The Village Money Market Revealed: Financial Access and Credit Chain Links Between Formal and Informal Sectors*

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Abstract

An all-or-nothing view of financial access leading to overly simplistic policy recommendations has been largely overturned in the data. Heterogeneity and explicit obstacles to trade are key aspects that need to be incorporated into models when looking at intermediate outcomes in the data. Networks in particular can amplify or work against policy interventions, and do so in different directions for different groups at the same time. Work on village money markets allows us to understand better how these networks function and how and why they can change with policy interventions. Nevertheless, though village economies are as sophisticated as those in NY financial markets, both suffer from familiar problems. One is reliance on relationships which segment markets and limit more universal benefits. A second is market contagion. Policy interventions facilitating financial access and the functioning of markets need to be guided by this stricter yet more realistic view.

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1 Introduction

The literature on financial access spans polar opposite views. In one view, financial access is so limited that, for the purpose of policy, we can act as if nothing were there at all. Financial access thus increases welfare. The opposite view is that village economies are fully functioning. They can be seen as republics, as in the sense of the political science literature, or as Arrow-Debreu economies, as in the economics literature. As such some might think financial interventions are not needed. This paper argues that the policy recommendations emanating from each of these simplistic views can be improved upon substantially. We have the theory and data to provide better, fine-tuned guidance.

We highlight here the interactions between the formal and informal sectors as an initial movement toward a modified ground, though each view retains its starting point. An outgrowth of the first view is that there are informal transactions in the village economy, but these are a poor substitute for formal sector institutions. Usurious moneylenders extract rents. Thus one expects the informal sector to contract as the formal sector increases. An outgrowth of the second view is that informal and formal credit and insurance transactions are complements, each with a role. One should not seek to get rid of informal transactions as the formal sector increases, but rather expect and want the informal sector to stay steady or even expand. Clearly the implications for the informal sector of external interventions still matter, suggesting that what is going on in the informal sector is key to thinking about policy.

There has been much progress, both theoretically with models and empirically with methods, exploring a more realistic middle ground, with models featuring heterogeneity or obstacles to trade. Policy in this context is likewise much more nuanced. With documented heterogeneity among households in risk aversion, for example, but maintaining the full insurance null, outside interventions which provide insurance against aggregate shocks can hurt groups that had been providing such insurance to others locally for an implicit premium. But external insurance spans more villages and the recipients of such insurance benefit. With obstacles to trade such as imperfect information, policy should focus on alleviating obstacles, e.g., enhanced monitoring. However, this view had not incorporated heterogeneity in monitoring costs. In general, both heterogeneity and various imperfect financial/information regimes need to be considered jointly.

Data on networks has given researchers the ability to explore further this middle ground. The findings include new pathways for the impacts of policy, which can be adverse, on the one hand, or which can help in external targeting, on the other. More specifically, even in contexts in which external formal credit and insurance are arguably substitutes, as in the first view, certain pre-existing beneficial social networks decline with policy interventions. This is evident in some of the data, though the mechanisms are less clear. Likewise, even when formal and informal sectors are complements, as in the second view, data on networks show that the capacity of the informal sector to cooperate, that is, to take advantage of policy interventions, can depend on network position. Relatedly, the effectiveness of external liquidity interventions can vary with the point where in the social networks the funds are injected.

Unique, high-frequency panel data, including transactions in networks over households and time, allows us to go even further. Documented in the data are active, high volume, and relatively sophisticated village money markets, especially and ironically among households in villages in relatively poor regions. Formal and informal transactions are shown in the data to be intimately linked, e.g., households borrow informally in order to pay off formal sector loans and borrow from the formal sector in order to relend to others in their informal network. As with traditional markets, loan repayment can be deferred through standard restructuring, but there are also more complicated internal credit refinancing chains involving multiple parties and short/medium maturities of debt.

A unifying theoretical model, with both heterogeneity and obstacles to trade, allows an interpretation of these network panel data. It shows that those engaged in credit refinancing chains have the smoothest consumption of all against income shocks, as estimated relatively high risk tolerance

is dominated by estimated low transaction costs. An explicit costly state verification model makes clear why a formal financial sector innovation can amplify and augment kinship networks, while the same intervention can injure those in the village without kin.

One overall takeaway is that village money markets are quite sophisticated. Nevertheless, they suffer from the same kinds of problems as those that plague the New York financial markets: dependence on relationships and lack of coordination. Both markets are in need of similar policy remedies for these two problems. The tools available for policymakers and private sector innovators include distributed ledgers, encryption, and multi-party programmed contracts on decentralized platforms.

This paper proceeds as follows. Section 2 describes the two polar views of financial access, with corresponding policy implications, along with modifications that emanate from those end points. Section 3 describes a middle ground incorporating robust methods, heterogeneity and imperfect financial/information regimes, with bottom line policy implications. Section 4 deals more explicitly with data from networks, providing a yet more granular data and policy view. Section 5 reports on the use of panel data from networks to uncover the village money market connecting formal and informal lenders and borrowers, and Section 6 provides a unifying theoretical model of that village money market, incorporating both heterogeneity and obstacles to trade. Section 7 traces out the impact through networks of an actual policy intervention carried out in real time, comparing networked and non-networked households before and after the implementation of a formal Village Fund program in Thailand. Section 8 concludes with a discussion of the common problems of relationship lending and coordination in both village money markets and New York financial markets that can be remedied with the emerging tools.

2 Two Polar Views of Financial Access, with Opposite Policy Implications

In developing countries, financial access is limited, especially at the village level. One commonly held policy view is that financial markets are not highly developed, poor people cannot organize, and therefore interventions are needed (Alliance for Financial Inclusion 2010). A more recent official statement from the G20 supports improved access to financial services by the poor (G20 Presidency of Indonesia 2022).

The closely related case for intervention is to get rid of informal usurious lending. In this view, informal and formal arrangements are substitutes. Bell, Srinivasan and Udry (1997) find that most borrowers among Punjabi cultivators are rationed in the formal market and demand for credit is inelastic with respect to interest rates. Banerjee and Duflo (2014) test this view and find that firms in India are so constrained that formal credit is not yet a substitute for the informal, that is, both are needed. More challenging, Hoff and Stiglitz (1990) find that the infusion of government-subsidized credit has not improved the terms offered by money-lenders.

The second policy view starts with the premise that there is much more going on in villages in the first place, to the point that policy interventions may not be needed at all. In the field of political science, villages are viewed as republics with their own intricate governance system (Wade 1988). Mahatma Gandhi had in mind a more normative criteria, as when he argued for village republics. A more contemporary economic idea is that villages are Arrow-Debreu economies; that is, they come close to achieving the standards of the optimal allocation of risk bearing (Townsend 1994, drawing on Wilson 1968 and Diamond 1967). Ravallion and Chaudhuri (1997) articulate the important policy implications of this second view for public safety nets, that micro, individual level, targeting may not be needed within villages, though they are wary of this conclusion. Note this implication for within-village targeting does not preclude the need for cross-village interventions.

