Kinship and Financial Networks, Formal Financial Access and Risk Reduction

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The importance of kinship networks in facilitating consumption smoothing and investment financing has been documented in many settings, but the channels through which networks matter are not well understood. We use detailed panel data on Thai households to study the financing devices used for consumption and investment by households with and without kin in the village, and with or without connections to financial institutions. Households that are connected to commercial and government banks directly or indirectly, through borrowing from connected households, achieve significantly better smoothing of consumption than unconnected households, controlling for the presence of kin and the effect of net worth. Investment, on the other hand, appears to be financed through kinship networks and through government banks: households with kin in the village and with connections to government banks display reduced sensitivity of investment to income, while connections to commercial banks do not significantly reduce investment sensitivity. We test the hypothesis that kin networks facilitate large investment expenditures through the relaxation of collateral constraints. The investment-smoothing benefit of kin networks is concentrated among households in occupations where the average investment size is high relative to net worth, suggesting that kin may act as "implicit collateral," permitting borrowing that cannot be collateralized with tangible assets.

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Many risks are present in rural developing economies: illness, business failure or job loss, income volatility due to weather and other shocks, the sudden need to finance an investment opportunity, etc. Yet for many households in rural developing economies, consumption and investment are insured against short-term, idiosyncratic risks to a large extent, despite these risks and the limited availability of formal banking and insurance products. (For evidence of a high degree of insurance see, among others, Rosenzweig (1988), Townsend (1994), Townsend (1995), Udry (1994), Morduch (1995) and Suri (2005). Limited access to formal banking is documented in Banerjee and Duflo (2007).)

The importance of kinship networks in facilitating consumption smoothing and investment financing has been documented in many settings, for instance early New England in Lamoreaux (1986), the Philippines in Fafchamps and Lund (2003), and Thailand in Ahlin and Townsend (2007) and Samphantharak and Townsend (2010), and Mexico by Angelucci et al. (2011). Guiso et al. (2004) study social capital as an important condition for financial development in Italy. The importance of kin networks in other contexts has been studied by Munshi (2003) in the case of Mexico-US migration, Munshi and Rosenzweig (2009) for intra-Indian migration, among others.

Access to formal financial institutions is also understood to play an important role in the smoothing of consumption and investment in developing countries. Burgess and Pande (2005) document the role of rural banks in poverty reduction in India. Kaboski and Townsend (forthcoming) and Fulford (2011) show the importance of formal credit in facilitating consumption smoothing in rural Thailand and India, respectively, by allowing households to keep lower buffer stocks. When Banerjee et al. (2010) study microloans in India and and Dupas and Robinson (2011) study bank savings accounts in Kenya, they find that such financial access facilitates a combination of business investment (for some entrepreneurs) and consumption smoothing. Highlighting the possible interplay

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between banks and networks, Karlan and Zinman (2010) study short-term bank loans in the Philippines and find that they improve business profits, by allowing businesses to shed unproductive family members from their payroll.

While the importance of kinship networks and financial access are increasingly well-documented, the *channels* through which these effects occur are not well understood. As noted by Samphantharak and Townsend (2010), network effects may arise due to direct effects, i.e. lending among network members, or due to signalling effects, whereby one's membership in the network provides information about one's type: riskiness, expected investment return, etc. Lending among network members, in turn, may serve primarily to move capital around within an essentially closed system, or it may serve to reallocate capital borrowed from outside the network, for instance from a bank, to network members with high marginal utility or rates of return, who cannot borrow from the bank directly.[1] In that case, networks and bank access may be important complements. Kinship and social ties have also been shown to play an important role in the functioning of joint-liability microfinance (Besley and Coate (1995)) and credit cooperatives (Banerjee, Besley and Guinnane (1994)). Recent theoretical advances in modeling the roles of networks in consumption smoothing have elucidated the workings of this channel: kinship and social ties may act as "implicit collateral," enforcing risk-sharing and loan repayment when formal enforcement is absent (Bloch, Genicot and Ray (2008), Karlan et al. (2009), Ambrus, Mobius and Szeidl (2010), Jackson, Rodriguez-Barraquer and Tan (forthcoming)).

Going beyond the reduced-form relationship between kinship networks, financial access and consumption/investment smoothing to distinguish the channels whereby they matter is of both theoretical and policy interest. For instance, understanding these channels is relevant to the ongoing policy debate about how to reach currently unbanked households.[2] If informal lending transmits many of the benefits of financial access to

[1] Individuals in need of credit may be unable to borrow from a bank directly due to lack of documentation, lack of collateral, costs of travelling to the bank, or credit rationing/targeting. All of these are potentially relevant in rural Thailand.

[2] There is a growing empirical and theoretical literature on the impacts of access to financial institutions which provide savings and credit to households unserved by banks Giné and Townsend (2004), Kaboski and Townsend (2005), Kaboski

those who do not borrow from banks directly, this has implications for the measurement, welfare impacts and optimal targeting of financial access. If kinship networks are passive conduits in the process of reallocating bank lending to those who need credit but cannot borrow from the bank due to paperwork or distance, lowering transactions costs at banks may allow those who lack a kinship network to borrow, without increasing default rates. However, if kinship networks are providing information or other complementary inputs along with credit, lowering transactions costs to allow those without kin to borrow may be ineffective: loan takeup may be low or (involuntary) default rates may be high. If kinship networks act as implicit collateral, lowering transactions costs may lead to increases in borrowing by those without kin, but the (voluntary) default rates on these loans may be high.

From a theoretical perspective, understanding the channels whereby kinship and financial networks matter can inform the growing literature that analyzes the interaction between network structures and risk sharing. Among this literature, one paper closely related to ours is Bloch, Genicot and Ray (2008), who build a model of informal insurance in social networks where agents face both informational and commitment constraints. Their main result is a characterization of network structures that are stable under certain exogenously-specified risk-sharing arrangements. In contrast, we do not restrict the degree of risk sharing exogenously, but instead study the degree and structure of informal risk-sharing observed in the data. That is, we imagine that among those in potentially endogenous financial networks connected to a commercial or government bank, the channels may work so well as to reach a full information full commitment optimum. We test this hypothesis for both consumption smoothing and investment smoothing.

Several recent papers modelling the role of networks suggest an explanation for the role of kinship networks in fostering investment smoothing. Ambrus, Mobius and Szeidl (2010) study punishments within social networks at the level of network connections: that is, assuming that in case of breach of a lending or insurance agreement, only the counterparty can inflict punishment. This is motivated by the assumption that "when a

and Townsend (2009*a*), Kaboski and Townsend (2009*b*), Dupas and Robinson (2009), Collins et al. (2009).

relationship goes bad, outsiders cannot assign the blame: they do not learn who broke a promise." In the resultant networks, "high value" links will support the most risk-sharing. Jackson, Rodriguez-Barraquer and Tan (2010) assume full information transmission within networks and study network structures that support renegotiation-proof risk-sharing and are robust to social contagion. The networks that emerge are unions of completely-connected subnetworks.

