An Evaluation of Financial Institutions: Impact on Consumption and Investment Using Panel Data and the Theory of Risk-Bearing*

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Abstract

The theory of the optimal allocation of risk and the Townsend Thai panel data on financial transactions are used to assess the impact of the major formal and informal financial institutions of an emerging market economy. We link financial institution assessment to the actual impact on clients, rather than ratios and non-performing loans. We derive both consumption and investment equations from a common core theory with both risk and productive activities. The empirical specification follows closely from this theory and allows both OLS and IV estimation. We thus quantify the consumption and investment smoothing impact of financial institutions on households including those

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running farms and small businesses. A government development bank (BAAC) is shown to be particularly helpful in smoothing consumption and investment, in no small part through credit, consistent with its own operating system, which embeds an implicit insurance operation. Commercial banks are smoothing investment, largely through formal savings accounts. Other institutions seem ineffective by these metrics.

JEL Codes: G2, O16, R1

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1. Introduction

There has been little theory-based assessment of formal and informal financial institutions which uses not only financial statements and institutional detail but also household panel data on actual customers. Here we explicitly incorporate the diversity of shocks across households in an environment with productive opportunities in a choice model of financial participation. We use the theory of an optimal allocation of risk-bearing to derive both consumption and investment equations for customers of financial institutions. We also do the same for those in financial autarky. Finally, we make participation endogenous and evaluate the formal and informal financial institutions that offer savings, credit and insurance.

We make use of the Townsend Thai data, a panel of approximately 960 households, including about 200 running their own businesses. The data start in May 1997, just prior to the onset of the July 1997 financial crisis, and continue through 2001, that is, through the recovery. Thus there is macro, aggregate risk.[1] The data are gathered from households and small businesses specialized in different mixes of occupations and subject to different shocks. Thus, there is ample idiosyncratic risk.[2] The data contain the measurements of consumption, investment, and income necessary to carry out the

[1] In the working paper version (Alem and Townsend, 2004), we show that consumption drops across both surveyed regions in the first three years. Surprisingly however, the few statistically significant common time effects in income over households explain little of the income variation. Droughts, floods and price changes are events that drive much income change according to the surveyed households, but these are not uniform within and across regions.

[2] In the working paper version (Alem and Townsend, 2004), we show that wage earners and those in agriculture suffered lower declines in income than anticipated in the Thai government's policy response, and business owners suffered large declines in income on average. Within each of the occupation groups there is enormous heterogeneity income change.

standard risk-bearing or equivalent-with-complete-market tests. Further, the data record the actual use of formal and informal financial institutions and mechanisms by type of financial product, both borrowing and saving. From this we can see which devices are used and gauge the plausibility of econometric instruments for subsequent actual participation. The instruments are derived from a baseline key informant interviews and from a baseline 1996 village-level census from the Community Development Department (CDD). One of the instruments makes use of a Geographic Information System (GIS).

The principal findings offer a score card or rating system for the major financial institutions of the country. A government development bank (BAAC) is shown to be particularly helpful in smoothing consumption and investment, in no small part through credit, consistent with its own operating system, which embeds an implicit insurance operation. Commercial banks are smoothing investment, largely through formal savings accounts. Other institutions seem ineffective by these metrics

The paper is outlined as follows. Section 2 describes the data used in the analysis. In Section 3, we present the basic choice model of financial regimes featuring the assumed environment. In Section 4, we derive from the theory of optimal allocation of risk the explicit consumption and investment equations used in the empirical work. In Section 5, we do the same for those in financial autarky. In Section 6, we derive the econometric specification, including how we use the data and our instruments. The assessed impact of each major financial institution is summarized in Section 7. Section 8 provides additional results and interpretation. Section 9 concludes.

2. Data and Institutions

The panel data used in this paper come from a project funded by the National Institutes of Health, the National Science Foundation, and the Ford Foundation (see Townsend, 1997). An initial cross-sectional survey, with retrospective data, was fielded in May, 1997, before the crisis that began with the devaluation of the Thai baht in July, 1997. Two regions were chosen deliberately: namely, the more developed Central region and the relatively poor, semi-arid Northeast. Within each region two provinces were chosen deliberately as each had at least one county (*amphoe*) that had been randomly selected in all previous rounds of the larger Socio-Economic Survey (SES). In the Central region the province of Chachoengsao is adjacent to Bangkok and contains an industrial corridor that makes its way to the eastern seaboard. The province of Lopburi is in the fertile central valley north of Bangkok. In the Northeast, the province of Sisaket is the poorest in Thailand according to provincial product data, and Buriram, also in the Northeast, represents a transition province as one moves west back toward Bangkok.

Within each province twelve *tambons* or sub-counties were chosen at random (see Binford, Lee, and Townsend, 2004). Within each *tambon*, four villages were chosen at random from an enumeration of villages available from the Community Development Department (CDD), and within each village fifteen households were chosen at random from a listing held by the headman.[3] In addition to the household questionnaire, survey instruments were designed for the headman of each village, soliciting in particular a retrospective village history of the use of formal and quasi-formal financial institutions.

[3] The mean and median numbers of villages in a *tambon* are 10.38 and 10.0 respectively. Thus, the fraction of villages chosen from the total is approximately 40%. The sampling rate for *tambons* in a province is 3% and the sampling rate for households in a village is 11%.

With the advent of the crisis, funding from the Ford Foundation allowed a resurvey one year later (in May, 1998) of one-third of the original sample, and this was continued with NICHD funding into subsequent years. The data used in this paper is through 2001. For this Townsend Thai resurvey panel, four *tambons* were chosen at random from the original twelve of each province.[4] Otherwise, the same villages and the same households were selected for re-interviews. The target number of households was 960, or 240 in each province. The actual response rate for this 1997-1998 pairing is relatively high, for example, 98.2% of the target 1997 households respond again to the resurvey. Likewise, there were successful re-interviews of 96.2%, 97.1% and 96.5% for the other pairs of years. Tables A.1 and A.2 in the appendix contain a summary of key variables used in the data analysis.

Measurement of income, consumption and investment. We note that income is measured as the difference between gross income and gross expenses, solicited from the household for each occupation category separately: business, agriculture, fish/shrimp, farming and livestock. Labor income is gross revenue from wages. Likewise, all physical assets held at each interview date are solicited along with purchase date and value at that time. Discrepancies in ownership across interviews are checked and reconciled with the households directly. Depreciation rates, e.g., 10%, can be applied to create retrospective panel data on wealth. There are, in addition, direct questions on land sales and acquisitions, the major asset in many cases (this is not depreciated). Consumption is

[4] With the exception that one *tambon* was set aside for a separate intensive monthly survey.

measured by a solicitation of 13 items[5] that best predict aggregated non-durable consumption expenditure in the larger more comprehensive Socio-Economic Survey. In practice, 50-80% of the variation can be explained by these 13 items. A price index at the province level was obtained using average prices of purchases of consumption in order to deflate and express income, consumption and investment in real terms.[6] Specifically, the Townsend Thai annual data records both the overall value and quantity of the first 9 consumption items purchased by each surveyed household. There is a considerable range for these deduced prices for a given year and province, and so in order to reduce measurement error and provide a reliable overall central tendency, the top and bottom 25% of the histogram for each item are removed, then a simple average is taken. The overall price index is constructed by weighting each price item by its quantity in the base year (Laspeyres).

Measurement of financial participation. Membership in or being a customer of the various financial institutions was solicited in the 1997 interview, along with a retrospective history. Hence, we know in principle if a household was using a commercial bank in, for example, the 1996 baseline year, the year prior to the survey. We also have measurements of all subsequent financial transactions (borrowing, lending, saving) with the formal sector (type of institution, e.g., BAAC, village funds such as Production Credit Groups [PCGs], commercial banks) and with the informal sector

[5] Grain, milk and milk products, meat, alcohol consumed at home, alcohol consumed away, tobacco, gasoline, ceremonies, house repairs, vehicle repairs, educational expenses, clothing and meals away from home.

[6] As a robustness check, a national deflator price index was obtained from the National Statistics Office and the results, though statistically weaker, did not vary in sign and order of magnitude.

(output purchaser, money lender, friends, relatives, store owners). There are also data on remittances and the use of rice in storage.

Financial institutions overview. We emphasize here that we have the typical array of financial institutions of emerging market economies: government banks, local savings and loans, a private (but regulated) commercial banking sector and, again, a substantial informal sector.

BAAC is the Thai government's Bank for Agriculture and Agricultural Cooperatives. It makes modestly sized loans, about half with joint liability and hence no physical collateral. Its interest rate is slightly subsidized, and the BAAC could break even by raising its on-lending rate only a modest amount (Yaron, 1994). The BAAC does compete actively for savings deposits (as commercial banks are no longer required to deposit funds). Though nominally lending to agriculture (fertilizer, seed), business households in the Townsend Thai survey sometimes report that they get initial funding from the BAAC. Most loans are short term, but long term investment is also possible. The BAAC has focused on getting credit to a certain segment of farmers, and in the data it appears they are more willing to lend off the main road, away from towns. The BAAC had 34% of all loans outstanding in the larger 1997 baseline survey and focuses on the middle wealth segment of the market in each village. Townsend and Yaron (2001) have featured the "risk-contingency" nature of lending, in which delayed repayment and possibly reduced interest and/or principal is part of the BAAC operating system. This presumably is a mechanism which would allow mitigation of idiosyncratic shocks, though that has not been tested previously.