However, consistent with the second policy view, formal and informal mechanisms can be complements, not substitutes. That is, formal policy interventions from outside the village and informal systems within the village can work in tandem. Gine (2011), in the context of Thailand, allows in his model both variation in enforcement and transaction costs, finding evidence favoring better enforcement of loans by the informal sector. The much-cited work of Peterson and Rajan (1997)

notes that larger firms on-lend finance acquired from formal sources via trade credit to smaller constrained firms, which is related to the Jain (1999) and Conning (2001, 2005) views of delegated monitoring. Karaivanov and Kessler (2018) study borrower choice between formal and informal credit in a setting with imperfect debt enforcement. In contrast to formal loans, as from banks, informal loans from friends or relatives can be enforced by the threat of severing social ties. This creates a coexistence and also a trade-off: Large collateralized formal loans versus smaller informal loans, with both being advantageous to borrowers.[1]

3 A More Realistic Intermediate Ground: Robust Methods, Heterogeneity, and Obstacles to Exchange

The debate engendered by these opposite policy views of financial access has been productive. Ravallion and Chaudhuri (1997) argue for methods and tests that are robust against alternatives, such as further corrections for measurement error. Related is the econometrics of reflection dealing with an average of the dependent variable (Deaton 1990). Parallel is the well known difficulty of estimating cohort effects (Angrist 2014). Subsequent work has incorporated most of these ideas. Deaton (1990) finds nevertheless a surprising amount of co-movement in consumption across villages in Cote d'Ivoire, captured by significant fixed effects not prevalent on the income side. Suri (2013) introduces tests that distinguish and quantify within- versus across-village insurance, combining both into a single framework. There is also a stress on identification, e.g., the difficulty in separating the sharing of income risk from preference shocks when all that one has are consumption data. This is consistent with the use of more data, more variables, and analysis of specific mechanisms, such as gifts, as a smoking gun, which will be featured below. Attanasio and Davis (1996) in a different context, the US, use panel data on consumption, labor supply and wages and find under-insurance: across-cohort-group consumption variability is large. Subsequent work by Bonhomme et al (2012), focusing on the poor as a potentially vulnerable group in villages, shows how to optimally insure against wage risk, determined from outside the village as a productivity substitution effect, something to which individuals and the village as a whole should respond in labor supply, while retaining full insurance for income effects.

More generally, one can distinguish in the literature two ways of proceeding. The first way continues to take the neoclassical hypothesis as the null and conducts tests, but, as anticipated, this work uses multiple data and examines underlying mechanisms. For example, Samphantharak and Townsend (2018) estimate from production data the premium for holding idiosyncratic risk and the premium for aggregate risk, where rates of return come from profits generated by portfolios of real assets used in production. The analysis follows the lead model in finance, though the latter deals with yields on financial assets. The premium for idiosyncratic risk at the within-village level is positive but small. Informal gift giving is the mechanism, the smoking gun as it were. Within a village, gifts account for a large percent percentage of the smoothing. An adverse productivity shock for a household is smoothed with incoming gifts from within the village, and vice versa for beneficial productivity shocks and lending. Consumption moves with shocks, so there is less than full insurance, but consumption moves relatively little. However, the premium for aggregate village risk is large. Though village shocks could in principle be smoothed by inter-regional pooling mechanisms, they are not. The suggestion to policymakers is to focus on the largely missing part: across-village infrastructure.

Likewise, Chiappori et al (2014) introduce heterogeneity and risk tolerance, correcting what is otherwise a bias on income coefficients. With this, they fail to reject the null hypothesis of full risk sharing. In the village level data, the more risk tolerant bear more aggregate risk. This brings a surprising policy implication: Though cross-village-level insurance can be beneficial, implementation would injure those currently providing insurance against aggregate shocks at the village level. Damage can come from external interventions, once we take heterogeneity into account.

The second way of proceeding introduces explicit obstacles to trade within villages. Largely, the data lie between perfect risk sharing and simple borrowing and lending. One such obstacle is

[1] For related literature on trade credit, see Boissay and Gropp (2013), Cocco, Gomes, and Martins (2009) and Jacobson and Schedvin (2015).

limited commitment, mitigated by internal penalties and enforcement. Ligon, Thomas and Worrall (2002) focus on this. If access to outside credit markets mitigates the damage of internal penalties, policy interventions which increase that access can weaken risk sharing. Silva and Townsend (2021) focus on moral hazard. They parameterize the degree of imperfect insurance in the village data as a skin-in-the-game constraint, consistent with life cycle observations on the holding of safe versus risky assets and consumption to income ratios. The impact of liberalization, a weakening of this constraint, is different from the impact of reducing the standard credit collateral constraint. They find that a policy improvement of providing more within-village insurance has economy-wide implications for inequality and growth, with heterogeneous impacts depending on cohort and the passage of time.

More recent literature posits a series of information/financial regimes ranging from exogenously incomplete regimes of savings only to mechanism design models with unobserved output as well as with limited commitment and moral hazard. Karaivanov and Townsend (2014) use the methods from Vuong (1989) to find which information/financial regime as a data generating process comes closest to the actual data on investment, capital stock, income and consumption. Obstacles are shown to vary by geography and urban versus rural status. When mechanisms/markets are found to be exogenously incomplete, there is an obvious rationale for policy interventions, for example by offering financial products that put risk contingencies into standard borrowing/lending contracts. The endogenously incomplete regimes suggest a focus on the specific obstacles to trade that are uncovered. If moral hazard with unobserved effort is the problem, then move toward systems with less expensive monitoring, as with the use of digital payments.

In sum, heterogeneity creates divergence in impacts within villages even from seeming beneficial interventions. Likewise, obstacles to trade create a middle ground between full insurance and simpler financial contracts. For example, with obstacles to trade such as imperfect information that are uncovered, policy should focus on alleviating those obstacles. In general both heterogeneity and various imperfect information/financial regimes need to be considered jointly. Heterogeneity in monitoring costs may be key, which we on elaborate next.

4 Networks

Work on networks within villages provides a more granular view with surprising implications for policy.

The view that formal and informal mechanisms are substitutes, and that outside interventions can only help borrowers, is overturned in various network studies. The introduction of formal institutions can shrink networks or alter transactions that might have otherwise been beneficial. Banerjee et al (2021) show that the number of network links (not just financial but also social) can diminish after a microfinance intervention, and that households unlikely to take up microfinance suffer nevertheless the greater loss of informal borrowing and risk sharing. Binzel, Field and Pande (2013) show that informal risk sharing in networks can be diminished, with transactions shifted towards more social links. Heß, Jaimovich and Schündeln (2018) find lower levels of transfers in networks, which they attribute to wealth effects from a village-level transformation process towards a more formal economy, and to elite capture with unequally distributed benefits leading to reductions in social capital.

The view that formal and informal are complements can also be qualified with network data. Though, overall, informal network links are helpful and effective in policy interventions, Chandrasekhar, Kinnan and Larreguy (2018) pinpoint the role of differential enforcement in informal networks. Socially close pairs cooperate even without enforcement, but distant pairs do not. Pairs with unequal importance also behave less cooperatively without enforcement. Thus capacity for cooperation in implementing an outside intervention depends on position in the underlying network.

Networks are also dynamic. With shocks to market/network participation, links for directly and/or indirectly connected households vary over time. Chandrasekhar, Townsend and Xandri (2021) find from risk sharing theory that the most valuable households are those that bring liquidity into the market when the market has few participants and covariate risks are high. Such households are

compensated via an informal insurance premium that is evident in the consumption data. They establish that external policy interventions can be guided: Liquidity injections should be targeted to the most valuable people, those in the network when the network is thin and risks are high.

In sum, data on networks and modeling explores the previously mentioned middle ground but with the additional data. It finds new pathways for the impact of policy, which can be perverse, on the one hand, or which can help in targeting, on the other. Unique, high-frequency panel data, including transactions in networks over household and time, allow us to go even further.