Like Ambrus et al., we take kinship networks as fixed, but study two different types of networks—kinship and financial—motivated in part by the possibility that information may travel differently in these networks; in particular, kinship networks may facilitate sharing information about "who broke a promise" and thereby allow greater punishments, such as punishment of the entirety of the promise-breaker's kinship network and/or punishment by the entirety of the party against whom the promise was broken. By allowing for assignment of blame and therefore greater off-equilibrium punishments, kinship networks may permit borrowing of larger amounts and the smoothing of larger shocks than could be smoothed by bilateral punishment alone.[3] Moreover, kinship is a transitive relation that naturally leads to completely-connected subnetworks of the kind that emerge in Jackson et al., while financial transactions may link subnetworks.

One difficulty in studying financial networks as related to, but distinct from kinship or social networks is observing financial networks, which requires data on the counterparties with whom a household engages in transactions. Ideally, one would also know which counterparties *could* be used for transactions, since expectations about the availability of credit or insurance will affect behavior even when the option is not exercised Deaton (1991). We are able to address both issues, using detailed monthly panel data on Thai households, residing in 16 villages, over the period from January 1999 to December 2005 Townsend (2007). These data include the identity of the counterparty for all within-village transactions, allowing us to construct financial networks within each village. Moreover, by pooling information over 84 months we will observe a better ap-

[3]Ambrus et al. acknowledge that sanctions extending beyond the counterparty will achieve greater risk sharing, but do not model such sanctions or consider when they might arise.

proximation to a household's full potential network than data covering only a single point in time. Combined with data on the presence of kin in the village, we study the financing devices used for consumption and investment by households with and without kin living in their village. More generally, we seek to understand the role of both endogenous financial networks and exogenous kinship networks, allowing for both simultaneously.

To briefly preview our findings, households that are connected to banks–either by borrowing from them directly, or indirectly, through borrowing from connected households–achieve significantly better smoothing of consumption than unconnected households, controlling for the effect of connections to kin and of household net worth. Indirect connections appear to as effective as direct connections, indicating that inter-household borrowing effectively circulates credit obtained from financial institutions. For connected households, we cannot reject that they attain the full information full commitment optimum in terms of consumption. This finding has implications for studies of the effect of financial access: ignoring the effect of being indirectly connected to financial networks and institutions, and using households not directly connected as a comparison group, may yield biased estimates due to the "spillover" of indirect financial access.[4]

Large investment expenditures, on the other hand, appear to be financed through kinship networks: households with kin in their village display significantly reduced sensitivity of investment to income, while connections to banks do not significantly reduce investment sensitivity. We test the hypothesis that kinship networks facilitate large investment expenditures through the relaxation of collateral constraints by showing that the investment-smoothing benefit of kin networks is concentrated among households in occupations where the average investment size is high relative to net worth. These results suggest that kin act as implicit collateral, permitting borrowing that cannot be collateralized with tangible assets.

The endogeneity of financial access is a concern in interpreting the correlation between bank access and consumption smoothing as a causal effect. Unlike the papers

[4]This echoes the findings of Angelucci et al.(2009) on the spillover effects of cash transfers in the presence of village-level insurance.

cited above on the effects of financial access, we do not exploit a randomized or natural experiment to identify exogenous changes in financial access.[5] However, we believe that endogeneity of financial access is unlikely to explain our results, for two reasons. First, households would likely select into being customers of a bank on the basis of having high consumption-income comovement, so if anything, our finding that direct bank access significantly reduces consumption-income comovement may be a lower bound on banks' true effect. Secondly, our measure of indirect access to banks is based on instances where borrowing, lending and/or gift-giving actually takes place. Of two households who have a partner from whom they could obtain a loan or a gift, the household who actually exercises that option is likely to have experienced greater income volatility. So our findings on the positive effect of indirect bank access are also likely to be, if anything, lower bounds on the true effect.

The rest of the paper proceeds as follows. Section I presents a theoretical framework illustrating the posible role of kinship ties in facilitating formal borrowing, and a simple example. Section II describes the data and construction of key variables. Section III presents the empirical specifications used to study the impact of kinship and connections to financial institutions. Section IV discusses the results, and Section V concludes.

I. Theory

To guide our empirical work, we begin by setting out a simple model of how the presence of kin may interact with access to credit. The model has predictions for when kin are likely to be especially important: namely, when a household has an opportunity to invest in a high-return project, but the amount of credit needed is too large to be financed from its own wealth, or by using that wealth as collateral to borrow. In such cases, kin can act as implicit collateral: the lender can threaten to punish not just the borrower, but his or her kin, if the loan is not repaid. (And the kinship network may help to repay the loan if the borrower's income is insufficient.) That is, we posit a role for kin similar to

[5] Although we use the same data as Kaboski and Townsend (forthcoming), in which a natural experiment occurred in terms of access to village funds (a type of community-controlled microcredit), our focus is on more formal banks, so we do not attempt to expoit that variation here.

that played by joint-liability microfinance groups.

Our model is similar to that developed in Karlan et al. (2009). In their model, different social ties carry different values, and as such they can sustain different levels of within-network cooperation. Our model introduces an outside lender, and shows that such an outside lender may also lend on the basis of this "social collateral" when physical collateral is insufficient. (This assumes the outside lender can assess the value of a given individual's social collateral, as banks in rural Thailand are likely able to do. We return to this issue below.)

A. Programming problem

Consider a group of three individuals. Person 1 has an income process $y_s(k)$, which is iid conditional on the investment level k. In the current period (t), individual 1 may get an opportunity to augment his capital by the nondivisible amount I^i, drawn from a distribution that puts positive mass on 0[6]:

$$k^i_{t+1} = k^i_t + I^i_t \tag{1}$$
$$I^i_t \in \{0,\ f(I)\}$$

We assume the expected marginal product of capital is high enough that, without borrowing constraints, individual 1 would always invest. Individuals whose wealth is not sufficient to finance their investment opportunities can borrow from their kin network. Those who are directly connected to a bank can borrow from the bank to finance their own investment, or borrow to on-lend to someone in their kin network. When they act as a group they are in effect pooling internal resources and outside access, subject to their current bargaining Pareto weights (or promised utilities).