Commercial banks make relatively few loans in the Townsend Thai peri-urban data, 3% of all loans in the 1997 data, but loan size is relatively large, larger than all other lenders. So, by value, commercial banks have 16% of all loans. Bank lending is clustered in the sense that if a commercial bank is active in a village, it is likely to be active nearby, and there remain plenty of gaps. Virtually all commercial bank loans require collateral. On the other hand, commercial bank savings account for 56% of all savings, especially for higher wealth households and those in more developed regions.

Agricultural Cooperatives are now part of the Bank for Agriculture and Agricultural Cooperatives, but many retain their former quasi-independent status, run by local boards and so on. The BAAC on-lends to Cooperatives and historically suffers a lower repayment rate than with direct loans to customers.

Village level financial institutions appear frequently. One of the more common types is a Production Credit Group, essentially a local savings and loan run by a village committee. There are also women's groups, rice banks, buffalo banks, poverty eradication funds, and others, though sample size in the annual panel did not allow us to do much with these.[7] The well-known and larger One Million Baht Village Funds, analyzed in Kaboski and Townsend (2011; 2012) were not introduced until 2002, and we do not use that data here.

The informal sector comprises approximately half of all loans, not only from money lenders but also from store keepers, traders, friends, relatives, and so on. There is great variety in collateral, interest rates and repayment. We also think of rice storage as

[7] See Kaboski and Townsend (2005) for a more detailed description and analysis using the 1997 data.

an activity of the informal sector, distinct from savings in commercial banks or the BAAC. Rice accounts for 14% of all savings (excluding the value of cash, gold, and jewelry which are not measured in the annual data).

Instruments for financial participation. We also employ the CDD data, a comprehensive village-level census and the key informant questionnaire to obtain instruments for membership of formal and informal institutions: (i) key informant responses regarding the availability of productive credit in the village from various specific financial institutions; (ii) travel times to district centers as measured in CDD data; and (iii) GIS-calculated probabilities based on CDD neighborhood averages that a village will have each of the various financial institutions.

As in the Greenwood and Jovanovic (1990) model, we test for the impact of financial sector participation versus non-participation on the ability to smooth consumption and investment. We do this for each institution, one at a time. Other strategies could be followed, though enumerating all possible combinations would be tedious, and it is not clear if our instruments are appropriate.[8]

3. A Choice Model of Financial Participation

[8] Ongoing work explores whether combinations of service providers might be a key to effectiveness. Kinnan and Townsend (forthcoming) look at village kinship networks and chains of gifts and loans which link households if only indirectly to primary formal sector providers. Sripakdeevong and Townsend (2010) study the role of informal sector bridge loans to mitigate adverse impacts of repaying when formal sector loans are due. But in this paper, our instruments for the informal sector are already not working well. Note also that time to the district center in Table 2 below is positively correlated with BAAC use and negatively correlated with commercial bank use.

To assess the impact of financial institutions on households, we follow a modified version of the financial choice model of Greenwood and Jovanovic (1990). In the model, households choose whether to become a member of a financial institution by weighing the costs and benefits of participation. On the one hand, as in Townsend (1978, 1983), we assume that financial institutions are costly to establish or to learn to use. Specifically, household i has to pay a once-and-for-all lump-sum cost Z_i to become a member of a financial institution, incurred at the time of joining. This captures initial household specific learning costs and more generally the cost of bank infrastructure itself. On the other hand, financial participation entails important potential benefits. Financial institutions collect and process information on project returns, and this allows participating households to achieve higher expected returns, essentially by coordinating production activities. Financial institutions also allow households to diversify away idiosyncratic risk, essentially by pooling returns. More generally, we interpret financial institutions as providing households access to better information and as-if-complete-markets, and we then compare the consumption and investment implications of members/customers of financial institutions to those in financial autarky.

Thus we start with a common environment, with risk and investment, and then consider two financial regimes. One regime is the full information, full risk-sharing regime, which comes from a programming problem for the determination of Pareto optimal allocations; the other regime is autarky. Each of these regimes gives us guidance about how to handle the actual variables and what to look for in the data.

To simplify, we imagine the decision of whether or not to join the financial system is taken at the initial date, $t = 0$. Thus, in empirical terms, all decisions before and during 1996 are encapsulated in the $t = 0$ decision. In the model, no one who has incurred the cost of entry and joined will ever, subsequently, give up the advantages of the financial system and exit, and this is largely true in the data, from 1997 on.[9] The participation decision is described in more detail below, and it makes clear that there may be information that a household has, that the econometrician does not see, which can show up later in correlations between right-hand side variables and error terms. For this and other reasons it is important to control for selection, with instruments, in the empirical work.

Environment. The underlying environment has a very large number of households. In Townsend (1983), this was a countable infinity and in Greenwood and Jovanovic (1990, hereafter referred to as GJ) a continuum of measure or mass equal to one. Here, for simplicity of exposition, we imagine the number of households is large but finite, so large that in effect the population-weighted sum over households in the financial system of any given idiosyncratic shock is zero. One can assume, as in GJ, that all idiosyncratic shocks are drawn from a uniform distribution, so one can drop the population weights, though here we try to be a bit more general. However, we do not want to stray too far from the original work of GJ, as this model was used in the work on growth, inequality, and financial repression in Jeong and Townsend (2008) and

[9] Puentes (2009) has summarized the annual Townsend Thai data on participation. The biggest innovation is the coming of village-level, Million Baht Funds in 2002, but this is after the 1997-2001 panel used here. There is a modest increase in the informal sector in the two years after the 1997 financial crisis, but, again, this then goes back down to its previous level, and, in the longer panel not used here, follows a downward trend.

Townsend and Ueda (2010; 2006), and part of our goal here is to provide some unity by testing the assumed micro underpinnings of all those models.

Preferences. Each household i has a contemporary utility function $u_i(c_{it}, \xi_{it})$, where c_{it} is consumption of household i at date t and ξ_{it} is a preference shock determining marginal utility. This shock is orthogonal to all other random variables other than its own past. Each household i seeks to maximize the discounted time separable flow of contemporary utilities at discount rate β. The preference shock ξ_{it} has an autoregressive structure: $\xi_{i,t+1} = \rho\ \xi_{it} + \upsilon_{it}$ where υ_{it} is i.i.d. over individuals and time and ρ is potentially zero. When ρ is greater than zero, some information on future preference shocks, that is, future urgency of consumption, is known at present, hence known in particular at the time of the participation decision, $t = 0$. As preferences are never observed by us as econometricians, this creates a potential endogeneity problem: The error term in the impact equations over the sample period can be correlated with the participation decision (and we will need instruments to correct for this). On the other hand, if $\rho = 0$, and the model is true, no such problem exists (and OLS will not be biased). We report both the OLS and IV regressions though we feature the latter as more robust.[10] Note that we can allow as well a common multiplicative preference shock in the utility function below. The empirical risk-sharing regression in consumption allows this, in the common time fixed effect, but naturally enough, one cannot identify, from the shadow price of

[10] The model here abstracts away from elastic labor supply. As is well known, if a utility function were non-separable in consumption and leisure, then even in an optimal allocation of risk bearing, consumption could move with an income term. In this paper, we focus on the differential response to income of those with financial access and those without, and as that is determined by (plausibly exogenous) instruments, there should be no differential due to this effect. We also test the null that those who are fully insured have zero coefficients on income, and are sometimes unable to reject this. Nevertheless endogeneity of labor supply remains a concern.

consumption, a distinction between shortage of aggregate resources and common urgency of consumption.

Technology. To focus on the financial participation, we abstract from occupation choice and imagine that each household i is tagged with an initial occupation that does not change. For those in agriculture and business, we collapse them into one sector and give them a production technology $q_{it} = f_i(k_{it}, \theta_t + \varepsilon_{it})$, where k_{it} is the capital stock of household i at date t, $\theta_t + \varepsilon_{it}$ is a *composite* technology shock, and output is measured in common units of consumption. Here θ_t represents a common, aggregate disturbance which is i.i.d over time and the idiosyncratic shock ϵ_{it} is i.i.d both over time and over households.[11]

Investment. There is also a cost of adjustment function $g_i(I_{it}, k_{it}, \omega_{it})$ where I_{it} is investment of household i at t and ω_{it} is an i.i.d. household-specific shock to the cost of capital stock adjustment. The law of motion for capital with depreciation rate δ is standard: $k_{i,t+1} = (1 - \delta)k_{it} + I_{it}$. Note that under the assumed costly adjustment function, investment can be negative, but it is costly to convert capital to the consumption good. Again, the population-weighted sum of these idiosyncratic shocks ω_{it} is zero so that *ex post*, for households in the financial sector, full insurance sets that sum to zero in consumption. But each shock enters into its own real production technology, making one technology different from another, so the ω_{it} matters for investment decisions even including those households in the financial sector.

[11] Townsend and Ueda (2010; 2006) show that the endogenously evolving wealth distribution can generate an autoregressive process on income, despite the i.i.d. specification on θ_t in the technology.