5 The Village Money Market, Panel Data Connecting Formal to Informal

Sripakdeevong and Townsend (2019) provide a rare in-depth look at exactly how networks function, and the relationship of formal institutions to these informal networks. This work uses the Townsend Thai monthly panel data, which began in September 1998 with an extensive baseline, then resurveying on a monthly basis over the next twenty years. These data have household identifiers for both sides of all pairwise transactions, including the nature of the transaction (finance, gift), quantities, and whether or not part of a large credit contract, i.e., borrow with a stated purpose versus repaying a loan. Thus one can link a given household to another in informal transactions, link a given household to a quasi-formal village level institution or link to an outside lender. Further, with the network data one can quantify the role of indirect links and various types of credit chains. Sripakdeevong and Townsend term all these connections the *village money market*.

To highlight the main results, there is great variety in both formal and informal lenders in these village data. There is high correlation and a heavy seasonal component between amounts borrowed and amounts repaid. This carries over to borrowing from one source to pay off another, which is often statistically significant and nontrivial in magnitude, both within and across lenders. A substantial amount of activity is within the same household over time and is often associated with borrowing from informal sources to pay off formal loans, or vice versa. These Repayment Loans are especially prevalent in poor provinces, and when borrowed from informal sources, these loans have atypically high interest rates and are atypically larger.

Half of these Repayment Loans are part of Credit Refinancing Chains – transactions involving two or more complementary links. For example, a medium-term formal loan A is due. There is borrowing of bridge loan B at short-term at high interest in the informal sector to pay off loan A, and then the proceeds of a new formal loan C allows for repayment of the short-term informal loan B. The two repayment links in this chain are short-to-long, B to A, and long-to-short, C to B. Figure 1 graphically illustrates this. There are also more complicated chains involving multiple medium-term lenders.

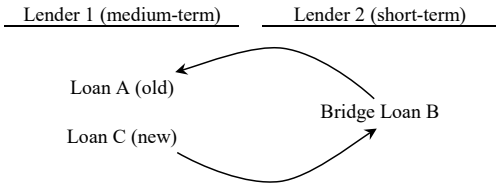

Figure 1: Credit Refinancing Chain
Note: Reproduced from Figure 1 in Sripakdeevong and Townsend (2019)

Another type of chain arises from loans that are borrowed to lend to someone else. These are referred to as Borrow-to-Relend loans. Lending is measured much less frequently in the data than borrowing, and so households may be under-reporting their own informal lending activity. But 2.5% of all loans are borrowed to be relent, and this can reach 19% in some circumstances. Though 40% of the source of funds for lending is from own-savings, 30% is borrowed from others. When a borrower down the credit refinancing chain is late in repaying, the delays often propagate and those

upstream are also late. However, it is sometimes the case that the lender at an intermediate link in the chain still repays the original loan, effectively providing loan-repayment insurance to others. Interesting and even more striking, when the downstream loan is repaid early, the original loan is also repaid early, a positive propagation back through the chain.

5.1 Data on Loans

Sripakdeevong and Townsend (2019) utilize the data from the Townsend Thai monthly survey to analyze loans that originated within the eight-year period from January 1999 to December 2007.[2] In total, the survey team collected information on a total of 16,283 loans borrowed by 694 households. For every loan entered into, both preexisting and over time, there is a survey form with detailed questions about the loan (interest, expected repayment, relationship with lender) and a roster to make sure the loan is tracked month by month, over time, from initiation to repayment (if any). If repayment is unobserved, the loan is kept on the roster and questions asked each month. Again, relatively high monthly frequency allows direct or indirect quantification of repayment, rollover, and refinancing strategies. Intensive but creative matching algorithms are utilized on the data to identify loans, transaction partners, and especially multiple links in credit refinancing chains.

5.2 Loan Duration, Rate, Amount

The Bank for Agriculture and Agricultural Cooperatives (BAAC) and the Village Fund are the primary institutional lenders, that is, formal sources of funds. The BAAC is a government development bank, and the Village Fund is a program introduced by the Thai government at the village level in 2002. Table 1 shows the total amount borrowed from these and others on the selected loans totaling 337 million Baht, tabulated across lender and province. Households borrowed 82% of this sum from formal institutions while the remaining 18% come from informal sources. This is not this surprising, given both institutions' mandates to operate in rural areas. Commercial banks are underrepresented in rural areas, claiming it is difficult to compete for small loans against government-subsidized rates.

In more detail, the BAAC accounts for 34% of loans compared to 22% for the Village Fund. The BAAC dominates Village Fund in all provinces except Si Sa Ket. Commercial bank loans are rare but do show up at 3.3% due to their large loan size.[3] The category of Agricultural Cooperative is significant in Chachoengsao but barely present elsewhere, due to the spotty nature of that institution. The Production Credit Group (PCG) is a precursor to Village Fund; the government promoted it in villages but did not provide funding, hence the lack of lending from this institution. The category of Other Institutions groups all institutional lenders that the survey does not code, such as credit unions and companies selling goods on finance; grouped together, they have a significant share at 17%.

(Amount Borrowed) % of Column	Buri Ram	Chachoengsao	Lopburi	Si Sa Ket	Total
Agricultural Cooperative	0.0	19.1	0.7	0.9	5.8
Commercial Bank	0.9	8.1	2.1	0.2	3.3
PCG	2.2	0.0	0.1	0.5	0.5
Village Fund	19.9	13.8	16.2	48.2	21.6
BAAC	30.0	32.4	42.8	20.2	33.6
Other Institution	21.8	16.7	13.7	19.9	17.1
Institution Total	**74.7**	**90.0**	**75.6**	**89.8**	**81.9**
Kin Relationship	9.4	8.1	3.0	3.7	5.8
Non-Kin Relationship	12.1	1.3	20.2	5.4	10.8
No Relationship	3.8	0.6	1.2	1.1	1.5
Informal Total	**25.3**	**10.0**	**24.4**	**10.2**	**18.1**

Table 1: Distribution of Loan Amount Across Lender and Province
Note: Reproduced from Table 1 in Sripakdeevong and Townsend (2019)

[2] Data from loans outside this range still play a part in how they interact with loans within the selected range.
[3] Chachoengsao's figure is high due to a single 10 million baht loan.

Informal lenders are classified by the relationship between the borrower and the lender. In most cases, the borrower knows the lender, with only 1.5% of the loans borrowed from someone without a previous relationship. Households obtained 6% from kin and another 11% from a person with a non-kin relationship (e.g., neighbor). The percentage of informal sources varies across provinces, from 10% in Chachoengsao to 25% in Buri Ram.[4]

Table 2 shows the median of loan duration, interest rate, and loan size for the entire sample of loans, in contrast to Repayment Loans to the right (purpose of borrowing is to repay another loan). The table weights the median values for duration and interest rates by the amount borrowed. Informal Repayment Loans have an interest rate that is even higher than for institutional loans, 10% versus 7%, and higher than informal loans overall, at 0%. Yet kin borrow-to-repay loans have a longer duration, 12 months, relative to 10 months for the entire data set, and, yet more salient, for non-kin and no relation, the borrow-to-repay loans have a high rate of 24%. Refinancing through non-kin is expensive.

(*Median*)	Whole Set			Subset with Purpose = Repay		
Duration and Rate Weighted by Amount	Duration (Month)	Rate (%)	Amount (Baht)	Duration (Month)	Rate (%)	Amount (Baht)
Agricultural Cooperative	7	8.0	40,000	6	9.5	27,500
Commercial Bank	12	5.5	50,000	8	9.6	20,000
PCG	12	12.0	3,000	11	12.0	5,000
Village Fund	12	6.0	15,000	12	6.0	18,000
BAAC	12	8.0	30,000	12	9.0	28,000
Other Institution	12	6.0	3,000	60	9.0	11,000
Institution Total	**12**	**7.0**	**13,000**	**12**	**7.0**	**20,000**
Kin Relationship	10	0.0	5,000	12	10.0	13,000
Non-Kin Relationship	1	0.0	5,000	0	24.0	11,000
No Relationship	6	1.9	5,000	1	24.0	10,000
Informal Total	**1**	**0.0**	**5,000**	**1**	**10.0**	**11,000**
Total	**12**	**6.8**	**10,000**	**12**	**7.0**	**17,000**

Table 2: Loan's Duration, Interest Rate, and Amount Across Lender and Purpose
Note: Reproduced from Table 2 in Sripakdeevong and Townsend (2019).