We can characterize the set of constrained efficient outcomes by solving the following planning problem, maximizing the utility of person 3 subject to promise-keeping con-

[6]For simplicity, persons 2 and 3 do not get to invest in period t. We also assume that persons 2 and 3 have high enough Pareto weights, or utility promises, that their commitment constraints will not bind. Allowing groups of larger size complicates the notation, but does not change the intuition.

straints for 1 and 2 (Spear and Srivastava 1987). Treating promises as parameters one can trace out the entire Pareto frontier in this way. There is also an aggregate resource constraint and a commitment constraint for each person. We focus on the commitment constraint of person 1. Person 3's utility, $V^3(.,.,.)$ depends on the utilities promised to 1 and 2, $\mathbf{V}_s \equiv \{V_s^1, V_s^2\}$; the incomes of all three, $\mathbf{y}_s(\mathbf{k}_t) \equiv \left\{y_s\left(k_t^1\right), y_s\left(k_t^2\right), y_s\left(k_t^3\right)\right\}$,and the level of bank borrowing, B.Thus Person 3's value function is:

$$V^3(\mathbf{V}_s, \mathbf{y}_s(\mathbf{k}_t), B) = \max \left\{ \begin{array}{c} u\left(y_s\left(k_t^3\right) - I_t^3 - \tau_s^1 - \tau_s^2 - (1+r)B\right) \\ +\beta \mathbb{E}_{s'} V_{s'}^3 \left(\begin{array}{c} V_{s'}^1, V_{s'}^2, y_{s'}\left(k_{t+1}^1\right), \\ y_{s'}\left(k_{t+1}^2\right), y_{s'}\left(k_{t+1}^3\right), B' \end{array} \right) \end{array} \right\} \tag{2}$$

Subject to the following:

Law of motion for capital:

$$k_{t+1}^1 = k_t^1 + I_t^1 \tag{3}$$

Person 1's promise-keeping constraint:

$$u\left(y_s\left(k_t^1\right) - I_t^1 + \tau_s^1\right) + \beta \mathbb{E}_{s'} V_{s'}^1 \geq V_s^1 \tag{4}$$

Person 2's promise-keeping constraint:

$$u\left(y_s\left(k_t^2\right) - I_t^2 + \tau_s^2\right) + \beta \mathbb{E}_{s'} V_{s'}^2 \geq V_s^2 \tag{5}$$

and Person 1's participation constraint:

$$\begin{array}{l} V_{Aut}^1\left(y_s\left(k_t^1\right)\right) - 1(kin) \leq \\ u\left(y_s\left(k_t^1\right) - I_t^1 + \tau_s^1\right) + \beta \mathbb{E}_{s'} V_{s'}^1 \end{array} \tag{6}$$

Eq. 6 requires that Person 1 be willing to stay in the group rather than revert to autarky, leaving 2 and 3 to repay the bank loan. The term $\mathbf{1}(kin)$ reflects the fact that defaulting on a loan may be higher if Person 1 has kin in the village, because the kin may be excluded from future lending and may punish Person 1 for bringing this about. There is also a constraint that the group be willing to stay together, and repay the bank rather than defaulting. If they refuse to repay, they keep the principal and interest, but never borrow again. We write this group constraint in terms of maximizing 3's utility (given that 1 and 2 are getting their promised utilities):

$$
\begin{aligned}
(7) \qquad & V^3\left(\mathbf{V}_s, \mathbf{y}_s\left(\mathbf{k}_t\right), B\right) \\
\geq\ & u\left(y_s\left(k_t^3\right) - I_t^3 - \tau_s^1 - \tau_s^2\right) \\
& + \beta \mathbb{E}_{s'} V_{s'}^3 \left(\begin{array}{c} V_{s'}^1, V_{s'}^2, y_{s'}\left(k_{t+1}^1\right), \\ y_{s'}\left(k_{t+1}^2\right), y_{s'}\left(k_{t+1}^3\right), 0 \end{array} \right), \\
& \forall V_s^1, V_s^2
\end{aligned}
$$

where the last argument is 0 because no future borrowing is possible.

B. Example

In the 3-person group ($i \in$1,2,3), person 1 has low period 1 wealth, and a large investment opportunity I, implying high expected period 2 income $y_1 = y\left(k_1\right)$. For simplicity there are only two periods. Persons 2 and 3 have average wealth and average expected period 2 incomes $\bar{y}_2, \bar{y}_3$. Person 2 is connected to the bank, and has the option to borrow from it. But, if he borrows from the bank and lends the money to person 1, there is the risk that person 1 will not repay. (Person 1 then doesn't have to repay the loan, but is in autarky thereafter.)

The group maximizes, from the standpoint of the first period, without future uncertainty, the $\lambda-$weighted utilities from the present and the future. The period 2 payoff

is:

$$\lambda_1 u(y_1 + \tau_1) + \lambda_1 u(y_2 + \tau_2) + (1 - \lambda_1 - \lambda_2) u(y_3 + \tau_3) \tag{8}$$

s.t. budget balance:

$$-\sum_{i=1}^{3} \tau_i - B(1 + r) = 0 \tag{9}$$

and person 1's participation constraint:

$$u(y(k_1)) - \mathbf{1}(kin) \leq u(y(k_1) + \tau) \tag{10}$$

Ceteris paribus, (10) is more likely to bind when B is higher (more must be borrowed from the bank), and when $kin = 0$, so the penalty from reneging is less.

There are 2 possibilities:

1) The group members' period 1 incomes (plus existing wealth) is not high enough to self-finance the investment I. In this case, person 2 can borrow from the bank and on-lend the money to person 1, financing the investment regardless of cash flow. But person 2, acting for persons 2 and 3 as a group, will only borrow from the bank if the group anticipates that person 1 will repay the loan. Groups whose kinship ties create a strong incentive for person 1 to repay will be able and willing to borrow from the bank. But if person 1's time 2 enforcement constraint is expected to be strongly binding, the group will be unwilling to lend tp person 1, and the investment will not be financed. This again assumes (as earlier) that having persons 2 and 3 default on the debt is not an attractive option for them.

2) Person 1 (or someone in the group) gets high period 1 income, allowing him to self-finance the investment I. Therefore even groups who cannot credibly borrow from the bank will be able to finance investment when cash flow is high, but not

otherwise.

C. Summing up

The simple model makes several predictions, which we test in our empirical work. If the amounts which households need to borrow to smooth consumption in the face of income fluctuations are typically small, then for most households, their physical collateral will be enough to allow them to borrow from the bank to smooth consumption, irrespective of the presence of kin. (Kin may be subject to covariate income-consumption shocks, such as weddings, funerals, etc., and so are less helpful in smoothing consumption; they may even be harmful because one's kin are asking for loans just when your own income is low; we examine this below.)

For investment opportunities which are small relative to wealth, a similar story applies. However, for larger investment opportunities, the collateralizable wealth of the individual (and liquid wealth his/her kin network could lend) is not sufficient. In these cases, an outside lender will lend to finance the investment opportunity, if the borrower has kinship network which can be pledged as implicit collateral.

We now turn to discussing the data we use to test these predictions.