Wage earners. There is a group of wage earning households who are not engaged in farming or running businesses of any kind. These households have an exogenous income process y_{it} which is not influenced by decisions such as capital investment. To simplify the notation, especially in the equivalent-with-complete-markets setting with financial participation, we give these households what would appear to be the same production technology as above, namely, $q_{it} = f_i(k_{it}, \theta_t + \varepsilon_{it})$ but with a fixed k_{it}, and so it must be understood that k_{it} is simply a constant, not business capital. Thus, for wage earners, only the aggregate and idiosyncratic shocks appear in income y_{it},[12] but, obviously, both of the latter are allowed. When a wage earning household *i* is in financial autarky, then we make explicit that household *i* has an initial beginning-of-period stock of savings s_{it} and can save an increment S_{it}, the difference between income and consumption, carrying all savings over into the next period. Note that lowercase and uppercase letters distinguish stocks and flows in both savings and capital. To be yet more comparable to the earlier investment technology, this savings can depreciate at rate δ and suffers a cost-of-adjustment $g_i(S_{it}, s_{it}, \omega_{it})$. Wage earning households participating in the financial sector would never use this technology for saving, as it is assumed to be strictly dominated in return by the real capital investment technologies. Wage earning households who do not participate in the financial sector do use the saving technology, since by assumption, as wage earners, they do not have the higher yield production technology available to them. This savings thus represents something like rice in storage, which depreciates. But again, to economize on notation below, we often replace s_{it} by k_{it} for these households.

[12] The cost of this is that k_{it} has a time date and it may appear as well that it is part of each and every household's state variable. But this should be suppressed when referring to wage earning households. We come back to this in our treatment of the data later.

Timeline and decision-making. To fix the timeline for initial decisions at $t = 0$, household i occupation, all initial preference shocks ξ_{i0}, technology shocks $\theta_0 + \varepsilon_{i0}$, adjustment cost shocks ω_{i0} and initial asset conditions k_{i0} (or savings s_{i0}) are pre-determined. Initially, the household can only see the sum, $\theta_0 + \varepsilon_{i0}$. Then a financial participation decision is made, and, if positive, a cost Z_i is subtracted from capital k_{i0} (or savings). Toward the end of the period, consumption and investment (or savings) decisions are made, in coordination with the bank or in autarky, depending on the participation decision, respectively.

Consider the decision-making of a household (of any occupation, replacing k by s *as necessary*) in period $t = 0$. Let $V_i(k_{i0} - Z_i, \xi_{i0}, \theta_0 + \varepsilon_{i0}, \omega_{i0})$ denote the discounted expected utility value of participating in the financial system. Note that Z_i subtracts from wealth k_{i0} (or saving). By the end of the period, participating households benefit from full insurance, from the next year on. Likewise, let $W_i(k_{i0}, \xi_{i0}, \theta_0 + \varepsilon_{i0}, \omega_{i0})$ denote the discounted expected utility of those households who choose financial autarky. These households retain their capital k_{i0} (or savings) and see only $\theta_t + \varepsilon_{it}$ in all future time periods, as by assumption they cannot distinguish between them. Now let a binary variable P_{i0} denote financial participation. With this notation, household i chooses whether to participate as a member of a formal financial sector using the following decision rule:

$$P_{i0} = 1 \text{ if } V_i(k_{i0} - Z_i, \xi_{i0}, \theta_0 + \varepsilon_{i0}, \omega_{i0}) \geq W_i(k_{i0}, \xi_{i0}, \theta_0 + \varepsilon_{i0}, \omega_{i0})$$

$P_{i0} = 0$ otherwise.

To anticipate what follows, after having made the participation decision, the solution of the appropriate dynamic programming problems, derived in detail below, will give us policy functions for consumption *c* and investment *I* (or saving).

(Insert Table 1 here)

$\overline{c}_t$ is aggregate consumption of those in the financial sector. Here λ_i is the Pareto-weight of household *i,* determined upon entry into the financial sector at $t = 0$ by initial wealth $k_{i0} - Z_i$ and shocks θ_t, ε_{i0}, and ω_{i0}. In the data, we see versions of these policy functions for all households that also depend on the participation decision *P*. That is, all households have consumption functions, but which one we see depends on the participation decision *P*. As some part of the policy functions has unobserved idiosyncratic shocks ξ_{it}, the error term is also a function of *P*. With serial correlation, this creates the potential endogeneity problem which requires the use of instruments to net out selection effects and truly gauge the impact of the financial participation.[13]

4. The Optimal Allocation of Risk-bearing and Investment for Financial sector Participants

For those participating in the financial sector, the set of Pareto optimal consumption and investment allocations are determined as if from a programming problem. In addition, we employ a decentralized complete markets version of the programming problem to better interpret the solution. This will give us the value function

[13] Selection effects can make OLS regressions quite distinct from those of IV or other corrections. See Townsend and Urzua (2009) for various examples using data generated from models themselves. Though we deal with selection, we restrict ourselves here to the case where IV and weighted averages of local treatment effects coincide. See Heckman and Vytlacil (2001) for more general treatments.

$V_i(k_{i0} - Z_i, \xi_{i0}, \theta_0 + \varepsilon_{i0}, \omega_{i0})$, the contemporary initial policies for household i in 1996, which are before we have the sampled data, and the policy functions c_{it} and I_{it} for all $t > 0$, just enumerated above in Table 1.

Suppose there are a large but finite number of households, $i = 1, 2, \ldots N$, who are participating in the financial system, where again N is large enough so that the sum of i.i.d. population-weighted idiosyncratic shocks is essentially zero. Denote h^t as the whole history of shocks through date t and h_t as the contemporary date t realization only. In principle, this aggregate state h_t includes the contemporary realization of idiosyncratic shocks for household i, $h_{it} = \{\xi_{it}, \theta_t, \varepsilon_{it}, \omega_{it}\}$ so the aggregate state is a long vector over all households i. But, with a large number of households in the financial sector, the fraction of households at various configurations of *idiosyncratic* shocks is all that matters for the aggregate, and as this configuration is virtually constant over all dates and states, it can be suppressed when we talk about aggregate shocks. Still, what matters for household i is its own position; that is, its shock h_{it} inclusive of household i idiosyncratic shocks ξ_{it}, ε_{it}, ω_{it} as embedded in the aggregate shock h_t. So when we refer to a decentralized decision of household i, h_{it} is embedded in h_t, as if it were written out explicitly. Finally, to be consistent with the notation, there is an initial aggregate state h_0 and the initial preference shock is in h_0, so with serial correlation, the future aggregate shock and idiosyncratic shock probabilities are conditioned on these. We thus write prob $(h_t \mid h_0)$. Occasionally we drop h_0 when it does not cause any confusion.

The programming problem under complete insurance and credit markets is to maximize the Pareto-weighted sum of households expected utilities:

$$\max_{c_{it}(h^t),i_{it}(h^t)} \sum_{i=1}^{N} \lambda_i \left\{ u(c_{i0}, \xi_{i0}) + \sum_{t=1}^{\infty} \beta^t \sum_{h^t} prob(h^t \mid h_0) u[c_{it}(h^t), \xi_{it}] \right\} \text{ subject to} \tag{1}$$

$$\sum_{i=1}^{N} c_{it}(h^t) \le C_t(h^t) \text{ for all } t \tag{2}$$

$$C_t(h^t) = \sum_{i=1}^{N} f[k_{it}(h^{t-1}), \theta_t + \varepsilon_{it}] - \sum_{i=1}^{N} I_{it}(h^t) - \sum_{i=1}^{N} g[I_{it}(h^t), k_{it}(h^{t-1}), \omega_{it}] \text{ for } t > 0 \tag{3}$$

$$C_0 = \sum_{i=1}^{N} f(k_{i0} - Z_i, \theta_0 + \varepsilon_{i0}) - \sum_{i=1}^{N} I_{i0} - \sum_{i=1}^{N} g[I_{i0}, k_{i0} - Z_i, \omega_{i0}] \text{ at } t = 0 \tag{4}$$

$$k_{it+1}(h^t) = (1-\delta) k_{it}(h^{t-1}) + I_{it}(h^t) \text{ for } t > 0 \tag{5}$$

$$k_{i1} = (1-\delta)(k_{i0} - Z_i) + I_{i0} \text{ at } t = 0. \tag{6}$$

The first-order condition for consumption is

$$\lambda_i \beta^t prob(h^t \mid h_0) u_c'(c_{it}, \xi_{it}) = \mu(h^t) \text{ at } t > 0 \tag{7}$$

Where $\mu(h^t)$is the Lagrange multiplier for (2), which is equivalent to the multiplier in (3). This first equation equates weighted marginal utilities of consumption over all households.