5.3 Repayment

The Townsend Thai monthly data has shown that households are borrowing new loans for repayment of older loans. While most loans have a single purpose, some have multiple purposes, which Sripakdeevong and Townsend (2019) split across the purposes into equal amounts. Summarizing the findings here: Consumption as a purpose has a higher share at 26%; meanwhile, households use 16% of loans for repayment of older loans.

For the Repayment loans, Sripakdeevong and Townsend (2019) observed some key patterns. Households receive cash from the Repayment loan and use it to repay another loan. This process usually involves creating a credit refinancing chain around a short-term Bridge loan which allows households to avoid a liquidity constraint. But there is also formal loan restructuring. This is a peculiar way to record such activity, but is due to a limitation in survey design. In these cases, money does not actually exchange hands, but the records are simply updated at the financial institutions. These Repayment loans are often used to defer repayment on consumption loans. Investment loans are present (8.9%) in the sample, but usually have multi-year duration from onset and do not require deferment.

Sripakdeevong and Townsend (2019) looked at the prevalence of Repayment loans across lender and province.[5] They observed that the Village Fund and BAAC are the institutional sources with higher percentages of loans borrowed for repayment, particularly in the poorer provinces of Buri Ram and Si Sa Ket. The village money market is more active there. The percentage of such Repayment loans for Village Fund is negligible in the rich provinces of Chachoengsao and Lopburi. The BAAC figures are also lower there but remain significant. Repayment loans involving Commercial Banks

[4] For more on heterogeneity and changes over time, see Sripakdeevong and Townsend (2019).
[5] Detailed in Table A.2 in Sripakdeevong and Townsend (2019).

are associated with formal restructuring, which is not very common in the rural economy. Informal sources have a higher percentage of repayment loans than institutional sources. This is especially true for loans borrowed from Kin. Loans borrowed from Non-Kin (e.g., high interest) occur only in the poor provinces. The proportion of Repayment loans also varies with time. The figure for the Village Fund has been growing over time since its inception. The proportion of Repayment loans for BAAC and Informal Sources were initially declining. But after the introduction of the Village Funds, the figures started to recover. The Village Fund plays a complementary role to both the BAAC and the Informal Lenders in the credit refinancing chain.

5.4 Matching Loans: Algorithms

Out of 14,109 loans, there are 2,422 repayment loans whose purpose is solely or at least partly to repay an older loan. Sripakdeevong and Townsend (2019) match these Repayment loans to the Target loans that they repay. This approach allows them to exclude households whose borrowing coincidentally occurs after repayment in the same month. Unfortunately, the information on these credit refinancing chains is not readily available because the activity was not anticipated in the survey design. Sripakdeevong and Townsend (2019) manually read through the notes on the 2,422 loan survey forms, and in 753 cases were able to deduce the loan number information of one or more Target loans. For these cases, the following procedure is used to generate matches, totaling 24.0 million Baht:

- One to One: In the most simple case, the surveyor notes that loan A is used to repay loan Z. Loan A could also be used for other purposes apart from repayment, but there is no other loan than loan Z mentioned. In this case, match A to Z with the amount $min(Repay_Z, Borrow_A)$.
- Multiple Repayment Loans: In this case, Repayment loans A and B are used to repay Target loan Z. The general principle is to compare dates and first match events occurring in the same month, then those occurring one month apart and so forth.
  - Example 1: Let A be borrowed at time t, B be borrowed at $t-1$, and Z be repaid at time t. First, match A and Z with the amount $min(Repay_Z, Borrow_A)$. Then moving on to events that occur one month apart, match to B with remaining amount $min(Repay_Z - min(Repay_Z, Borrow_A), Borrow_B)$. Of course, this amount could be zero, in which case no match is made. One could imagine that in a more complicated case it is not zero and there could be loan C borrowed at $t-2$, continuing the matching process.
  - Example 2: Let A and B be borrowed at t; and Z repaid at t. In this case, match $min(Repay_Z, Borrow_A + Borrow_B)$ and attribute it proportionally.[6]
- Multiple Target Loans: In this case, loan A is used to repay loan Z and loan Y (and possibly more). The procedure is similar to the previous case, with the roles reversed, following the same principle of matching events occurring in the same month, and then those occurring one month apart and so forth. If the Target loans are repaid in the same month, then match $min(Repay_Z + Repay_Y, Borrow_A)$ and attribute it to Z and Y proportionally.[7]

Table 3 describes the patterns of repayment and target loans. Overall, exchanges between informal and institutional source are quite substantial at 38%, and also balanced: 17% of institutional repayment loans target informal loans versus 21% of informal loans that target institutional sources. The majority (54%) of the Repayment flows are within the Institutional Lenders, and these are mainly from within the same lender: BAAC (19%) and Village Fund (23%). Meanwhile, the flows within the Informal source are small at 6.5%.

The diagonal entries show flows within the same lender, and together they account for 51% of repayment flows. This number is surprisingly high because a careful lender will never allow a

[6] Proportionally means: $\frac{Borrow_A}{Borrow_A+Borrow_B} min(Repay_Z, Borrow_A + Borrow_B)$ to A and $\frac{Borrow_B}{Borrow_A+Borrow_B} min(Repay_Z, Borrow_A + Borrow_B)$ to B.

[7] Further discussion of Multiple Repayment Loans and Multiple Target Loans can be found in Sripakdeevong and Townsend (2019).

	(*Flow of Repayment*) % of Total (62.5 M Baht)	Agricultural Cooperative	BAAC	Commercial Bank	Other Institution	PCG	Village Fund	**Institution Total**	Kin Relationship	Non-Kin Relationship	**Informal Total**	**Total**
Repayment Loan	Agricultural Cooperative	0.3	0.0	0.0	0.0	0.0	0.0	**0.4**	0.0	0.5	**0.6**	**1.2**
	BAAC	0.0	19.2	0.3	1.6	0.1	0.9	**22.0**	5.0	4.9	**9.9**	**32.4**
	Commercial Bank	0.0	0.1	0.1	0.0	0.0	0.0	**0.1**	0.0	0.0	**0.1**	**0.2**
	Other Institution	0.0	1.2	0.2	2.8	0.0	1.3	**5.5**	0.3	0.1	**0.4**	**5.9**
	PCG	0.0	0.0	0.0	0.0	0.1	0.1	**0.2**	0.0	0.0	**0.0**	**0.2**
	Village Fund	0.1	0.8	0.0	1.5	0.0	23.2	**25.6**	4.5	1.6	**6.2**	**32.0**
	Institution Total	**0.5**	**21.3**	**0.6**	**6.0**	**0.2**	**25.4**	**53.9**	**9.9**	**7.2**	**17.1**	**71.9**
	Kin Relationship	0.0	4.7	0.0	0.7	0.2	5.5	**11.1**	1.4	0.6	**2.0**	**13.5**
	Non-Kin Relationship	0.6	6.7	0.0	0.6	0.0	2.0	**9.9**	0.7	3.8	**4.5**	**14.7**
	Informal Total	**0.6**	**11.4**	**0.0**	**1.2**	**0.2**	**7.5**	**21.0**	**2.1**	**4.4**	**6.5**	**28.2**
	Total	**1.1**	**32.7**	**0.6**	**7.2**	**0.4**	**33.0**	**75.0**	**12.0**	**11.6**	**23.6**	**100.0**

Table 3: Repayment Loan as Source to Pay Off Target Loan
Note: Reproduced from Table 3 in Sripakdeevong and Townsend (2019).

particular household to literally borrow a new loan to repay an old one. Even if the household does not make explicit its true purpose, the lender can easily deduce foul play. The lender could, of course, agree to restructure the loan. In this case, no money will actually exchange hands, but the survey will still record it as one loan paying off another. The possibility of restructuring makes the debt state-contingent. Townsend and Yaron (2001) documented the restructuring process for the BAAC, and found that it is accompanied by state verification. Apart from verification costs, households have other reasons to avoid verification: They might not be able to account for their investment, having instead consumed it, or they might have already received previous deferments from the lender and are not eligible for more.