II. Data

A. Household data

Data are from the 1999-2005 monthly waves of the Townsend Thai Monthly Survey, which covers 16 villages in central and northeastern Thailand, four villages each in four provinces, two in the central region near Bangkok and two in the northeast near the Cambodian border. In each village, 45 households were initially selected at random and reinterviewed each month. (See Townsend et al. (1997) for details.) Detailed data were collected on households' demographic composition and their income, including farms, businesses, and wage employment. Information was also collected on household expenditure, using detailed bi-weekly and monthly surveys. Expenditure is likely to be quite well-measured in this dataset, relative to datasets which measure expenditure over

a longer recall period and/or which collect information on only a subset of expenditures, such as only food in the Panel Survey of Income Dynamics in the US.

A total of 670 households were interviewed in January 1999. However, some households subsequently migrated away. Households who permanently move away are replaced with another randomly-selected household from the village, so that the data continue to be representative of the village as a whole. Households who migrate temporarily are not replaced; they are surveyed when they return to the village. In total of 789 households took part in the monthly survey at some point during the 84 months we consider, and a total of 531 households are observed in each of the months between January 1999 and December 2005. When studying consumption and investment smoothing, we focus on the continuously-observed sample to aid in comparing our results to previous results on this sample, such as Samphantharak and Townsend (2009). Average household size is 4.5 individuals, or 3.8 adult equivalents. Average reported monthly per capita expenditure is 5,213 2002 baht (approximately 124 2002 US dollars[7]). Average reported monthly income per capita is 8,981 baht. Income is higher than expenditure, due largely to investment, which we measure as the change in a household's total stock of physical assets, net of depreciation, during a given month.[8]

Using information on households' stock of assets, as well as net savings[9], we can construct a measure of the household's net worth (see Samphantharak and Townsend (2009) for details). Since financial access may be correlated with wealth, and wealth can serve as a substitute for access to credit markets (Bewley (1977), Deaton (1991)), we control for the household's net worth in our empirical specification.

Finally, households are classified into occupations based on the primary occupation reported by the household head in the initial wave of the survey. The most common occupation in the sample is rice farming (35 percent of household heads), followed by non-agricultural labor (including owning a non-agricultural business) (12 percent of house-

[7]The exchange rate in 2002 was approximately 42 baht=$1. All following references to baht refer to 2002 baht.

[8]We also replace very small investment events with zero. These small values are likely to be rounding errors arising from calculation of depreciation. Monthly investment rates between -0.05% and 0.05% are replaced with zero.

[9]We do not observe initial stocks of savings held in cash, but flows into and out of savings are measured.

hold heads), growing corn (10 percent), raising livestock (9 percent), and agricultural wage labor (5 percent). Growing other crops, raising fish or shrimp, growing orchard crops, and construction each account for less than 5 percent. Seven percent report an occupation classified as "other."

B. Financial network data

Another strength of the data is that households are asked separately about gifts, transfers and loans (both in money and in-kind) from organizations, from households in the village, and from households outside of the village. Transfers with other households in the village are prevalent: gifts given to other households in the same village equal 5.4 percent of average expenditure, while gifts from others in the same village equal 9 percent of average expenditure. Borrowing from and lending to other households in the village are also widespread in the data. We use these data on loans and transfers with other households in the village to construct a financial network of the village. We are able to do this because, for borrowing/lending and transfers with other households in the village, the surveyed household is asked to identify the structure (essentially, the address) in which the counterparty household lives. This can be matched to a village census which records the address of every household in the village, and which is updated when households move. This allows us to identify the counterparty household for each within-village transaction, even if they are not themselves in the survey. This is important because it allows us to observe links of the form "A borrows from B, and B borrows from C," even if B is not in the survey.[10] Figures 1 and 2 show the borrowing-lending networks for two villages: Klongkahi, in the relatively poor Northeast; and Bankrod, in Central Thailand. Some households can be seen to be directly connected to the BAAC and to commercial banks, while others are indirectly connected, because they borrow from an individual who in turn borrows from the BAAC or a commercial bank.

[10] We will miss links of the form "A borrows from B, who borrows from C, who borrows from D" if neither B or C is in the survey. This can cause nonclassical measurement error, causing some linked individuals to appear unlinked Chandrasekhar and Lewis (2011). This will bias the estimated effect of indirect links toward zero, limiting our ability to identify this effect if it exists. However, we show below that our results focusing on direct links, which are unaffected by this problem, are similar to those including indirect links.

Because we are interested in the role of indirect access to financial institutions in facilitating access to credit, we construct directed links, from lender/giver to borrower/receiver. We have time-varying information on when households borrow from each other, but anticipation of being able to borrow may matter for consumption and investment decisions even in months when borrowing does not take place. Moreover, capital does not necessarily flow instantaneously through the financial network: a household may borrow from a bank in January, and then on-lend some of the money in March, for example. Therefore, we collapse the time variation in the data and construct, for each pair of households i, j in the dataset, an indicator for whether i ever borrows/receives transfers from j.[11] If there are N individuals in the village, these indicators can be stacked into an $N \times N$ matrix A whose $(i, j)th$ element is 1 if i borrows/receives transfers from from j, and 0 otherwise. We can then construct a variable d_{ij} that represents the length of the shortest directed path from i to j. In network theory, this is referred to as the geodesic distance from i to j, and is defined as

$$d_{ij} = \min_{k \in \mathbb{N}} : \left[A^k\right]_{ij} > 0. \tag{11}$$

where A^k is the kth power of the adjacency matrix A. Household i is said to be *reachable* by household j ($r_{ij} = 1$) if there exists any path from i to j:

$$r_{ij} = \mathbf{1}\left\{d_{ij} < \infty\right\}. \tag{12}$$

Accordingly we can define the reachability matrix $R = \left[R_{ij}\right]$ and the distance matrix $D = \left[d_{ij}\right]$. If i borrows from j directly, $\gamma_{ij} = 1$; If i borrows from k, who borrows from j, $\gamma_{ij} = 2$, etc.

Additionally, for each household i we construct a measure of how many other house-

[11] We have also examined separately borrowing-only and gift-only networks; results are similar, but less precise, as those discussed below.

holds ever give loans or gifts to household i :

$$a_i \equiv \#\left\{j : d_{ij} = 1\right\}. \tag{13}$$

We do this because, mechanically, households who transact with more other households may have shorter path lengths to financial institutions.

For the 600 households who ever borrow from another household in the village, the average household borrows from 2.5 other households (min 1, max 19). The average total amount borrowed from other households in the village over our 7-year sample, conditional on ever borrowing, is 73,727 baht. The average amount borrowed per transaction is 12,200 baht, which is equal to 60% of average monthly household expenditure (19,800 baht). In other words, intra-village borrowing transactions tend to be large, but relatively infrequent, with the average household who ever borrows, borrowing from other villagers 4.75 times over 84 months.