We now derive the first-order condition for investment (Euler equation) where the contemporary marginal cost of investment is equated to the future marginal revenue from production, summing over future states, as expressed in the next equation:

$$\left\{1+\frac{\partial g\left[I_{it}\left(h^t\right),k_{it}\left(h^{t-1}\right),\omega_{it}\right]}{\partial I_{it}}\right\}\mu\left(h^t\right)$$
$$=\sum_{h_{t+1}}\mu\left(h^t,h_{t+1}\right)\left[\frac{\partial f\left[k_{i,t+1}\left(h^t\right),\left(\theta_{t+1}+\varepsilon_{i,t+1}\right)\right]}{\partial k_{i,t+1}}-\frac{\partial g\left[I_{i,t+1}\left(h^{t+1}\right),k_{i,t+1}\left(h^t\right),\omega_{i,t+1}\right]}{\partial k_{i,t+1}}\right]. \tag{8}$$

We can exploit the equivalence between Pareto optimal allocations and competitive equilibria to decentralize the problem, hence further characterize the investment equation by tying it into existing literature. Specifically, let the price of consumption at date t under state h^t be equal to the Lagrange multiplier, that is, fix $p(h^t) = \mu(h^t)$. We can arbitrarily choose the numéraire to be the price of consumption at date 0. Again we note that the pricing function depends on aggregate states, those things which determine the marginal utility of (aggregate) consumption, and that prices do not depend on idiosyncratic shocks. However, a household can purchase insurance against idiosyncratic shocks, and as there is no aggregate risk involved, that insurance will be priced at its actuarial value. More specifically, a household can buy insurance that gives an indemnity for low idiosyncratic income shocks and sell insurance that effectively pays out when the issuer household has high income. The price of each is simply the associated probability. Thus the net purchase price of the indemnity/premia bundle is zero as its actuarial value is simply the probability weighted sum of idiosyncratic shocks, and the latter is zero by construction (see the initial assumption in the environment of the model). Then the problem for household i under complete markets is:

$$V_i\left(k_{i0}-Z_i,\xi_{i0},\theta_0+\varepsilon_{i0},\omega_{i0}\right)=\max\left\{u\left(c_{i0},\xi_{i0}\right)+\sum_{t=1}^{\infty}\beta^t\sum_{h^t}prob\left(h^t\middle|h_0\right)u\left[c_{it}\left(h^t\right),\xi_{it}\right]\right\} \tag{9}$$

$$c_{0t} + \sum_{t=1}^{\infty}\sum_{h^t} p(h^t)c_{it}(h^t) = f[k_{i0} - Z_i, \theta_0 + \varepsilon_{i0}] - I_{i0} - g[I_{i0}, k_{i0} - Z_i, \omega_{i0}]$$
$$+ \sum_{t=1}^{\infty}\sum_{h^t} p(h^t)\{f[k_{it}(h^{t-1}), \theta_t + \varepsilon_{it}] - I_{it}(h^t) - g[I_{it}(h^t), k_{it}(h^{t-1}), \omega_{it}]\} \tag{10}$$

$$k_{it+1}(h^t) = (1-\delta)k_{it}(h^{t-1}) + I_{it} \text{ for } t > 0 \tag{11}$$

$$k_{i1} = (1-\delta)(k_{i0} - Z_i) + I_{i0}\ . \tag{12}$$

The wealth of household i at $t = 0$ upon entering the financial system is determined by initial capital k_{i0} minus entry cost Z_i and the initial shocks, including ε_{i0} and ω_{i0}. The solution to this maximization problem is again $V_i(k_{i0} - Z_i, \xi_{i0}, \theta_0 + \varepsilon_{i0}, \omega_{i0})$. The first-order condition for investment is the following equation:

$$\left\{1 + \frac{\partial g[I_{it}(h^t), k_{it}(h^{t-1}), \omega_{it}]}{\partial i_{it}}\right\} p(h^t)$$
$$= \sum_{h_{t+1}} p(h^{t+1})\left[\frac{\partial f[k_{i,t+1}(h^t), \theta_{t+1} + \varepsilon_{i,t+1}]}{\partial k_{i,t+1}} - \frac{\partial g[I_{i,t+1}(h^{t+1}), k_{i,t+1}(h^t), \omega_{i,t+1}]}{\partial k_{i,t+1}}\right]. \tag{13}$$

It is explicit in this market context that the marginal cost of investment inclusive of adjustment costs on the left-hand side of (13) is equal to the net marginal revenue product on the right-hand side of (13), which is revenue less costs of adjustment. This is the same investment rule as was previously derived under the programming problem. More to the point, the usual separation theorem applies, and we can determine investment independent of household utility or wealth. Though firm size matters as it enters into the cost of adjustment, the "firm" in this competitive complete markets setting will simply maximize profits at date $t = 0$ choosing current investment and future plans:

$$\max f\left[k_{i0}-Z_i,\theta_0+\varepsilon_{i0}\right]-I_{i0}-g\left[I_{i0},k_{i0}-Z_i,\omega_{i0}\right]$$
$$+\sum_{t=1}^{\infty}\sum_{h^t} p\left(h^t\right)\left\{f\left[k_{it}\left(h^{t-1}\right),\theta_t+\varepsilon_{it}\right]-I_{it}\left(h^t\right)-g\left[I_{it}\left(h^t\right),k_{it}\left(h^{t-1}\right),\omega_{it}\right]\right\} \tag{14}$$

by choice of investment I_{i0} and state-and-date-contingent investments $I_{it}(h^t)$. This delivers exactly the same investment behavior. Furthermore, multiplying and dividing by probabilities at each date and state, this is also equivalent with maximizing the discounted expected stream of dividends (namely, consumption) where the discount rate appears stochastic but is actually just a renormalization of prices divided by probabilities. This then looks like the risk neutral firm of the investment literature.

5. Autarky

We now turn to the problem of households who do not participate in the financial sector and so are entirely on their own. It is best to distinguish here those who can invest in farm and other business with income y_{it} = q_{it} gross of costs of adjustment (costs which we do not observe) and those wage earners with income y_{it} as a function of θ_t and ε_{it} who do not invest in productive technologies, though the notation is similar in the end. For both we ignore demographics. For the former group with investment, the problem is:

$$W_i\left(k_{i0},\xi_{i0},\theta_0+\varepsilon_{i0},\omega_{i0}\right)=\max_{c_{it}\left(h^t\right),i_{it}\left(h^t\right)} u\left(c_{i0},\xi_{i0}\right)+\sum_{t=1}^{\infty}\beta^t\sum_{h^t} prob\left(h_i^t \mid h_{i0}\right)u\left[c_{it}\left(h_i^t\right),\xi_{it}\right]$$
$$c_{it}\left(h_i^t\right)=q_{it}\left(h_i^t\right)-I_{it}\left(h_i^t\right)-g\left[I_{it}\left(h_i^t\right),k_{it}\left(h_i^{t-1}\right),\omega_{it}\right]$$
$$k_{it+1}\left(h_i^t\right)=(1-\delta)k_{it}\left(h_i^{t-1}\right)+I_{it}\left(h_i^t\right)$$

The Euler equation is familiar:

$$\left\{1+\frac{\partial g\left[I_{it}\left(h_i^t\right),k_{it}\left(h_i^{t-1}\right),\omega_{it}\right]}{\partial i_{it}}\right\}u'\left(c_{it},\xi_{it}\right)$$

$$=\sum_{h_{t+1}}\left[\frac{\partial f\left[k_{i,t+1}\left(h_i^t\right),\theta_{t+1}+\varepsilon_{i,t+1}\right]}{\partial k_{i,t+1}}-\frac{\partial g\left[I_{i,t+1}\left(h_i^{t+1}\right),k_{i,t+1}\left(h_i^t\right),+\omega_{i,t+1}\right]}{\partial k_{i,t+1}}\right]u'\left(c_{it+1},\xi_{it+1}\right)$$

For wage earners, just replace flows *I* with *S* and stock *k* with *s* and function *f* as described earlier. That is, replace $f\left(k_{it},\theta_t+\varepsilon_{it}\right)$ with a separate term of income $y_{it}\left(\theta_t+\varepsilon_{it}\right)$ gross of savings adjustment costs, which we do not observe, and of course add to the resource constraint initial stock s_0. Stock of savings s_{it} accumulates as in the law of motion for capital above at depreciation rate δ. We do not treat the stocks of savings at the beginning of the period *t* as a real capital asset but rather something retained and unobserved in the backyard (unproductive) storage technology.

6. Empirical Strategy

The empirical implementation of the general problem will make use of additional assumptions on the functional forms for preferences and technology, convenient for obtaining closed-form solutions or linear approximations to the consumption and investment policy functions. We follow the empirical strategies in the existing literature on consumption smoothing (Townsend 1994, among others) and on investment financing (Gilchrist and Himmelberg 1999, among others), but again we use the common derivation from the given model for both.

Consumption policy equation with financial participation. To be yet more specific about within-household members' allocations, suppose the utility function of member *k* of household *j* is of the form $u^k(c_t^k,\xi_{it}) = -\frac{1}{\sigma}\exp\left[-\sigma\left(\frac{c_t^k}{A_t^k}+\xi_{it}\right)\right]$ where A_t^k is a gender-age weight of member *k* determined by metabolic requirements. Then, adjusting for these metabolic requirements by age and gender of the N_{it} members *k* of household *i*, assuming common risk aversion, *σ*, common preference shocks, and equal within-household Pareto weights, we obtain from (7) the following equation:

$$\frac{\sum_{k=1}^{N_t^i} c_t^k}{\sum_{k=1}^{N_t^i} A_t^k} = \frac{1}{\sigma}\left(\log(\lambda^i) - \frac{1}{N}\sum_{j=1}^{N}\log(\lambda^j)\right) - \frac{1}{\sigma}\left[\frac{\sum_{k=1}^{N_t^i} A_t^k \log(A_t^k)}{\sum_{k=1}^{N_t^i} A_t^k} - \frac{1}{N}\sum_{j=1}^{N}\frac{\sum_{k=1}^{N_t^j} A_t^k \log(A_t^k)}{\sum_{k=1}^{N_t^j} A_t^k}\right] + \frac{1}{N}\sum_{j=1}^{N}\frac{\sum_{k=1}^{N_t^j} c_t^k}{\sum_{k=1}^{N_t^j} A_t^k} + \xi_{it} \quad (15)$$

Here the dependent variable is the per-capita (weighted)[14] consumption of household *i*, c_{it}. The first term on the right-hand side is the household-specific fixed effect, which is essentially household *i*'s relative λ-weight. Note that the average weight in the population is virtually constant, as it is assumed in equilibrium a large number of households have entered and the impact of household *i* on the sum is negligible. This first term is denoted f_i in equation (16) below. The second term on the right-hand side is a demographic term reflecting the age-adjusted number of members N_t^j of household *j* relative to the aggregate risk-sharing group, the set of financial participants. In principle, as in Townsend (1994), this may move over time, but here we suppose it to be constant, and we have verified this makes little difference in the empirical specification below. Hence this term does not appear in equation (16) below. The final term is the average

[14] ICRISAT weights are calculated following Townsend (1994).

consumption of financial participants. In practice, that latter term is replaced by a common, time-specific fixed effect to avoid biases and to have power against alternative hypotheses (Ravallion and Chaudhuri, 1997). This then is term d_t in equation (16) below, as determined by the Lagrange multiplier.[15] In sum, we can express each term of equation (15) for household *i* with the following notation in (16):

$$c_{it} = f_i + dem_i + d_t + \xi_{it} \,. \tag{16}$$

The main point here is that consumption depends on income only through the common fixed-effect d_t.