To avoid verification, the insolvent household could mimic the behavior of a solvent household. The household will have to repay a loan A before borrowing a new loan C from the lender. The insolvent household can easily solve his liquidity constraint by borrowing a short-term Bridge loan B from another lender. Having proven his solvency, he can borrow loan C from the same lender. This explains the repayment flow between institution lenders and informal sources. The credit refinancing chain allows households to avoid verification, while still deferring repayment. A simple rule to distinguish a credit refinancing chain versus restructuring is to check whether repayment flows are between lenders or within lender. The number for refinancing is higher for the institutional sources because they allow restructuring. Meanwhile, informal loans are primarily used in credit refinancing chains, and so involve repayment flows to other lenders.

The figure for the Village Fund is unusually high, at 70 percent.[8] This contradicts anecdotal evidence that restructuring is not common for Village Fund loans. When we started writing the original working paper, we were not able to explain this discrepancy. To better understand this issue, we traveled to the four provinces during the summer of 2011 and talked with the Village Fund loan officers. A single Village Fund sometimes acts as two units separated by a "firewall," with one unit providing the Bridge loan for the household to overcome the liquidity constraint imposed by the other. More generally, Village Fund officers may not want to officially defer loan repayment because they might well need to explain to the government why they approved a loan in the first place. They thus turn a blind eye as the households use the credit refinancing chain to avoid liquidity constraints; a local money-lender can offer short-term Bridge loans. The Village Fund officer can help approve the new loan so that the household can in turn repay the informal Bridge loan within a couple of days. With such high turnaround, a given money-lender can lend out several Bridge loans within the month, all while earning a hefty fee for each loan.

Again, some Village Funds go a step further. They help households avoid these fees by providing the Bridge loan themselves. They set aside an amount (usually from the savings account the household has with the Village Fund) and lend it off the books as a Bridge loan. These Village Funds boasted how they complete this task with such efficiency. They only need an amount in the segregated

[8] See Sripakdeevong and Townsend (2019) for Figure A.4 which shows percentage of flow that happens within each lender.

Bridge loan fund equal to the biggest loan being deferred. The new loan can be approved within the same day the old one was repaid. The same capital is used as a Bridge loan for every member of the village that needs deferment. This collusion against the government is not necessarily malicious. The Village Funds have a relatively low verification cost and thus are able to optimally allocate loans to the households in need. From this perspective, the villagers have invented a scheme to overcome inflexible government rules.[9]

We also find more complicated credit refinancing chains, as illustrated in Figure 2. All of the four main formal institutional lenders form a part of the simple credit refinancing chain $medium_{old} \leftarrow short_{bridge} \leftarrow medium_{new}$. Informal lenders provide the Short-term Bridge loan part, $medium_{old} \leftarrow short_{bridge}$, which allows the household to defer repayment of the BAAC loans. Village Fund is special in that it provides both the Short-term Bridge loan as well as the Medium-term loan being deferred. The Village Fund bridge loan is usually within lender, but we do see cases where it is used with medium-term BAAC loans.[10]

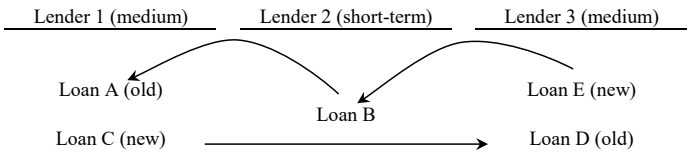

Figure 2: More Elaborate Credit Refinancing Chains
Note: Reproduced from Table 4 in Sripakdeevong and Townsend (2019)

As anticipated, only 5% of Village Fund deferment is done through formal restructuring. The BAAC, on the other hand, has almost 60% restructuring. We know from Townsend and Yaron (2001) that the BAAC is lenient with its borrowers, through building in contingency clauses. It makes sense for the household to first try formal restructuring and use a credit refinancing chain as a last resort. Kin relationship has a substantial $medium \leftarrow medium$ chain, but most of these are not loan restructuring (64.9% vs. 25.5%); the excess is repayment flow to other lenders. These represent an informal method of traditional refinancing, as Kin have cheap interest rates (on medium-term loans).

Sripakdeevong and Townsend (2019) find that the majority of Target loans are themselves repayment loans.[11] This makes sense in the context of the credit refinancing chain. The Bridge loan is used to repay another loan and is itself a target of repayment from a third loan. Households can receive multiple deferments so that the credit refinancing chain extends for several years.

5.5 Borrowing to Relend

Looking at the lending data module in the Townsend Thai monthly resurveys, between 1999 and 2007, Sripakdeevong and Townsend (2019) see that households lent 2,021 loans totaling 28.6 million baht. The biggest source of these funds is savings (40%) followed by borrowed money (30%) and business proceeds (13%). The term "Relend" is used to describe the lending of borrowed money. This process creates a network involving financial institutions and households. Out of the 2,021 loans lent out, relending occurs in 332 loans, totaling 8.4 million baht.[12] Because households borrow money to relend, the counterpart should exist in the separate borrowing dataset. Indeed, we find that households borrowed 191 loans for relending.[13]

To further study this issue, Sripakdeevong and Townsend (2019) link the 191 borrowed loans to the 332 relent loans by matching the cash flow based on the proximity of the transaction date, e.g.,

[9] See Ru and Townsend (2022) for related quantification of verification costs.

[10] The number of Village Fund $medium \leftarrow short$ transactions is lower than $short \leftarrow medium$ transactions because some Village Funds do not provide bridge loans. For those latter village cases, informal bridge loans form the credit refinancing chain with medium-term Village Fund loans.

[11] See Table A.3 in Sripakdeevong and Townsend (2019).

[12] In 324 cases, borrowed money is the sole source, and in 8 cases it is one of the sources.

[13] There is not in the sample the universe of all households.

for each of the borrowed loans looking for relending that occurs in the same month. If it does not exist, they continue looking at future months until a match is found, or never found.

In total, 6.7 million baht of borrowing can be linked to the relending data.[14] Matching is difficult for the 59 borrowed loans with multiple purposes. The remaining 132 loans solely used for relending have a much lower unmatched rate of 9%. For those matched, relending usually happens in the same month as borrowing.[15]

What if the relent loan is not repaid on time? Because the relender still needs to repay his own borrowed loan, and he is in the middle so to speak, he is in the position to provide insurance. Sripakdeevong and Townsend (2019) compare repayment dates of the borrowed and relent loans using the above-described links. A borrowed loan and its corresponding relent loan are more likely to be repaid in the same month if relending is the sole purpose: 70.3% vs. 36.9%. This is natural since the repayment the household receives should cover the amount of the corresponding borrowed loan. In total, both loans are repaid in 81% of the cases. On average, the borrowed loan is repaid 0.8 months after the relent loan.