We also have information on individuals' borrowing from financial institutions. The institutions we consider here are commercial banks and the Bank for Agriculture and Agricultural Cooperatives (BAAC), which we refer to jointly as banks. Accordingly, we can define $\gamma_{i,B}$ as the length of the shortest directed path from i to a bank: 1 if i borrows directly from the bank, 2 if i borrows from someone who borrows from the bank, etc. Naturally, $r_{i,B} = 1$ if there exists any path from i to the bank. We will use the variable $d_{i,B} \equiv \mathbf{1}\left\{\gamma_{i,B} = 1\right\}$ to look at the impact of being directly connected to banks. We use $r_{i,B}$ to examine the effect of being connected at any distance.[12]

C. Kinship network data

We have data on the location of the parents, siblings, adult children, and parents' siblings of each surveyed household head and his/her spouse, if these relatives are living. If any of these relatives live in the same village as the surveyed household, we define

[12]We have also examined how the effect of indirect access changes with greater path length, but, conditional on being connected at any distance, we find little evidence of a gradient in distance, so we focus on the indicators of direct connection reachability.

the household as having kin in their village, $k_i = 1$. Otherwise, $k_i = 0$. Seventy-nine percent of households have at least one relative living in the same village. The kinship data for these villages, and its role in consumption smoothing, are also analyzed by Samphantharak and Townsend (2010).

III. Empirical specifications

A. Consumption

To investigate the impact of both kin presence and financial networks on consumption smoothing, we run regressions that modify the standard omnibus insurance specification Townsend (1994) to allow the effect of income fluctuations to depend on the presence of kin, on net worth, and on direct and indirect connections to financial institutions. Alem and Townsend (2011) show that, with endogenous financial participation, a per-period shock common to all households who participate in the financial system should be added to the standard full insurance regression. Our notion of access to the financial system is connection to the BAAC or to to commercial banks or to either type of bank. We focus on results for any connection (either direct or indirect).

Therefore, our consumption-smoothing specification takes the form:

$$\begin{aligned}\Delta c_{ivt} = {} & \alpha_1 \Delta y_{ivt} + \alpha_2 \Delta y_{ivt} \times r_{i,B} + \\ & \beta_1 \Delta y_{ivt} \times k_i + \beta_2 \Delta y_{ivt} \times \bar{\omega}_i \\ & + \beta_3 \Delta y_{ivt} \times a_i + \delta_{B_B,t} + \varepsilon_{it}\end{aligned} \tag{14}$$

where c_{ivt} and y_{ivt} are, respectively the per capita consumption and income of household i in month t, $r_{i,B}$ indicates connection to the financial system; k_i is an indicator for presence of kin in the village, $\bar{\omega}_i$ is household i's average net worth over the sample period, a_i is the number of transaction partners a household is ever observed to have, and $\delta_{B,t}$ is a common time effect for all households connected to the financial system.

First-differencing removes any non-time varying characteristics of households which

might be correlated with their ability to smooth consumption. For this reason, we do not include the main effects of financial access, presence of kin, degree, or net worth. We use levels, rather than logs, because some households have zero or negative net income in a given month, and we do not want to discard those observations.[13]

B. Investment

To investigate the impact of kinship networks and financial networks on the ability to smooth investment in the face of cash flow fluctuations, we run regressions that modify the standard cash flow-sensitivity specification to allow the effect of income fluctuations to depend on the presence of kin, on net worth, and on connections to financial institutions. Alem and Townsend (2011) show that the investment and income variables should be scaled by total household assets to create an appropriate linear approximation to the optimal investment function of a firm.[14] Because this will introduce heteroskedasticty, we compute heteroskedasticty-robust standard errors. We focus on positive investment events, and examine how the size of such events responds to the household's cash flow. We do not include household fixed effects in the investment regression because the number of positive investment events is small for each household. However, we include village-fixed effects to capture common characteristics such as suitability of the area for different occupations (rainfall, proximity to large towns, etc.)

Our investment-smoothing specifications takes the form:

$$\left(\frac{I}{A}\right)_{i\upsilon t} = \alpha_1 \left(\frac{y}{A}\right)_{i\upsilon t} + \alpha_{21} \left(\frac{y}{A}\right)_{i\upsilon t} \times r_{i,B} + \beta_{11} \left(\frac{y}{A}\right)_{i\upsilon t} \times k_i + \beta_{21} \left(\frac{y}{A}\right)_{i\upsilon t} \times \bar{w}_i + \delta_\upsilon + \varepsilon_{it} \quad . \tag{15}$$

[13] As noted below, we are not able to first-difference the investment data due to a small number of positive investment events per household, we have also run levels results for consumption. These results are directly comparable to the investment results. In these specifications we include the main effects of presence of kin k_i, degree a_i, and net worth $\bar{w}_i$. The qualitative results of these regressions are similar to the differenced specifications. (Results available on request.)

[14] The approximation is exact when the production function is linear and capital adjustment costs are quadratic in the investment rate, investment divided by total assets.

IV. Results

A. Consumption

Table 1 shows the results for (14). First, we estimate a restricted version of Eq. (14) which does not allow the effect of income fluctuations to vary by financial access, kinship or net worth. The results show that the Thai households in our sample achieve quite good consumption smoothing on average, with a one baht income change associated with a 0.0078 baht consumption change; however this is significantly different from zero at the 1 percent level, indicating that the households are not fully insured. Estimating a full version of Eq. (14), we see that households not connected at all to a bank are much worse insured than the average, with a one baht income change associated with a 0.1645 baht consumption change (significant at 1 percent) for this group. Being directly connected to a bank reduces the consumption-income comovement by 0.1658 baht (significant at 1 percent), yielding a net sensitivity of -0.0013, insignificantly different from zero (p=0.696). An indirect connection has a virtually identical impact, reducing the consumption-income comovement, relative to no connection, by 0.1643 baht (significant at 1 percent), yielding a net sensitivity of 0.0002, insignificantly different from zero (p=0.958). Net worth is associated with significantly reduced consumption-income sensitivity, as expected, but the impact is small: one million baht in additional net worth is associated with a reduction in the consumption response to a one baht income change of 0.00021 baht (significant at 1 percent). Conditional on financial access and net worth, the effect of kin is to *increase* consumption sensitivity by 0.0102 baht per one baht income change (significant at 1 percent).

These results indicate that access to the formal financial system plays an important role in smoothing consumption in the face of income shocks. Strikingly, an indirect connections is as effective as a direct connection, suggesting that borrowing and lending among households acts to distribute capital from formal financial institutions. Ignoring the effect of being indirectly connected to financial networks and institutions, and using households not directly connected as a comparison group, may yield biased estimates

of the effect of financial access, due to the spillover of indirect access through other households.[15]

These results indicate that access to the formal financial system plays an important role in smoothing consumption in the face of income shocks. However, the fact that an indirect connection seems to be as effective as a direct connection suggests that borrowing and lending among households acts as the "circulatory system" that distributes capital from formal financial institutions. It also demonstrates that ignoring the effect of being indirectly connected to financial networks and institutions, and using households not directly connected as a comparison group, may yield biased estimates of the effect of financial access, due to the "spillover" of indirect access through other households.