Investment policy equation with financial participation. The production function is imagined to be linear in capital and multiplicative in the shocks: $q_{it} = f_i(k_{it}, \theta_t + \varepsilon_{it}) = (\theta_t + \varepsilon_{it})k_{it}$. This makes the average and marginal product of capital easy to compute (if the data came from the model). The adjustment cost function takes the form $g_i(I_{it}, k_{it}, \omega_{it}) = \frac{1}{2}\left(\frac{I_{it}}{k_{it}}\right)^2 k_{it} + I_{it}(\omega_{it} + b_i)$, where b_i is a household-*i* specific fixed effect. Note that taking the derivative of the function *g* with respect to investment *I* gives a partially closed form decision rule for investment with fixed effect b_i and an additive unobserved error ω_{it} as the marginal cost of adjustment. Further, under as-if-complete markets, this gives the empirical specification of the investment equation used in the literature. In summary, both the investment and consumption equations of the literature

[15] This is the intuition for why we can also accommodate common aggregate preference shocks, which also show up in the Lagrange multiplier.

are derived in the next section from a common foundation based on the optimal allocation of risk. Note that subscript *i* can now be deleted from functions $u_i(\cdot), f_i(\cdot)$, and $g_i(\cdot)$.

Under the thus assumed functional forms for *f* and *g*, we can substitute into the equation of marginal utility of consumption and costs/return on investment in Euler equation (13) above to get:

$$\left(1+\frac{I_{it}}{k_{it}}+b_t+\omega_{it}\right)p(h^t)=\sum_{h_{t+1}}\left[\left(\theta_{t+1}+\varepsilon_{i,t+1}\right)+\frac{1}{2}\left(\frac{I_{i,t+1}}{k_{i,t+1}}\right)^2\right]p\left(h^{t+1}\right). \tag{17}$$

Note first in equation (17) that I_{it}/k_{it} is already on the left-hand side, and while b_i and ω are as well, they can easily be moved the right-hand side, as in equation (18) below, switching signs. Next, as in Gilchrist and Himmelberg (1999), one can rewrite the Euler equation (17) at *t* + 1, and then with the original equation (17) at *t* we derive with substitution an overall equation in three periods, *t*, *t* + 1, and *t* + 2. Then, continuing in this way, making repeated substitutions for the investment-to-capital ratios one can derive an expression on the right-hand side which is a nonlinear function of θ_t over all future *t* and the contingent prices over all future *t*. The price of an idiosyncratic shock such as $\varepsilon_{i,t+1}$ is simply its probability, as that shock does not influence the aggregate state and it averages out in the population. Thus, as anticipated, adding up the probability-weighted sum, with some terms negative and some positive, delivers the mean, namely zero. What remains on the right-hand side, both current and future prices and aggregate shocks, are common to all the households in the financial sector and thus are captured by a single common time dummy. This is d_t in equation (18) below.[16] The main point is that household investment depends on the aggregate fixed effect d_t and not on household income. The normalization with respect to k_{it} gets rid of household specific technology effects except for the marginal cost shifter ω_{it}. Then, linearizing, again as in Gilchrist and Himmelberg (1999):

$$\frac{I_{it}}{k_{it}} = const_1 + d_t + b_i + \omega_{it}\ . \tag{18}$$

Consumption and investment equations under financial autarky. In the autarky problem, consumption is determined at the same time as investment for households running businesses, or at the same time as savings for wage earners, and so consumption will be captured by similar equations to investment. The relevant state variables are $\{k_{it}, \xi_{it}, \theta_t + \varepsilon_{it}, \omega_{it}\}$ and we write the policy functions as follows: $I_{it} = I_i(k_{it}, \xi_{it}, \theta_t + \varepsilon_{it}, \omega_{it})$ and $c_{it} = c_i(k_{it}, \xi_{it}, \theta_t + \varepsilon_{it}, \omega_{it})$. For wage earners, again replace k with s and I with S. But again, we do not track savings the way we do for investment by businesses, and so there are no investment equations to be estimated for wage earners. The key point is that the current state for a household at the time of making the joint consumption and investment (or savings) decision includes current income plus other idiosyncratic shocks to preferences and adjustment costs. That is, for farms and business, the state includes both the contemporaneous shocks $\theta_t + \varepsilon_{it}$ and also k_{it}. Current income is $q_{it} = k_{it}\ (\theta_t + \varepsilon_{it})$, and as we have already included the contemporaneous shocks, the

[16] This is related to d_t in the consumption equation though not identical to it. We do not test the two equations jointly, so the distinction does not matter.

capital piece k_{it} is the only thing otherwise left out of q_{it}. With the linear approximation we include each term separately.

In sum, the linear approximation of the policy functions for those in financial autarky, replacing $\theta_t + \varepsilon_{it}$ by q_{it}/k_{it} are, for consumption

$$c_{it} = \eta_0 k_{it} + \eta_1 \left(\frac{q_{it}}{k_{it}} \right) + \chi_{it}, \tag{19}$$

where χ_{it} captures both ξ_{it} and ω_{it}; and, for investment

$$I_{it} = \phi_0 k_{it} + \phi_1 \left(\frac{q_{it}}{k_{it}} \right) + \widetilde{\upsilon}_{it} \tag{20}$$

where $\widetilde{\upsilon}_{it}$ captures again both ξ_{it} and ω_{it}. Now, as in equation (17) above for those in as-if-complete markets, we normalize investment by the scale of the capital stock:

$$\frac{I_{it}}{k_{it}} = \phi_0 + \phi_1 \left(\frac{q_{it}/k_{it}}{k_{it}} \right) + \widetilde{\upsilon}_{it}. \tag{21}$$

In this specification, with the error term now normalized by k, it is natural to check for heteroskedasticity.

Impact equations of financial participation. Observed consumption and investment at time $t > 0$ for those households i participating in the financial sector $P_{i0} = 1$ and in financial autarky $P_{i0} = 0$ can be written by using equations (16), (18), (19) and (21):

$$c_{it} = P_{i0}\left[f_i + dem_i + d_t + \xi_{it}\right] + \left(1 - P_{i0}\right)\left[\eta_0 k_{it} + \eta_1\left(\frac{q_{it}}{k_{it}}\right) + \chi_{it}\right] \tag{22}$$

$$\frac{I_{it}}{k_{it}} = P_{i0}\left[const_1 + d_t + b_i + \omega_{it}\right] + \left(1 - P_{i0}\right)\left[\phi_0 + \phi_1\left(\frac{q_{it}/k_{it}}{k_{it}}\right) + \nu_{it}\right]. \tag{23}$$

By rearranging terms and taking first differences, and letting $\Delta d_t = d_t - d_{t-1}$, we rid ourselves of household-specific effects and get the following impact equations for changes in consumption and investment-per-unit capital:

$$\Delta c_{it} = P_{i0}\Delta d_t + (1 - P_{i0})\eta_0 \Delta k_{it} + (1 - P_{i0})\eta_1 \Delta\left(\frac{q_{it}}{k_{it}}\right) + \left[(1 - P_{i0})\Delta\chi_{it} + P_{i0}\Delta\xi_{it}\right] \tag{24}$$

$$\Delta\frac{I_{it}}{k_{it}} = P_{i0}\Delta d_t + (1 - P_{i0})\phi_1 \Delta\left(\frac{q_{it}/k_{it}}{k_{it}}\right) + \left[(1 - P_{i0})\Delta\nu_{it} + P_{i0}\Delta\omega_{it}\right]. \tag{25}$$

If the idiosyncratic shock ξ_{it} is i.i.d., then the error terms in equations (24) and (25) are i.i.d., and the participation decision P_{io} taken at $t = 0$ would be independent of error terms in the impact equations, which implies in turn that the OLS estimates of financial participation impact are unbiased. However, allowing serial correlation in the idiosyncratic shock ξ_{it} will make OLS estimates biased and would require Instrumental Variable (IV) estimation. Note that cost Z_i does not affect potential levels of consumption or investment other than in the initial date before our sample periods, but cost Z_i does affect the initial choice of financial participation. In this sense, Z_i in the theory is a valid instrument for the participation decision. The question is then what instrument we employ in the data. IV estimation requires finding variables in the data that are correlated with the cost of participation but uncorrelated with initial shocks ξ_{i0}, ω_{i0}, θ_0 and ε_{i0}.