When a borrower down the credit refinancing chain is late in repaying, what happens to the upstream lender who had borrowed money in the first place? For some, the delays propagate, and both are late. This happens 19 out of 28 times.[16] However, in the remaining cases, the lender in the chain still repays the original loan, effectively absorbing the risk and providing loan-repayment insurance. Interestingly and even more striking, when the downstream loan is repaid early, the original loan is also repaid early, a positive propagation back though the chain. This happens most of the time, 19 out of 23 times.[17]

6 Accounting for Heterogeneity and Participation in the Village Money Market: Obstacle-Adjusted Risk Sharing Equations

We will bring in the explicit notation from Sripakdeevong and Townsend (2019) to formalize the risk sharing equations mentioned above and to help explain the finding on the village money markets described in the previous section.

Smoothing and risk sharing continuously improve as the household moves from autarky, to savings only, to savings and borrowing, and then to state-contingent borrowing. Full state-contingency in loan repayment creates a complete market environment, resulting in Pareto optimal allocations characterized by full risk sharing. However, access to contingent loan products such as restructuring and credit refinancing chains does not necessarily achieve full insurance. With continuous income, it is unlikely that these products can be contingent on every state. For example, the lender might only be able to observe whether income is high or low and either demand full repayment or allow for full deferment. Furthermore, there are costs associated with the borrowing process. Therefore, this is a partial insurance environment.

This section formally models household-specific transaction costs and verification costs, which, along with risk aversion, allow for heterogeneity in risk sharing results.[18]

The economy consists of J networks, each with I_J agents.[19] Define the following household lifetime utility as:

$$U_i = \sum_t \sum_{s^t} \beta_i^t u_i(c_i(s^t)) \quad \text{for all } i \in I_J, \text{all } J \ ,$$

[14] There are 202 total pairs. Some borrowed loans are relent into multiple smaller loans.

[15] See Figure A.6 in Sripakdeevong and Townsend (2019) for a graphical illustration of this.

[16] See Jorion and Zhang (2009) for counter-party risk.

[17] See Sripakdeevong and Townsend (2019), Table A.5 for a summary of the relationship between on-time, early or late payment of borrowed and relent loans.

[18] See Sripakdeevong and Townsend (2019) for complete notation.

[19] The adjusted income variable is $y_i(s^t)$.

where s^t denotes history up to and including date t. Allow for heterogeneous discount rate, β_i, as well as heterogeneous risk aversion γ_i in CARA utility:

$$u_i(c_i(s^t)) = 1 - e^{-\gamma_i c_i(s^t)}.$$

Household i can borrow a one-period loan $b_i(s^t)$ at interest rate R. This generalizes into lending of the second party k, in which case $b_k(s^t) < 0$. The household's income is private information, but the network achieves truth-telling by allowing state verification as in Townsend (1979). The total verification costs borne by the two parties i and k are $v_i(b_i(s^t))$ and $v_k(b_k(s^t))$. Additionally the parties must also pay transaction costs $n_i(b_i(s^t))$ and $n_k(b_k(s^t))$, per Townsend (1978). Here transaction and verification costs are combined into a single term, which varies with $b_i(s^t)$ in the following fashion:

$$n_i(b_i(s^t)) + v_i(b_i(s^t)) = \frac{\phi_i}{2}(b_i(s^t))^2 \text{ for } i \in I_J.$$

This convex cost function was first introduced in Schulhofer-Wohl (2011). The framework allows for autarky as an extreme case with $\phi_i \to \infty$.

The household budget constraint is given below. Note that income is net of depreciation, investment and saving:

$$c_i(s^t) = y_i(s^t) + [b_i(s^t) - (R)b_i(s^{t-1}) - \frac{\phi_i}{2}(b_i(s^t))^2].$$

In the risk sharing equation, consumption will depend directly on income, and therefore there is only partial insurance:

$$c_i(s^t) \approx \frac{1}{\gamma_i + \phi_i} log\alpha_i\gamma_i + \frac{t}{\gamma_i + \phi_i} \log \beta_i - \frac{1}{\gamma_i + \phi_i} \log \lambda_{js^t} + \frac{\phi_i}{\gamma_i + \phi_i} y_i(s^t). \tag{1}$$

The coefficients ϕ_i and γ_i together determine the degree of dependency on income. The model can distinguish whether smooth consumption arises from low transaction/verification costs or from risk aversion. If $\phi_i = 0$, there is no cost, and the result reverts back to classical risk sharing. For $\phi_i > 0$, the degree of risk sharing depends on γ_i. Risk averse households are willing to pay cost ϕ_i to achieve smooth consumption. More risk tolerant households are willing to suffer consumption fluctuation to save on transfer cost. For a risk neutral household, $\gamma_i = 0$, consumption moves one-to-one with income, as they are not affected ex ante by consumption shocks. The household that has more financial access should, all else equal, have a lower ϕ_i and thus a lower income coefficient.

With household-level coefficients, Sripakdeevong and Townsend (2019) are able to distinguish whether a high $\hat{\delta}_i$ on the income term is due to high cost $\hat{\phi}_i$ or low risk-aversion $\hat{\gamma}_i$.[20] The results are presented in Table 6

The result of the $\hat{\delta}_i$ regression tells a consistent story. Borrowing is associated with a higher income coefficient. Within borrowers, the credit refinancing chain is associated with a lower income coefficient. From the $\hat{\gamma}_i$ regression, we see that borrowers are more risk-tolerant than non-borrowers. Additionally, from the weighted $\hat{\phi}_i$ regression, borrowing is associated with lower transaction/verification cost. We take up this more in Section 7 below.

At first glance, it might seem that borrowers are worse off from a risk sharing perspective, but in fact borrowers receive less insurance because it is optimal for them to bear the volatility. The $\hat{\phi}_i$ regression shows that access to a credit refinancing loan is associated with lower transaction/verification cost, beyond that of normal borrowing. When $\hat{\phi}_i$ is close to zero, even risk-tolerant but still somewhat risk-averse households can enjoy full risk sharing. This explains why households with access to a credit refinance chain have smooth consumption, despite being relatively risk-tolerant.

[20] See Sripakdeevong and Townsend (2019) for details.

	Income Coefficient $\widehat{\delta_i}$		CARA $\widehat{\gamma_i}$		Cost Parameter $\widehat{\phi_i}$	
	OLS	weighted	OLS	weighted	OLS	weighted
Borrow	0.0064*	0.00563	-0.550***	-0.561***	-0.0160	-0.0324*
	(1.97)	(1.58)	(-5.17)	(-6.02)	(-1.14)	(-2.47)
Contingent	-0.00188	-0.00204	-0.128	-0.0533	-0.00214	0.00172
	(-0.77)	(-0.89)	(-1.60)	(-0.90)	(-0.20)	(0.20)
Chain	-0.0105***	-0.0101***	-0.0587	-0.0668	-0.0424***	-0.0365***
	(-4.29)	(-4.48)	(-0.73)	(-1.13)	(-4.04)	(-4.37)
R^2 adjusted	0.113	0.132	0.098	0.105	0.0975	0.119
N	475	475	475	475	475	475

Table 4: Distribution of Amount Borrowed by Purpose
Notes: t statistics in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001. Reproduced from Table 5 in Sripakdeevong and Townsend (2019)

It is not surprising that users of the credit refinancing chain enjoy the lowest cost $\hat{\phi}_i$. Recall that this scheme is usually associated with the Village Fund and lenders from the informal sector, in particular borrowing and lending among kin. Kin are usually physically located within the same village, have a natural advantage in verifying income, and have lower marginal costs relative to others as formal credit from the Village Fund expanded. We also take this up below.