B. Investment

We now turn to discussing the results for smoothing investment in the face of cash flow fluctuations. Table 1 presents the results. Column 1 shows results for the full sample: unconditionally, a one baht increase in cash flow increases investment by 0.1078 baht, consistent with the findings of Samphantharak and Townsend (2010), chapter 6. Column 2 adds controls for kinship, financial access, and net worth (main effects and interactions with income; we report only the interactions with income to save space). Investment is highly sensitive to cash flow for households without kin in the village, with a one baht income change associated with a 0.6526 baht investment change, significantly different from zero at the 1% level. The presence of kin in the village substantially mitigates this sensitivity, however, reducing the response to a one baht change by 0.4136 baht. Bank connections do not appear to be significantly helpful in smoothing investment, in contrast to their central role in consumption smoothing.

C. Why are consumption and investment different?

The theory of the role of social networks suggests a possible explanation for these findings. Ambrus et al. (2010) and Karlan et al. (2009) argue that, in the absence

[15]This echoes the findings of Angelucci et al. (2009) on the spillover effects of cash transfers in the presence of village-level insurance.

of formal commitment, networks that generate the most surplus for their members can sustain the largest flows of funds. For a household who has borrowed and now must repay or, received insurance-motivated transfers and now must reciprocate, the threat of losing a high-value relationship, or seeing a close friend or relative ostracized in response to the household's defection, relaxes the temptation to renege on the loan or reciprocal insurance obligation. Anticipating this, households with strong ties can credibly transfer larger sums among each other. Borrowing large sums from formal financial institutions, on the other hand, typically requires tangible collateral.

Therefore, if the role of kin is to facilitate borrowing large amounts for investment, amounts that are too large to collateralize with tangible assets, we should see the effect of kin concentrated among households for whom investment opportunities are large relative to wealth. Since observed investment sizes are endogenous with respect to the household's access to financing, we use a household's occupation, in essence, as an proxy for the average scale of investment opportunity a given household might face. Our theory predicts that households in occupations where the average investment size is large relative to average wealth should derive the most benefit from presence of kin. We group together the occupations with the above-median observed investment-to-net worth ratios: business owners; farmers of crops other than rice, corn and orchard trees; and non-agricultural workers (including business owners). Table 3 presents investment-to-net worth ratios for each occupation group. The occupations with below-median investment-to-net worth ratios are rice farmers; farmers raising pigs and cows; corn and orchard tree farmers; and shrimp and fish farmers. Columns 3 and 4 of Table 1 present the results. As in column 2, the effect of cash flow fluctuations is allowed to vary by kinship, net worth, and connection to banks. Strikingly, it is for the occupation group with above-median ratios of observed investment to net worth that the effect of kin presence is evident: in this group, those without local kin experience an investment change of 0.637 associated with a one baht income change, and having kin in the village reduces this by 0.506 baht (significant at 1 percent). For occupation categories with smaller investment-to-net worth ratios the effect of kin presence is small in magnitude and insignificant.

D. Is bank access endogenous?

While selection into kinship networks strikes us as unlikely, the endogeneity of financial access is a concern in interpreting the correlation between bank access and consumption smoothing as a causal effect. Papers which exploit randomized or natural experiments to identify exogenous changes in financial access often find that treatment effects purged of endogeneity are different from correlations which do not account for endogeneity. However, we believe that endogeneity of direct or indirect financial access is unlikely to explain our results, for two reasons. First, households would likely select into being customers of a bank on the basis of having high consumption-income comovement, so if anything, our finding that direct bank access significantly *reduces* consumption-income comovement may be a lower bound on banks' true effect. A similar argument applies to our finding that access to the Bank for Agriculture and Agricultural Cooperatives reduces investment-income comovement. Secondly, our measure of indirect access to banks is based on instances where borrowing, lending and.or gift-giving actually takes place. Of two households who have a partner from whom they could obtain a loan or a gift, the household who actually exercises that option is likely to have experienced greater income volatility. So our findings on the positive effect of indirect bank access are also likely to be, if anything, lower bounds on the true effect.

E. How do households with kin differ?

A natural question when interpreting the differences between households with and without kin in their village is how these sets of households differ. If households with kin in their village ("kin households") have characteristics that are likely to independently improve their ability to smooth investment, we may incorrectly attribute this to the effect of kin per se. Table 4 shows that, in fact, the opposite may be the case. Kin households have lower income, a smaller income-consumption difference (i.e., lower savings) and lower net worth. Their average investment size and average return on investment are not significantly different than no-kin households. Kin households do have more borrowing and gift partners–other households in the village from whom they borrow or receive

gifts, respectively. This suggests a mechanism whereby kin households achieve better investment smoothing: through having transactions with a greater number of households in the village.

Table 5 investigates whether kin households are differentially likely to be directly connected to banks. If the implicit collateral of kinship ties can be harnessed by banks, kin households may be more likely to borrow from these banks. Kin households are 16 percentage points more likely to borrow directly from the BAAC, a 25% increase relative to non-kin households. Controlling for net worth does not change this conclusion. Kin households are 11 percentage points (17%) *less* likely to borrow directly from commercial banks. On net, kin households are 8 percentage points less likely to borrow directly from a bank, but this different is not significant when controlling for net worth.

Table 6 repeats this analysis, considering whether kin households are differentially likely to be connected to banks, directly or indirectly. Kin households are 10 percentage points (13%) more likely to be connected to the BAAC, but are not significantly different in terms of connection to commercial banks (although the point estimate, 6 percentage points, is positive). Thus, kin households erase their deficit in terms of direct connection to commercial banks via indirect connections. Non-kin households do not fully erase their deficit in terms of direct connection to the BAAC, however. Kin households are not significantly different in terms of connection to any bank (combining the BAAC and commercial banks). Thus kin household's greater ability to smooth investment is not fully explained by connection to banks (on the intensive margin), suggesting that some portion of the smoothing benefit comes from borrowing from other households (which was not, in turn, borrowed from a bank). There may also be an extensive margin effect, relating to the amount borrowed and/or the quickness with which the needed capital can be access.

An explanation for the difference between kin households' ability to borrow from the BAAC vs. commercial banks may lie in the fact that BAAC loans are typically joint liability, and BAAC joint liability groups have, on average 58% of members related to one another (Ahlin and Townsend (2007)). This offers a priori evidence that the BAAC

is able to harness social collateral via its joint liability structure. Commercial bank loans, on the other hand, are generally individual liability and rely on physical collateral.