Note that q / k appears in the consumption and investment equations for those autarky households running firms and businesses, but not for wage earners who have no k, only wage income. For empirical purposes we now put q / k in units of income for both groups. That is, we run a simple linear regression of income onto q / k each year one at a time for farms/businesses, and then use the rescaled predicted value. Note that this income term is just a linear function of q / k. For wage earners we need not run a regression and we just use reported income. This in first differences is "income change", one of the variables on the right-hand side of the consumption equation. The other term in the consumption equation is capital change. We ran this specification and conducted robustness checks with its exclusion. Results are not sensitive, so capital change is dropped from results reported in Table 4 below. This also has the advantage of making the autarky consumption equation more comparable to the empirical literature. The investment equation is run only for farms and businesses and is already scaled by k so there is no need to include k on the right-hand side. Finally, in earlier work (Alem and Townsend 2004) we included demographic effects in levels and all interaction terms, though this specification does not come from the theory. Results are largely similar.[17]

[17] Specifically, control X_{j96} is an expanded vector of household j characteristics including age, wealth, gender, and also other demographic terms (number of adult males, adult females and children). Control Z_{ji96} is a vector of characteristics for village i of household j. From the Townsend Thai data we include average wealth of the village and average education. We also include measured CDD village characteristics such as fraction of households with piped water and state supplied electricity, number of households with migrants outside the village, whether there is a village assembly hall, fraction of households in agriculture, in cottage

Instruments. We employ several candidates as instruments for Z_i and test them as over-identifying restrictions (OIR) as we describe below. Each instrument has its strength and limitations, and they all consist of alternative measures of the cost of financial participation Z_i based on geographic variation, as in Card (1995).[18]

Headman Response (HEAD): The key informant of a particular village in the Townsend Thai survey answers retrospective questions delivering the history of institution use, in particular the presence of a named institution in the base year, 1996. That is, were there any households who were clients or used the services of a named financial institution? This seems likely correlated with whether an individual is a member or a customer, particularly so for institutions that operate at the village level only or institutions that target or expand at the village level (less so for Commercial Banks, for example). This instrument is not available for informal borrowing or savings.

Time to District Center (TIME): CDD data estimates travel times from the village to District Centers. These are used as instruments for all formal institutions, though it is questionable *a priori* if there is relevance in this for village institutions. Commercial

industries, in paddy production, and fraction receiving government assistance, and with multiple occupations. The X_j and Z_{ji} are all dated 1996 and all entered in both levels and interacted with income change. The goal is to have as many controls as possible for consumption and investment change to extract out the incremental smoothing effect of membership in an institution.

[18] This strategy is vulnerable to the possibility that financial institutions choose where to operate based on the risk sharing capabilities of their borrowers. Though not implausible, there are indications of other motives in the data: Commercial banks cluster around towns as if a more aggressive strategy of lending to farmers or putting branches or mobile vans in rural areas were inconsistent with Bank of Thailand regulation. The BAAC tends over time to try to establish a branch in every county. Here we treat the placement as random, though clearly this at best an approximation, and focus on the choice of potential customers given branch location. It is clear from CDD data that households can travel non-trivial distances to get to somewhat distant branches. It is the cost of doing this that rationalizes several of the instruments we use. Ongoing work with Assuncao, Mityakov and Townsend (2010) is exploring these issues in detail but not enough is known at present to incorporate here.

banks might be supposed to operate near district centers, and the BAAC may target poor farmers far off the main road.

Geographic Information System (GIS): We also created from CDD data another instrument for financial participation that indicates institutional presence in 1996. Again, Headmen of all villages in Thailand are asked in the CDD survey whether anyone in the village has access to credit from each one of several named institutions such as village funds, commercial banks, agricultural cooperatives, and traders or suppliers of inputs (as a proxy for the informal sector). As all villages in each of the survey provinces have been vectorized in a GIS, we can use the responses from nearby villages in 1996 to create a weighted membership variable for each of the villages of the Townsend Thai survey.[19] The GIS variable has several advantages. First, the response of any given headman may be inaccurate, so with presumed spatial correlation, the averaging is removing some measurement error. Second, we can impute values to villages that otherwise are missing headmen responses. Third, there may be supply-side variation: For example, village funds (PCG's) are promoted by energetic local officials responsible for *tambons* or *amphoes*.

The instruments we have chosen are by and large correlated with active participation in the base year and subsequent use of the financial institutions, as shown in Table 2. In many other applications with limited data, being a customer or member

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[19] Specifically every pixel is assigned a number by weighting the nearest 12 villages to the center of the pixel, the weight falling inversely with distance. Thus every village, including those of the Townsend Thai data, can be assigned an indicator. The weights and number of villages used were chosen to produce non-trivial variation, between zero and one, so that on average there is neither too little nor too much damping. Robustness checks with alternative specifications were performed.

cannot be checked directly with actual subsequent use, so here again a panel which asks about savings and borrowing transactions by provider has its huge advantages.

(Insert Table 2 here)

Method. We use Instrumental Variables (IV) as the benchmark case but employ Generalized Method of Moments (GMM) when the presence of heteroskedasticity in the error term makes IV estimates of standard errors inconsistent. Assuming conditional homoskedasticity, we calculate an IV estimator in two stages, test for the validity of sets of instruments as over-identifying restrictions (OIR), and report the Sargan statistic. We test for heteroskedasticity as in Pagan and Hall (1983), and when indicated, we use GMM and report Hansen J-statistics for the validity of instruments. We first test for the validity of the three instruments, and if this is rejected we test for the various combinations of instruments pair-wise. The advantage of GMM in overcoming heteroskedasticity comes with a cost, as Hayashi (2000) points out, which is that estimates of the optimal weighting matrix require a very large sample size. We come back to this issue when we report results.

Table 3 reports statistics on the relevance and validity of instruments employed on each financial institution for both consumption and investment impact equations. The first column presents the Shea (1997) partial R^2 measure for (time) dummies interacted with measured participation P_0, and the second column the income coefficient interacted with measured participation P_0. Results indicate that the instruments are largely correlated with these endogenous variables, which is what we expected. There are exceptions. Note in particular that the partial correlation of instruments in the income column for Agricultural Cooperatives and PCG in the consumption specification are low, to anticipate future results. This is also true for Agriculture Cooperatives in the investment specification. The third column reports the p-value of the Pagan-Hall (1983) test for the presence of heteroskedasticity in the error term. It was found that the null hypothesis of conditional homoskedasticity is not rejected for the consumption specification, but it is uniformly rejected at 1% in the case of the investment equation. The investment equation is thus estimated using the GMM instead of IV, and again we anticipate weaker results. The last two columns report the p-value of the over-identifying restrictions test, and we present in the last column the combination of instruments for which the Sargan/Hansen statistic did not reject the null hypothesis of validity of instruments.

(Insert Table 3 here)

7. The impact of financial institutions

Tables 4 and 5 present the estimates of consumption and investment impact equations (24) and (25), respectively. The first column reports the point estimates (and p-values) of the time-varying constant that measures consumption/investment co-movements for members of the particular institution under analysis (BAAC, Commercial Banks, Agricultural Cooperatives, PCG and the Informal Sector). The second column reports the sensitivity of consumption/investment to income changes for non-participants of the financial institution, and the third column measures the effect of financial participation on the income coefficient sensitivity (that is, income change sensitivity for members is the sum of the second and third columns). Finally, the last, fourth column, tests the complete-markets-full-insurance hypothesis for financial participants.

(Insert Table 4 here)

Summary of results. The BAAC is the most helpful institution in the sense that it helps both in consumption and investment. The sensitivity of consumption to income changes is highest for those non-members of BAAC under IV estimation, but it is fully undone for members in the IV specification, that is, members of the BAAC seem to enjoy full insurance against income shocks (see the results in the last column). For investment, both OLS and IV indicate that the BAAC has a favorable impact, though the impact of the financial institution on the income coefficient ($P_0\eta_1$) subtracts too much and consequently the complete markets hypothesis of the last column is rejected (at p-value 0.000). But see below for further discussion on this last point. The instruments employed are correlated with subsequent use of both savings and credit (Table 2), though TIME has a somewhat weaker correlation with subsequent use and is not a valid instrument in consumption regression. Note that TIME has a positive correlation as more distant customers are better served, consistent with the premise that BAAC customers are usually located off road, so to speak.

(Insert Table 5 here)

What is the characteristic of the BAAC that allows this beneficial effect? Townsend and Yaron (2001) examine this in a study of the BAAC risk contingency system. When a farmer experiences an adverse shock during crop production, either idiosyncratic illness which impedes farming, or an aggregate shock such as flood or drought, then this is reported and verified if necessary by a BAAC field officer. The BAAC can then extend the loan, and sometimes will forgive some of the (compound) interest due and/or forgive some of the principal. The funds for this come from the central government and are a line item in the BAAC accounts. In effect, the government is paying a premium for insurance, while the farmers clearly receive an indemnity. The point is that this de facto insurance arrangement is tailored around the farmers' actual situation and so *a priori* one might think that it would show up in consumption and investment smoothing. Evidently this is the case.

Commercial banks are also helpful. In consumption smoothing, similar to the BAAC, the impact of income changes on consumption is mitigated by financial participation, again significant in the IV. For investment, the OLS specification indicates a reduction in idiosyncratic risk, but that is not the case for the IV specification. It is interesting that for commercial banks all three instruments (GIS, HEAD, TIME) are valid, always. For commercial banks the correlation in Table 2 of the instrument *Time to District Center* with subsequent use is negative, as one might anticipate, that is, nearby customers are better served, so to speak. The negative sign on the instrument HEAD is a puzzle.