7 Policy Interactions: Formal Credit Amplifies Informal Networks Through the Village Money Market While Damaging Non-Network Households

Thus armed with our understanding of the village money market, we return to the initial debate over formal versus informal arrangements, from substitutes to complements. Formal and informal act as complements, reinforcing each other for some groups while not for others: Formal sector interventions can amplify informal social networks, while damaging welfare in non-networked groups.

The existing literature on the Village Fund intervention is the backdrop that provides exogenous variation. Kaboski and Townsend (2012) analyze a reduced form difference-in-difference specification in annual data, pre- versus post-Village Fund, interacted with inverse village size (number of households) as an instrument. The funding was one million baht per village, but the number of households in a village varies, so per capita treatment increased with inverse village size. By this metric, the formal sector intervention increased credit and consumption – seemingly less so for investment. Kaboski and Townsend (2011) use a structural model to evaluate the Village Fund intervention. This model features a permanent income model with buffer stocks, limited credit, and lumpy investment, estimated in baseline annual data pre-intervention, then allowing more liberal credit limits in post-intervention, replicating many aspects of reduced-form estimates in the post-intervention data. The evaluation showed there is subsequent support for the structural model chosen. Karaivanov and Townsend (2014) show that an exogenously incomplete savings-only regime and/or the lending/borrowing regime best fit the rural data. Subsequent work has added key aspects of heterogeneity. Specifically, Banerjee, Breza, Townsend, and Vera (2019) show that Village Funds were not allocated based on productivity but nevertheless profits and capital increase for the high TFP baseline households with TFP estimated in baseline pre-intervention data. This was possible through an indirect mechanism: Short-term non-program credit from other households. In the Townsend Thai monthly data, Vera-Cossio (2022) analyses how Village Fund committees allocated direct funds to richer, less productive, and elite-connected villagers.

Kinnan and Townsend (2012) had established that kinship networks act as collateral in the sense of connecting households indirectly to the formal sector. Ru and Townsend (2022) show that formal and informal financial sectors are more than simple complements. The Village Fund financial interventions reinforced and amplified informal kinship links. Transfers (gifts) among poor households

play a crucial role in funding investment, a role amplified by the Village Fund program, especially for those with preexisting informal kinship ties. Moreover, a financial/information regime shift is evident in the data. Though two exogenously incomplete regimes (saving-only and lending/borrowing) dominated for the relatively poor households before the Village Fund, costly state verification, a less incomplete financial regime, dominates in the sub-sample of poor households following the Village Fund intervention. When this verification cost is high, the model reduces to borrowing and lending with unobserved output. When the verification cost is low, the model reduces to perfect risk sharing. The structurally-estimated verification cost of the households with kinship ties is significantly lower than the one without kinship after 2001 relative to before.

The key to these results is the village money market delineating how informal kinship links interacted with the administration of the Village Fund. Borrowing to repay a given loan and borrowing to lend are key. As shown in the previous section, loan sizes are larger and interest rates are (much) lower if these borrowing-lending transactions are done within family groups. Evidently, the relatively large size of the Village Fund forced an information/financial regime shift. That regime shift to costly state verification is only apparent for relatively poor households indirectly linked through kinship to the original recipients of the Village Funds. Likewise, there is a significant double difference – a decline in verification costs when comparing indirectly linked via kin to non-linked households, after versus before the advent of the Village Fund. Related, there is some evidence that households without kin links suffered in this regime shift, moving to a less complete regime and suffering higher verification costs.

8 Conclusions and Tailored Policies

Though the debates have been productive, rationales for overly simplistic policy recommendations coming from an all-or-nothing view of financial access have been largely overturned in the data. Heterogeneity and explicit obstacles to trade are key aspects of models that need to be incorporated. Networks in particular can amplify or work against interventions, and do so for different groups at the same time. More work is needed to understand better exactly how networks function and how and why they can change with policy interventions. The work on village money markets is an important step in that direction.

Though the village economies are evidently every bit as sophisticated as financial markets in New York, as described by Pozsar (2014), the village money markets also suffer from similar problems. One such is an over-reliance on relationships, as these segment markets and limit more universal benefits. A second such are market problems stemming from contagion. Policy interventions facilitating financial access and the functioning of markets need to be guided by this view.

In terms of increasing financial access, distributed ledgers, cryptography, and smart contracts are powerful tools. Smart programmable contracts allow for not only a formalization of arrangements but also a commitment among those without kin or other relationships. In Thai villages, such multi-agent platform technologies would allow the benefits of outside interventions to extend beyond kinship networks. Likewise, the repo market in New York relies in large part on bilateral relationships among dealers with clients, and of dealers with each other. An uneven distribution of liquidity can cause repo rates to move dramatically against recommended policy rates. Programmable multilateral contracts can be shown to mitigate coordination problems and conserve on required liquidity provisions (Aronoff, Townsend and Zhang 2021).

In terms of market problems, financial contagion is also a problem. Kinnan et al (2021) establish that insurance, labor, and business supply chain networks in a village are not coincident. Thus an adverse, high expenditure shock to a household not in the gift-giving network forces a cut in hired labor and in input purchases. These adverse impacts propagate along labor and supply chain networks. Similarly, adverse shocks to balance sheets propagate through networks in the New York financial markets. The common remedy in both settings is for policymakers to take an ex ante point of view, to allow private/public sector innovations that provide better arrangements for agents to enter into insurance for idiosyncratic and aggregate shocks, including cross-village, cross-market infrastructures. This is the next challenge.

9 References

1. Alliance for Financial Inclusion. 2010. "G20 leaders emphasize financial inclusion as driver for social and economic growth." Press release, June 28. https://www.afi-global.org/newsroom/news/g20-leaders-emphasize-financial-inclusion-as-driver-for-social-and-economic-growth/

2. Angrist, Joshua D. 2014. "The Perils of Peer Effects." *Labour Economics* 30 (Oct): 98–108.

3. Aronoff, Daniel, Robert M. Townsend and Nicholas Zhang. 2021. "Coordination Problems, Leverage Constraints and A Smart Contract Implementation for the Repo Market." Working Paper, Massachusetts Institute of Technology.

4. Attanasio, Orazio and Steven J. Davis. 1996. "Relative Wage Movements and the Distribution of Consumption." *Journal of Political Economy* 104 (6): 1227–62.

5. Banerjee, Abhijit, Emily Breza, Arun G. Chandrasekhar, Esther Duflo, Matthew O. Jackson and Cynthia Kinnan. 2021. "Changes in Social Network Structure in Response to Exposure to Formal Credit Markets." NBER Working Paper No. 28365.

6. Banerjee, Abhijit, Emily Breza, Robert M. Townsend and Diego Vera-Cossio. 2019. "Access to Credit and Productivity: Evidence from Thai Villages." Working Paper, Massachusetts Institute of Technology.

7. Banerjee, Abhijit V, and Esther Duflo. 2014. "Do Firms Want to Borrow More? Testing Credit Constraints Using a Directed Lending Program." *Review of Economic Studies* 81 (2): 572–607.

8. Bell, Clive, T. N. Srinivasan, and Christopher Udry. 1997. "Rationing, Spillover, and Interlinking in Credit Markets: The Case of Rural Punjab." *Oxford Economic Papers* 49 (4): 557–85.