V. Discussion and conclusions

These results shed light on the question of *why* kinship networks and financial access matter in smoothing consumption and investment in the face of income volatility, by examining which type of networks (kin vs. financial) matter for which type of insurance: the relatively small deviations of realized income from desired contemporaneous consumption, vs. the sometimes very large difference between the scale of an investment opportunity and the amount of cash on hand to finance it. The fact that access to financial institutions appears to be helpful in smoothing consumption, while kinship networks are not helpful (and may even increase the exposure of consumption to income volatility) suggests that financing needs of these magnitudes can be most effectively met with borrowing that can be implicitly or explicitly collateralized with tangible assets. This borrowing may be from a financial institution directly, or from another village member who in turn borrows from a financial institution. The fact that kin do not appear to be important in consumption smoothing suggests that the types of extended or nonpecuniary punishments which may operate particularly on kinship networks (guilt, ostracism, or the exclusion of one's kinship network from credit or other transactions) do not come into play when households receive gifts or loans to finance consumption.

On the other hand, kinship networks are important in financing investment, especially for households whose investment opportunities are large relative to their net worth. This suggests that, for transactions too large to be collateralized with tangible assets, extended or nonpecuniary punishments on kinship networks are important in assuring lenders that their loans will be repaid.

As noted by Ambrus et al. (2010), however, the value of social collateral generated by kinship networks is unlikely to be infinite, meaning that there will be a maximum loan amount which can be secured with kinship collateral. Investigating how (if at all) households obtain amounts of credit too large to be secured with kinship collateral is left

to future research.

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VI. Tables

Table 1: Kinship, financial access and consumption smoothing

	No controls	Direct link only		Direct or indirect	
Income change	.0078***	.0066**	.0066**	.1645***	.1645***
	[.001]	[.0033]	[.0033]	[.0122]	[.0122]
Income changeX…					
Direct link		-0.0033	-0.0033		
		[.0024]	[.0024]		
Net worth		-2.7e-04***	-2.7e-04***	-2.1e-04***	-2.1e-04***
(mill. baht)		[7.5e-05]	[7.5e-05]	[7.4e-05]	[7.4e-05]
Kin in		.0069**	.0069**	.0102***	.0102***
village		[.0028]	[.0028]	[.0028]	[.0028]
Indirect link					0.0015
					[.0025]
Any link				-.1647***	-.1658***
				[.0122]	[.0124]
Constant	18.2	17.34	17.34	17.33	17.34
	[52.54]	[52.4]	[52.4]	[52.26]	[52.26]
N	4.40E+04	4.30E+04	4.30E+04	4.30E+04	4.30E+04
r2	0.0013	0.0041	0.0041	0.0094	0.0094
Total sensitivity for directly connected HHs		0.0033	0.0033	-1.80E-04	-0.0013
Std error		0.0028	0.0028	0.0028	0.0033
pval		0.2416	0.2416	0.9476	0.696
Total sensitivity for indirectly connected HHs			0.0033		1.50E-04
Std error			0.0028		0.0028
pval			0.2416		0.9575

Robust standard errors in brackets. *p<.1, ** p<.05, *** p<.01

Table 2: Kinship, financial access and investment

	No controls	All households	Above-median investment size	Below-median investment size
Income	.1078*	.6526***	.637***	0.0077
	[.0649]	[.195]	[.2102]	[.3359]
IncomeX…				
Any link		-0.1268	-0.0821	0.2931
to bank		[.1288]	[.1292]	[.3983]
Kin in		-.4136***	-.5056***	0.4543
village		[.1549]	[.1599]	[.3256]
Net worth		-0.1087	-.0405**	-0.371
(mill. baht)		[.0762]	[.0205]	[.2357]
Main effects				
Future ROA		0.0617	.1658***	-.4994*
		[.0608]	[.0591]	[.2621]
Kin in		-0.0121	-0.0111	-0.0162
village		[.0191]	[.0247]	[.0389]
Net worth		-.0039***	-.0052***	-.0026**
(mill. baht)		[.0012]	[.0014]	[.0012]
Constant	.0582***	.0548***	.0581**	0.0635
Total sensitivity for				
HHs with kin		0.2391	0.5548	0.3008
Std error		0.123	0.1606	0.1596
pval		0.052	5.60E-04	0.0596
N	6055	5794	2319	3463
r2	0.0299	0.0422	0.0473	0.1852

Robust standard errors in brackets. * p<.1, ** p<.05, *** p<.01

Table 3: Average investment size, scaled by net worth

Occupation	Mean investment amount/net worth	N
Business owners, other crop farmers and non-agricultural workers	0.081	2362
Rice farmers	0.073	1785
Raises pigs/cows	0.047	676
Corn/orchard farmers	0.025	1024
Shrimp/fish farmers	0.021	195

Note: Investment events are positive changes in household assets, valued in 2002 baht. Net worth is total value of household fixed assets.

Table 4: How do those with kin differ?

	No-kin mean	Kin difference	Std error
Avg income	10938	-2546.9*	[1454]
Avg expenditure	6371.5	-1288.2***	[375.63]
Avg wealth (million baht)	3.9194	-2.3075***	[.76894]
Borrowing partners	0.65138	1.0453***	[.24612]
Gift partners	0.76147	.49683***	[.15749]
Avg investment size	24415	-2424.3	[6245.6]
Avg return on assets	0.02717	0.02691	[.02846]

Notes: 531 households, 79% with kin in village. Average wealth includes land. Baht-demonimated variables in 2002 baht.