For Agricultural Cooperatives and PCG/Village Funds it appears that customers are as vulnerable as non-customers to shocks with respect to consumption. The sign is negative for most specifications, but it is not statistically significant. With respect to investment, the sign is perverse and significant in one case. These two institutions do not appear helpful. Related perhaps, in Table 2, the correlation of the instruments with subsequent use displays weak results for Agricultural Cooperatives.

The Informal Sector presents neutral if not perverse results with respect to the smoothing of consumption from income shocks. Surprisingly, the favorable impact, though overdone, is in investment (the F-test for complete markets is rejected), though again see the discussion immediately following. Also, it seems it is the savings part (rice storage), and not the informal borrowing part, which is picked up by the instruments (TIME and GIS). Note the instrument TIME has a positive coefficient, as again more distance from the district center means more use of rice storage.

As noted earlier, the coefficients in the IV regressions in investment for the BAAC and the informal sector are negative and significantly different from zero, an odd result. We have investigated this further. In the data used in this paper, the result for the BAAC appears to be driven by low wealth households: if we drop the bottom 15% then there is no net response to idiosyncratic risk, as the theory of full risk sharing implies, i.e., full risk-sharing. In contrast, dropping high wealth households, different treatment of outliers, and different treatment of zero investment events seem not to impact the result in Table 5. The odd result for the informal sector and investment remains despite all these robustness checks. However, results may be due to some kind of measurement error in the annual data rather than anything substantive economically. In a different monthly data set, but also for Thailand and these same provinces, Samphantharak and Townsend (2009) do not find negative coefficients on either rich or poor households. Ongoing work by Kinnan and Townsend (forthcoming) with that same monthly data find that the BAAC and also commercial banks are helping in smoothing consumption (perfectly) and investment (partially); further, there is no over-correction. Indeed, in the more detailed monthly data where we know who is related to whom, and whether households give gifts and transfers to each other, it seems indirect connections of a household to these formal lenders can be quite helpful, either in smoothing along the equilibrium path, as for consumption, or punishing off-equilibrium behavior, as for investment. These results are preliminary, however.

8. Additional Results and Interpretation

As with the macro aggregates featured in the literature on the Asian financial crisis, the first two years after the 1997 crisis correspond with drops in income and other key variables, and the last year of the data corresponds with a recovery, especially so in the Central Region. But despite the prevalence of aggregate shocks in income, consumption and investment, idiosyncratic shocks abound. Part of this can be explained by distinguishing income source and occupation group. For example, incomes did not drop on average in these data for wage earners and those receiving remittances, unlike the presumptions which underlay safety net targeting. Business on the other hand did suffer income drops. Still, within each occupation category there remains considerable idiosyncratic variation, evident in the histograms of income change. Thus an analysis of the optimal allocation of risk is appropriate for these data.

The analysis of risk-sharing indicates there is little pattern by age and gender of the household head, groups which are typically thought of as being in need of safety net targeting. The least educated are more vulnerable, but there are exceptions. The most salient finding is that wealth does matter, and the poor are uniformly more vulnerable in both consumption and investment.

Stratifications by wealth and a frequency-of-use analysis with transactions data seem to confirm a stereotypical picture of the literature: The poor lack access to formal credit and insurance markets and are more reliant on remittances, moneylenders, and the informal sector. They also seem more reliant on rice storage and livestock sales. The rich have access to formal credit and use informal lending, savings in financial institutions, and household and productive assets. However, when the transactions data are coupled with the consumption, income, and investment data, a strikingly different pattern emerges. Partial correlation coefficients of consumption-income deficits and investment-income deficits with the various potential smoothing devices show that the poor segment of the population are heavy users of formal credit, for both consumption and investment smoothing. Informal borrowing is used more by the middle and upper wealth groups. Likewise remittances, though used by all, seems relatively more important to the middle and upper wealth groups. What remains of the stereotypical picture of the literature is that the poor, and middle, segments are users of rice storage and the rich use savings in formal institutions.

Stratifying by institution we find that the middle and upper classes by wealth do seem to use commercial bank savings accounts to smooth consumption, running down savings when there is a gap between consumption and income. Commercial bank lending is available to few households. In contrast, we find in the transaction data that both borrowing and saving with BAAC are helpful in consumption smoothing for the relatively poor. This result helps us interpret the OLS and IV regressions. For example, for village level quasi-formal financial institutions, we find in the transactions data that movements in PCG credit and saving accounts do help smooth consumption, though only for the rich, and smooth investment, but only for the middle group. An analysis of the informal sector and the transactions data shows for consumption that informal borrowing is helpful and significant under stratifications for the middle class only, not the poor. Money lenders in particular serve the middle segment of the market. Regarding investment, consistent with Tables 4 and 5, the transactions data show that informal borrowing is helpful for the middle and rich, again with money lenders serving the middle segment. Remittances help only the middle segment also. Storeowner credit helps the rich (and to a lesser extent the poor, an exception). The conclusion again is that the informal sector helps the wealthier groups. In contrast, here but not in Table 4, informal savings in the form of buffer stocks is helpful in smoothing consumption for the poor and middle wealth segments of the surveyed population.

9. Concluding Remarks

This paper presents a theory-based assessment of the impact of financial institutions at the micro level, beyond financial statements and stand-alone financial indicators. Access to financial institutions, as predicted from the theory, entails substantial beneficial effects at the household level, particularly in eliminating the damaging effect of income variability on consumption and investment. In particular, and consistent with previous analysis (Townsend and Yaron 2001), government development banks, usually considered culprits, seem to have a particularly beneficial effect. The more general point is that theory and data can be combined to provide a rating of how well financial service providers are doing as regards their actual customers and clients in the provision of insurance. This link between the ratings of financial institutions and their impact is rare. Certainly, the panel data required to do this is not typically available, but on the other hand, the knowledge gained can be critical for regulators and policymakers as they try to assess how well a given financial system is functioning and whether or not there can be improvements.

References

Alem, M. and R.M. Townsend, 2004. An Evaluation of Safety Nets and Financial Institutions in Crisis and Growth. Working paper, Dept. of Economics, University of Chicago.

Assuncao, J., S. Mityakov and R.M. Townsend, 2010. Bank Ownership and Expansion of the Financial System in Thailand. Presentation made at AEA Annual Meetings, January 2, 2010, Atlanta.

Binford, M., T.J. Lee and R.M. Townsend, 2004. Sampling design for an integrated socioeconomic and ecological survey by using satellite remote sensing and ordination. Proceedings of the National Academy of Sciences, 101, 11517-11522.

Card, D., 1995. Using Geographic Variation in College Proximity to Estimate the Return to Schooling, in: L.N. Christofides, E.K. Grant, and R. Swidinsky (Eds.), Aspects of Labor Market Behaviour: Essays in Honour of John Vanderkamp. University of Toronto Press, Toronto.

Gilchrist, S., and C. Himmelberg, 1999. Investment: Fundamentals and Finance, in: B. Bernanke, and J. Rotemberg (Eds.), NBER Macroeconomics Annual 1998. MIT Press, Cambridge and London.

Greenwood, J., and B. Jovanovic, 1990. Financial development, growth, and the distribution of income. Journal of Political Economy, 98, 1076-1107.

Hayashi, F., 2000. Econometrics. Princeton University Press, Princeton, NJ.

Heckman, J.J. and E.J. Vytlacil, 2001. Local instrumental variables, in: C. Hsiao, K. Morimune, and J.L. Powell (Eds.), Nonlinear Statistical Modeling: Proceedings of the Thirteenth International Symposium in Economic Theory and Econometrics: Essays in Honor of Takeshi Amemiya. Cambridge University Press, New York.

Jeong, H. and R.M. Townsend, 2008. Growth and Inequality: Model Evaluation Based on an Estimation-Calibration Strategy. Macroeconomic Dynamics, 12, 231-84.

Kaboski, J,P., and R.M. Townsend, 2005. Policies and Impact: An Evaluation of Village-Level Microfinance Institutions. Journal of the European Economic Association, 3, 1-50.

Kaboski, J.P., and R.M. Townsend, 2011. A Structural Evaluation of a Large-Scale Quasi-Experimental Microfinance Initiative. Econometrica, 79, 1357-1406.

Kaboski, J.P., and R.M. Townsend, 2012. The Impact of Credit on Village Economies. American Economic Journal: Applied Economics, 4, 1-38.

Kinnan, C. and R.M. Townsend, forth. Kinship and Financial Networks, Formal Financial Access and Risk Reduction. Forthcoming in American Economic Review Papers and Proceedings.

Pagan, A., and A.D. Hall, 1983. Diagnostic Tests as Residual Analysis. Econometric Reviews, 2, 59–218.

Puentes, E., 2009. Financial Deeping in Thailand. Unpublished project document, University of Chile.

Ravallion, M., and S. Chaudhuri, 1997. Risk and Insurance in Village India: Comment. Econometrica, 65, 171-184.

Samphantharak, K., and R.M. Townsend, 2009. Households as Corporate Firms: An Analysis of Household Finance Using Integrated Household Surveys and Corporate Financial Accounting. Cambridge University Press, Cambridge; New York.

Shea, J., 1997. Instrument Relevance in Multivariate Linear Models: A Simple Measure. Review of Economics and Statistics, 79, 348-352.

Sripakdeevong, P. and R.M. Townsend, 2010. Informal Networks and Shadow Banking. Unpublished project document, MIT.

Townsend, R.M., 1978. Intermediation with Costly Bilateral Exchange. Review of Economic Studies, 45, 417-425.

