZIR loan option necessarily takes the form of a money transfer since there is no other good or service that the parties might exchange, directly or through a market. We define only notation not already introduced in the text. A more complex model would also include nonmonetary exchanges, along with a corresponding set of markets.

A. Positive–Interest Rate Loans

Suppose that households h and i are matched at the beginning of period 2 and h wants to borrow. Among PIR loans, h offers i the contract that solves

$$V_{hi}^{+} = \max_{\{l,r\}} F_h(l) - r \quad \text{subject to } -C_i(l) + r \geq 0. \tag{A1}$$

As $C_i' > 1$, the solution to this problem satisfies $r > l$, and so a positive interest payment, $r - l$, is forthcoming. Letting M_h denote household h's expected payoff from participating in the matching process in period t as a borrower who exclusively negotiates PIR loans, we have that $M_h = \Sigma_{i \in H} \alpha_{hi} V_{hi}^{+}$, where H denotes the set of households residing in the village and α_{hi} denotes the joint probability that i wants to lend and that h and i are matched.

If h and i are matched at the beginning of period 1 and h wants to borrow, h offers i the contract that solves

$$\max_{\{l,r\}} F_h(l) - r + \delta p_h M_h \quad \text{subject to} \quad -C_i(l) + r + \delta p_i M_i \geq \delta p_i M_i, \tag{A2}$$

where δ is the common discount factor, p_i is the probability that i will participate on the demand side of the second-period market, and M_i is the corresponding expected payoff; participation on the supply side occurs with probability $1 - p_i$ but yields a payoff of zero. The present discounted value of household h's two-period payoff is $V_{hi}^{+} + \delta p_h M_h$.

B. Zero–Interest Rate Loans

Suppose that households h and i are matched in period 1 and that h wants to borrow. Letting b_{ih} denote the second-period cost borne by i of confirming that h is in a position to lend, the expected present value of household i's payoff from the ZIR loan $\{l, \theta\}$ is given by

$$-C_i(l) + l + \delta p_i\{-b_{ih} + p_h M_i + (1 - p_h)\max[\tilde{F}_i(\theta), M_i]\}, \tag{A3}$$

where p_i is the probability that i needs funds in period 2, $1 - p_h$ is the probability that h is able to supply these funds in period 2, and M_i is i's expected return from participating (as a borrower) in the second-period market. With probability $1 - p_i$, i can lend again, choosing to forgo exercising the ZIR loan option, and as a lender has an expected payoff of zero from participating in the market. This expression says that if i discovers that h is unable to lend, i has no choice but to go to the market to secure funds; if i discovers that h is able to lend, i will then exercise the option if doing so dominates the market alternative, that is, $\tilde{F}_i(\theta) \geq M_i$. Household i will therefore expend b_{ih} to determine h's status if and only if the ex post payoff, $-b_{ih} + p_h M_i + (1 - p_h)\max[\tilde{F}_i(\theta), M_i]$, exceeds M_i; this is equivalent to $(1 - p_h)\max[\tilde{F}_h(\theta) - M_i, 0] \geq b_{ih}$.

The expected present value of household h's payoff from the ZIR loan $\{l, \theta\}$ is $F_h(l) - l - \delta p_i(1 - p_h)\tilde{C}_h(\theta) + \delta p_h M_h$ when $(1 - p_h)\max[F_h(\theta) - M_i, 0] \geq b_{ih}$. Here, $p_i(1 - p_h)$ is the probability that i needs to buy a good or service that h is able to supply; $(1 - p_i)(1 - p_h)$ is the probability that h participates on the supply side of the second-period market and earns zero. Thus, household h offers i the ZIR loan contract that solves

$$\max_{\{l,\theta\}} F_h(l) - l - \delta p_i(1 - p_h)\tilde{C}_h(\theta) + \delta p_h M_h \text{ subject to} \tag{A4}$$

$$-C_i(l) + l + \delta p_i\{-b_{ih} + p_h M_i + (1 - p_h)\max[\tilde{F}_i(\theta), M_i]\} \geq \delta p_i M_i,$$

where $\delta p_i M_i$ is i's expected discounted payoff from rejecting h's offer in period 1 and participating in the matching process in period 2.

To facilitate comparisons with the optimal PIR loan contract, we define the principal plus implicit interest as $l + a_{ih}\tilde{C}_h(\theta) = r$, where $a_{ih} = \delta p_i(1 - p_h)$, so that the borrower's payoff can be written as $F_h(l) - r$. The expected discounted value of a ZIR loan option, which is the implicit interest cost of the loan, can then be written as $r - l = a_{ih}\tilde{C}_h(\theta)$. Solving for θ gives

$$\theta = G_h\left(\frac{r-1}{a_{ih}}\right), \tag{A5}$$

where $G_h(\ )$ is the inverse of $\tilde{C}_h(\ )$. Household h's problem can now be written as

$$V_{hi}^0 + \delta p_h M_h = \max_{\{l,r\}} F_h(l) - r + \delta p_h M_h \tag{A6}$$

$$\text{subject to } -C_i(l) + l - \delta p_i b_{ih} + a_{ih}\max[0,\ \tilde{F}_i(G_h((r-l)/a_{ih})) - M_i] \geq 0.$$

C. Contract Choice

Households h and i will negotiate a ZIR loan agreement if and only if $V_{hi}^0 \geq V_{hi}^+$. This means that we can restrict attention to ZIR loans having options that household i will subsequently choose to exercise (otherwise, the optimal ZIR loan size and option are equal to zero); that is, we consider $\{l, r\}$ pairs satisfying $\tilde{F}_i(G_h((r-l)/a_{ih})) \geq M_i$.

D. PP and ZZ Slopes

At different points in the text, reference is made to the slopes of PP and ZZ. The slope of PP is $C_i'(l) > 1$. The slope of ZZ is $1 + [C_i'(l) - 1]\tilde{C}_h'(\theta)/\tilde{F}_i'(\theta)$, where θ satisfies $r = l + a_{ih}\tilde{C}_h(\theta)$. The slope of ZZ exceeds the slope of PP when $\tilde{C}_h'(\theta)/\tilde{F}_i'(\theta) > 1$. Along PP, $r = C_i(l)$, and so the corresponding value of θ satisfies $C_i(l) - l = a_{ih}\tilde{C}_h(\theta)$. Thus, as l becomes large, so does θ; in particular, $\tilde{C}_h'(\theta)/\tilde{F}_i'(\theta) \to \infty$ as $\theta \to \infty$ if either $\tilde{F}_i'(\theta) \to 0$ or $\tilde{C}_h'(\theta) \to \infty$ as $\theta \to \infty$. In consequence, the slope of ZZ exceeds the slope of PP as l becomes large.

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