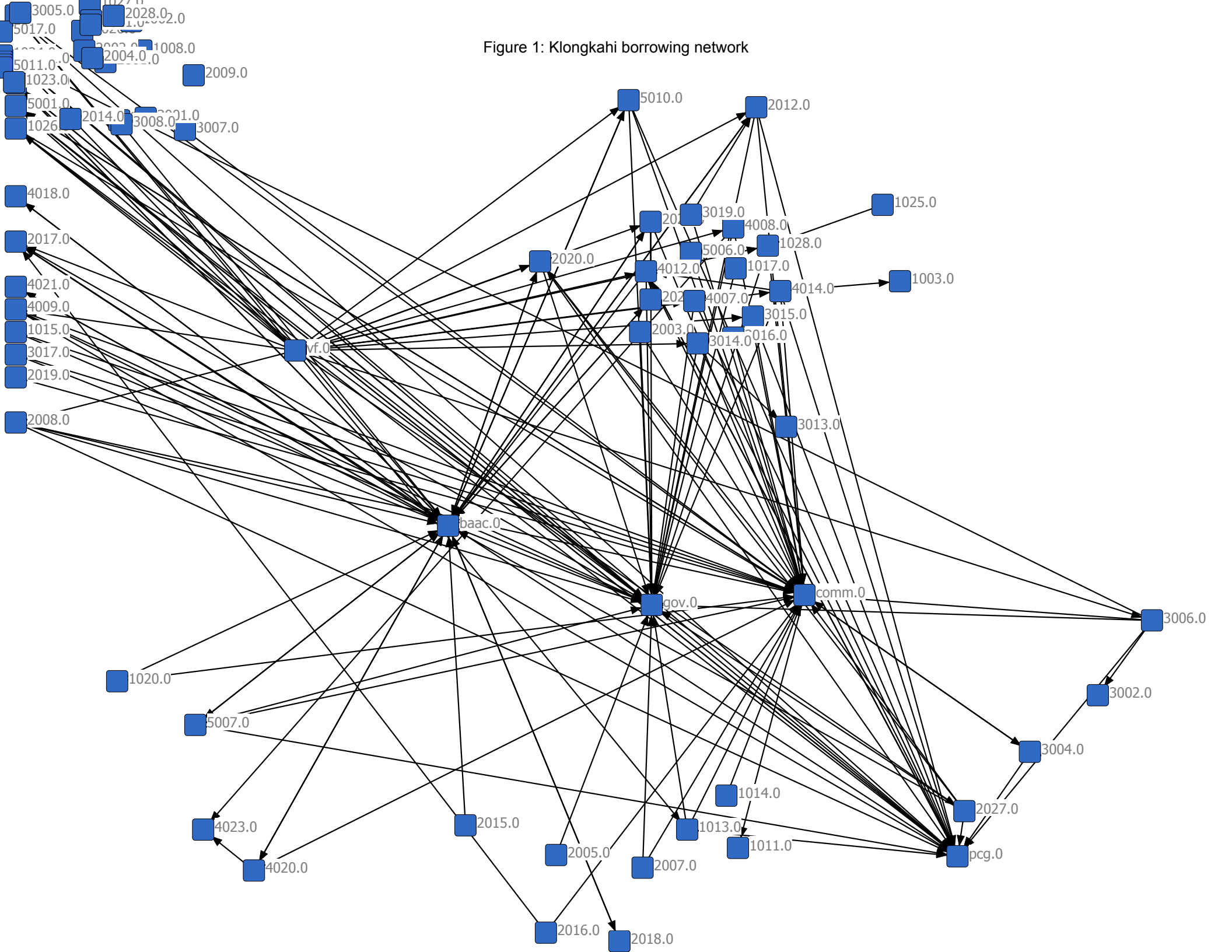
Table 5: Correlates of direct bank access

		BAAC		Commerical		Any
Kin	.1613***	.1646***	-.1127**	-.0944*	-.0905*	-0.084
	[.0474]	[.0479]	[.0549]	[.0551]	[.0535]	[.0539]
Net worth		0.0014		.0076**		0.0027
		[.0026]		[.003]		[.003]
Constant	.6154***	.6098***	.6471***	.6164***	.6827***	.6719***
	[.0424]	[.0437]	[.0491]	[.0503]	[.0478]	[.0492]
N	516	516	510	510	516	516

Table 6: Correlates of any bank access

		BAAC		Commerical		Any
Kin	.1000***	.1059***	0.0515	0.0608	0.0189	0.0215
	[.0357]	[.036]	[.042]	[.0423]	[.0222]	[.0224]
Net		0.0025		.0039*		0.0011
worth		[.002]		[.0023]		[.0012]
Constant	.7981***	.7882***	.7843***	.7687***	.9423***	.9379***
	[.0319]	[.0329]	[.0376]	[.0387]	[.0198]	[.0204]
N	516	516	510	510	516	516

Figure 1: Klongkahi borrowing network



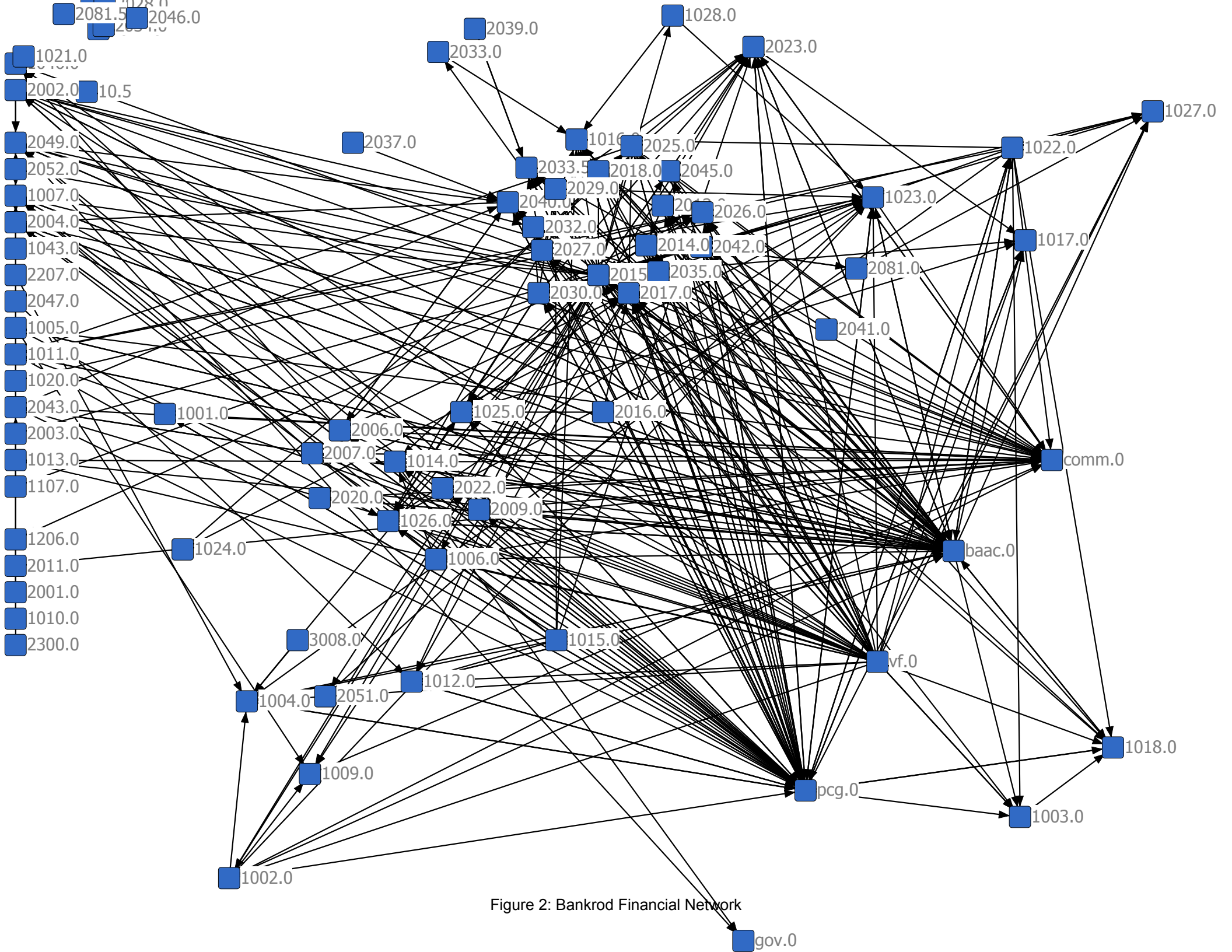


Figure 2: Bankrod Financial Network