Townsend, R.M., 1983. Forecasting the Forecasts of Others. Journal of Political Economy, 91, 546-587.

Townsend, R.M., 1994. Risk and Insurance in Village India. Econometrica, 62, 539-91.

Townsend, R.M., 1997. Townsend Thai Project Initial Institutional Survey, 1997. http://hdl.handle.net/1902.1/10675 UNF:3:OHaCwbvWAvaqa3xrAMBFTA== Robert M. Townsend; Murray Research Archive [Distributor] V1 [Version].

Townsend, R.M., and K. Ueda, 2006. Financial Deepening, Inequality, and Growth: A Model-Based Quantitative Evaluation. Review of Economic Studies, 73, 251-93.

Townsend, R.M., and K. Ueda, 2010. Welfare Gains from Financial Liberalization. International Economic Review, 51, 553-597.

Townsend, R.M., and S.S. Urzua, 2009. Measuring the Impact of Financial Intermediation: Linking Contract Theory to Econometric Policy Evaluation. Macroeconomic Dynamics, 13, 268-316.

Townsend, R.M. and J. Yaron, 2001. The Credit Risk Contingency System of an Asian Development Bank. Economic Perspectives, Third Quarter, Federal Reserve Bank of Chicago, 25, 31-48.

Yaron, J., 1994. What Makes Rural Financial Institutions Successful? World Bank Research Observer, 9, 49-70.

Tables

Table 1
Policy Functions for the Different Financial Regimes

		Consumption	Investment
$P_{i0} = 1$ (participation)	for all $t > 0$	$c_{it} = c_i(\lambda_i, \xi_{it}, \bar{c}_t)$	$I_{it} = I_i(k_{it}, \omega_{it}, \bar{c}_t)$
$P_{i0} = 0$ (autarky)	for all $t > 0$	$c_{it} = c_i(k_{it}, \xi_{it}, \theta_t + \varepsilon_{it}, \omega_{it})$	$I_{it} = I_i(k_{it}, \xi_{it}, \theta_t + \varepsilon_{it}, \omega_{it})$

Table 2
Correlation of Instruments (listed in columns 2, 4, 6) with Frequency of Use

	HEAD	P-value	TIME	P-value	GIS	P-value
BAAC						
- Borrowing	.0869	(.0050)	.0675	(.0307)	.2115	(.0000)
- Savings	.0667	(.0313)	.0602	(.0540)	.2140	(.0000)
Commercial Banks						
- Borrowing	-.0209	(.4995)	-.0795	(.0108)	.0977	(.0016)
- Savings	.0558	(.0714)	-.0988	(.0015)	.0889	(.0041)
Agric. Cooperatives						
- Borrowing	.1062	(.0006)	.0045	(.8847)	.1818	(.0000)
- Savings	.1527	(.0000)	-.0013	(.9678)	.1897	(.0000)
PCG						
- Borrowing	.2186	(.0000)	-.0961	(.0020)	.1312	(.0000)
- Savings	.1943	(.0000)	-.0930	(.0028)	.1668	(.0000)
Informal sector						
- Borrowing	NA	-	.0174	(.5770)	.0098	(.7522)
- Savings (Rice)	NA	-	.1228	(.0001)	.0696	(.0244)

Notes: GIS is the Geographical Information System instrument, TIME measures the travel time from the village to the district center and HEAD is the response of the Headman to questions about institutional presence. Frequent use is a dummy variable indicating whether the household had a transaction with named institution in 3 out of the 4 years in the panel. Note that informal sector borrowing is not highly correlated with the two available instruments.

Table 3
Properties of the Instruments

	Shea (1997) partial R^2 for endogenous variables		Pagan-Hall (1983) Test of Heteroskedasticity	OIR test: Sargan/ Hansen	Combinations of instrument
	P_0 dt	P_0 q/k	p-value	p-value	
Consumption					
BAAC	.994	.208	.675	.276	GIS,Head
Comm. Banks	.878	.424	.998	.668	GIS,Head,Time
Agric. Coop.	.4160	.0121	.891	.2259	GIS,Time
PCG	.9056	.0984	.911	.1644	GIS,Time
Informal sector	.8747	.3306	.952	.6710	GIS,Time
Investment					
BAAC	.9922	.2300	.004	.8176	GIS,Head,Time
Comm. Banks	.8751	.2123	.000	.9158	GIS,Head,Time
Agric. Coop.	.8403	.0628	.000	.5266	GIS,Head
PCG	.9273	.2223	.000	.7414	GIS,Head
Informal sector	.8984	.3615	.000	.4915	GIS,Time

Table 4
Impact of Financial Institutions on Consumption Smoothing (Eq. 24)

	F-test $P_0\,dt = 0$	η_1	$P_0\,\eta_1$	F-test $\eta_1+P_0\,\eta_1= 0$
	(p-value)	(p-value)	(p-value)	(p-value)
<u>BAAC</u>				
OLS	1.66	.249***	-.062	13.04
	(.157)	(.000)	(.439)	(.000)
IV	17.21	.571***	-.618***	.31
	(.002)	(.000)	(.000)	(.578)
<u>Commercial Banks</u>				
OLS	8.01	.246***	-.094	7.97
	(.000)	(.000)	(.234)	(.0048)
IV	29.58	.299***	-.223*	1.08
	(.000)	(.000)	(.072)	(.300)
<u>Agric. Cooperatives</u>				
OLS	7.17	.204***	-.006	1.95
	(.000)	(.000)	(.966)	(.163)
IV	34.25	.303***	-1.427	.77
	(.000)	(.010)	(.304)	(.379)
<u>PCG – Village Funds</u>				
OLS	1.19	.221***	-.116	.33
	(.313)	(.000)	(.539)	(.567)
IV	23.82	.196***	.427	1.31
	(.000)	(.000)	(.455)	(.253)
<u>Informal Sector</u>				
OLS	4.45	.117***	.223***	50.35
	(.001)	(.001)	(.000)	(.000)
IV	32.70	.156***	.114	13.44
	(.000)	(.001)	(.279)	(.000)

Table 5
Impact of Financial Institutions on Investment Sensitivity to Shocks (Eq. 25)

	F-test P_0 dt = 0	φ_1	$P_0 \varphi_1$	F-test $\varphi_1 + P_0 \varphi_1 = 0$
	(p-value)	(p-value)	(p-value)	(p-value)
BAAC				
OLS	.76	.031***	-.192***	77.19
	(.5151)	(.000)	(.000)	(.000)
IV	3.54	.162***	-1.372***	270.36
	(.3150)	(.000)	(.000)	(.000)
Commercial Banks				
OLS	.06	.010***	-.058*	2.26
	(.983)	(.002)	(.066)	(.133)
IV	6.54	-.003	.026	.07
	(.088)	(.807)	(.739)	(.787)
Agric. Cooperatives				
OLS	.00	.010***	.381***	9.32
	(.999)	(.002)	(.003)	(.002)
IV	2.98	-.011	.436	.04
	(.395)	(.403)	(.844)	(.848)
PCG – Village Funds				
OLS	.03	.010***	.019	.01
	(.994)	(.002)	(.956)	(.932)
IV	2.56	-.012	.966	.06
	(.464)	(.473)	(.805)	(.807)
Informal Sector				
OLS	1.20	.030***	-.162***	58.12
	(.308)	(.000)	(.000)	(.000)
IV	.02	.332***	-2.696***	90.01
	(.991)	(.000)	(.000)	(.000)

Appendix

Table A.1
Summary Statistics, 1997

Variable Description	# of obs.	Mean	St.Dev.
Households variables (total 960)			
Household Consumption (Baht)	924	90964	151241
Household Investment (Baht)	429	13960	96630
Household Income (Baht)	927	76119	232359
Age of Head	912	51	14
Gender of Head (1 if Male)	912	.75	.43
Household Wealth (in Baht)	924	62670	115217
Household Size (members)	923	4.6	1.9
Financial institution participation (total 960)			
Dummy BAAC (1 if member)	884	.29	.46
Dummy Comm. Banks (1 if member)	884	.27	.44
Dummy Agric. Cooperatives (1 if member)	884	.15	.36
Dummy PCG-Village Fund (1 if member)	884	.06	.24
Dummy Informal Sector (1 if informal debt)	793	.59	.49
Instruments for participation			
GIS _ BAAC (village level, total 192)	192	.86	.23
GIS _ Comm. Banks (village level, total 192)	192	.33	.24
GIS _ Cooperatives (village level, total 192)	189	.60	.35
GIS _ Village Funds (village level, total 192)	192	.18	.20
GIS _ Supplier Credit (village level, total 192)	192	.45	.29
HEAD _ BAAC (village level, total 192)	192	.20	.40
HEAD _ Comm. Banks (village level, total 192)	192	.02	.14
HEAD _ Cooperatives (village level, total 192)	192	.09	.28
HEAD _ Village Funds (village level, total 192)	192	.09	.28
TIME to District Center (village level, total 192)	192	.25	.14

Table A.2
Summary Statistics, panel data, 1998-2001

Variable Description	# of obs.	Mean	St.Dev.	Min.	Max.
Household variables (total 3840)					
Change in Consumption (Baht)	3682	-5183	46523	-154737	150106
Change in Income (Baht)	3698	-8770	104747	-283033	147934
Change in Investment/Capital (Baht)	2441	-.20	2.47	-12.08	6.46
Capital - Level of Productive Assets (Baht)	3682	61359	78314	0	493790