9. Binzel, Christine, Erica Field and Rohini Pande. 2013. "Does the Arrival of Formal Financial Institutions Alter Informal Sharing Arrangements? Experimental Evidence from Village India." Working Paper.

10. Boissay, Frederic, and Reint Gropp. 2013. "Payment Defaults and Interfirm Liquidity Provision." *Review of Finance* 17 (6): 1853–1894.

11. Bonhomme, Stephane, Pierre-Andre Chiappori, Robert M. Townsend and Hiroyuki Yamada. 2012. "Sharing Wage Risk." Working paper, MIT.

12. Chandrasekhar, Arun G., Cynthia Kinnan, and Horacio Larreguy. 2018. "Social networks as contract enforcement: Evidence from a lab experiment in the field." *American Economic Journal: Applied Economics* 10 (4): 43-78.

13. Chandrasekhar, Arun G., Robert M. Townsend, Juan Pablo Xandri. 2021. "Liquidity, Financial Centrality and the Value of Key Players." Working paper, MIT.

14. Chiappori, Pierre-Andre, Krislert Samphantharak, Sam Schulhofer-Wohl, and Robert M. Townsend. 2014. "Heterogeneity and Risk Sharing in Village Economies." *Quantitative Economics* 5 (1): 1–27.

15. Cocco, João F., Francisco J. Gomes, and Nuno C. Martins. 2009. "Lending Relationships in the Interbank Market." *Journal of Financial Intermediation* 18 (1): 24–48.

16. Conning, Jonathan. 2001. "Mixing and Matching Loans: An empirical analysis of credit rationing and Spillovers in a Rural Credit Market in Chile." Project IRIS working paper # 164, University of Maryland.

17. Conning, Jonathan. 2005. "'Ventas Piratas': Product market competition and the depth of lending relationships in a rural market in Chile." Working paper, City University of New York.

18. Deaton, Angus. 1990. "On risk, insurance, and intra-village consumption smoothing." Working paper, Princeton University.

19. Diamond, Peter. 1967. "The Role of a Stock Market in a General Equilibrium Model with Technological Uncertainty." *American Economic Review* 57 (4): 759-776.

20. G20 Presidency of Indonesia. 2022. "Recover Together Recover Stronger." g20.org, Accessed February 11, 2022. https://g20.org/g20-presidency-of-indonesia/#recover

21. Gine, Xavier. 2011. "Access to capital in rural Thailand: An estimated model of formal vs. informal credit." *Journal of Development Economics* 96 (1): 16-29.

22. Heß, Simon, Dany Jaimovich, and Matthias Schündeln. 2021. "Development Projects and Economic Networks: Lessons from Rural Gambia." *Review of Economic Studies* 88 (3): 1347–1384.

23. Hoff, Karla, and Joseph E. Stiglitz. 1990. "Introduction: Imperfect information and rural credit markets: Puzzles and policy perspectives." *World Bank Economic Review* 4 (3): 235-250.

24. Jain, Sanjay. 1999. "Symbiosis vs. crowding-out: the interaction of formal and informal credit markets in developing countries." *Journal of Development Economics* 59 (2): 419-444.

25. Jacobson, Tor, and Erik von Schedvin. 2015. "Trade Credit and the Propagation of Corporate Failure: An Empirical Analysis." *Econometrica* 83 (4): 1315-1371.

26. Jorion, Philippe, and Gaiyan Zhang. 2009. "Credit Contagion from Counterparty Risk." *Journal of Finance*, 64 (5): 2053-2087.

27. Kaboski, Joseph P., and Robert M. Townsend. 2011. "A Structural Evaluation of a Large-Scale Quasi-Experimental Microfinance Initiative." *Econometrica* 79 (5): 1357-1406.

28. Kaboski, Joseph P., and Robert M. Townsend. 2012. "The Impact of Credit on Village Economies." *American Economic Journal: Applied Economics* 4 (2): 98-133.

29. Karaivanov, Alexander, and Anke Kessler. 2018. "(Dis)advantages of informal loans – Theory and evidence." *European Economic Review* 102 (February): 100-128.

30. Karaivanov, Alexander and Robert M. Townsend. 2014. "Dynamic Financial Constraints: Distinguishing Mechanism Design from Exogenously Incomplete Regimes." *Econometrica* 82 (3): 887–959.

31. Kinnan, Cynthia, Krislert Samphantharak, Robert M. Townsend, and Diego Vera-Cossio. 2021. "Propagation and Insurance in Village Networks." Working Paper, Massachusetts Institute of Technology.

32. Kinnan, Cynthia, and Robert Townsend. 2012. "Kinship and Financial Networks, Formal Financial Access, and Risk Reduction." *American Economic Review* 102 (3): 289-93.

33. Ligon, Ethan, Jonathan P. Thomas and Tim Worrall. 2002. "Informal Insurance Arrangements with Limited Commitment: Theory and Evidence from Village Economies." *Review of Economic Studies* 69 (1): 209-244.

34. Petersen, Mitchel A., and Raghuram G. Rajan. 1997. "Trade Credit: Theories and Evidence." *Review of Financial Studies* 10 (3): 661-691.

35. Pozsar, Zoltan. 2014. "Shadow Banking: The Money View." US Department of Treasury, Office of Financial Research Working Paper 14-04.

36. Ravallion, Martin, and Shubham Chaudhuri. 1997. "Risk and Insurance in Village India: Comment." *Econometrica* 65 (1): 171–184.

37. Ru, Hong, and Robert M Townsend. 2022. "Kinship Networks Enhanced by a Formal Financial Intervention: Costly State Verification and the Thai Village Fund." Working Paper, Massachusetts Institute of Technology.

38. Samphantharak, Krislert, and Robert M. Townsend. 2018. "Risk and Return in Village Economies." *American Economic Journal: Microeconomics* 10 (1): 1-40.

39. Schulhofer-Wohl, Sam. 2011. "Heterogeneity and Tests of Risk Sharing." *Journal of Political Economy* 119 (5): 925–958.

40. Silva, Dejanir H. and Robert M. Townsend. 2021. "Risk-taking over the Life Cycle: Aggregate and Distributive Implications of Entrepreneurial Risk." Working paper, Massachusetts Institute of Technology.

41. Sripakdeevong, Parit and Robert M. Townsend. 2019. "The Village Money Market Revealed: Credit Chains and Shadow Banking." Working paper, Massachusetts Institute of Technology.

42. Suri, Tavneet. 2013. "Estimating the Extent of Risk Sharing Between Households." Working paper, Massachusetts Institute of Technology.

43. Townsend, Robert M. 1978. "Intermediation with Costly Bilateral Exchange." *Review of Economic Studies* 45 (3): 417-425.

44. Townsend, Robert M. 1979. "Optimal Contracts and Competitive Markets with Costly State Verification." *Journal of Economic Theory* 21 (2): 265-293.

45. Townsend, Robert M. 1994. "Risk and Insurance in Village India." *Econometrica* 62 (3): 539-591.

46. Townsend, Robert M., and Jacob Yaron. 2001. "The Credit Risk-Contingency System of an Asian Development Bank." *Economic Perspectives* 25 (3): 31-48.

47. Vera-Cossio, Diego. 2022. "Targeting Credit through Community Members." Forthcoming in *Journal of the European Economic Association*.

48. Vuong, Quang H. 1989. "Likelihood Ratio Tests for Model Selection and Non-Nested Hypotheses." *Econometrica* 57 (2): 307-333.

49. Wade, Robert. 1988. *Village Republics: Economic Conditions for Collective Action in South India*. Cambridge: Cambridge University Press.

50. Wilson, Robert. 1968. "The Theory of Syndicates." *Econometrica* 36 (1): 119-132.