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Abstract This paper provides a theory-based empirical framework for understanding the risk and return on productive capital assets and their allocation across activities in an economy characterized by idiosyncratic and aggregate risk and thin formal markets for real and financial assets. We apply our framework to households running business enterprises in Thai villages with extensive networks, taking advantage of panel data: income, assets, consumption, gifts, and loans. We decompose risk and estimate the risk premia faced by households, distinguishing aggregate risk from idiosyncratic, potentially diversifiable risk. This distinction matters for estimating measures of underlying productivity and has important policy implications.

Keywords: Rate of Return, Aggregate Risk, Idiosyncratic Risk, Household Enterprise, Risk Sharing, Kinship Networks, Village Economy, Asset Pricing, CAPM, Risk Premium, Risk-Adjusted Return, Productivity

JEL Classification: D12, D13, G11, L23, L26, O12, O16, O17

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1. Introduction

This paper provides a theoretical framework for understanding the allocation, risk, and return on productive real capital assets across activities and sectors in an economy characterized by idiosyncratic and aggregate risk and thin formal markets for real and financial assets. We apply our framework to households running farm and non-farm business enterprises in rural and semi-urban Thai villages with extensive family networks, taking advantage of unusual panel data, a monthly household survey over 156 months that measures income, assets, consumption, gifts and loans.

Our framework allows us to quantify and decompose the risk faced by households running these business enterprises into two components: (1) aggregate, non-diversifiable risk, and (2) idiosyncratic, potentially diversifiable, risk. In particular, we are able to estimate the risk premia for the aggregate and the idiosyncratic risk components separately. We find these two risk premia are quite different from each other, specifically, much higher for the aggregate risk than for the idiosyncratic risk. The distinction thus matters for backing out accurate measures of underlying productivity, risk-adjusted net returns, i.e., what remains after subtracting risk premia from expected, average returns.

Many households in the data face relatively more idiosyncratic risk. Idiosyncratic risk carries a low risk premium. For these households, although the quantity of this risk can be high, not much of it is borne by the household as it is diversified away to a considerable degree. Thus these households have low risk premia and, with not much to subtract, net returns are relatively close to unadjusted returns. In contrast, other households in the data bear considerably more aggregate risk than idiosyncratic risk. As this aggregate risk cannot be diversified away, it bears a high risk premium. Thus unadjusted returns for such households can seem quite high, but the net returns after subtracting the risk premia, i.e., the measures of their latent productivity, are low.

This in turn has important policy implications. To the extent that a community faces aggregate risk, there is little more that could be done within the community itself for alleviating that risk. Aggregate risk is not entirely exogenous. Under our framework, aggregate risk is chosen optimally as sectors and activities within and across households, but beyond that there is little the community can do ex post. On the other hand, idiosyncratic risk is in principle diversifiable, hence one can think about potential policy improvements, e.g., improved ex ante insurance products within the community or ex post government transfers.[1] Therefore, the distinction between aggregate and idiosyncratic risk is important for policies that are geared toward risk sharing.

Other policies addressing credit constraints, financial access, and occupation choice also hang on the distinction between aggregate and idiosyncratic risk. The relatively poor households in the village economies of our sample are engaged in production activities with high expected returns. Thus they might appear to be credit constrained in the usual, stereotypical sense. But these poor households face high aggregate risk, and also idiosyncratic risk. Adjusting for each of these risks appropriately, with differential risk premia, we find that poor households in the more developed region of the country have net returns which are actually lower than the relatively wealthy in that region. So poor households in the developed region seem constrained after all but in a different sense: they are not constrained within their chosen sectors and activities but rather are constrained away from the activities with the highest returns net of risk premia that are available for richer households. Further, the returns of the relatively poor in the less developed, agrarian region are not different from those of the relatively wealthy in that region, after adjusting for risk premia. Thus poor households are not credit constrained in the usual sense, either.

[1] There may be underlying obstacles such as moral hazard that prevent idiosyncratic risk from being fully covered. Likewise, there can be interactions between aggregate and idiosyncratic risk that move us away from the full information standard on both dimension. See for example Di Tella (2015). Put another way, businesses need to be exposed to at least some idiosyncratic risk, to have some "skin in the game" in order to mitigate unobserved reallocation of capital.

Our framework and the results are made clear by a comparison of two extreme benchmarks. A full risk-sharing benchmark, not with ex ante asset trades, but with ex post transfers of consumption goods contingent on output, delivers the prediction that only aggregate covariate risk contributes to the risk premium. In contrast, an autarky benchmark would predict that aggregate and idiosyncratic risks should enter the risk premium with the same weight because total risk faced by the household business is simply the sum of the risks from each component. In the data, the risk sharing benchmark picks up a large part, though not all, of the variation in risk premia. There is a residual, smaller part due to idiosyncratic risk, but otherwise it is substantially diversified away. More specifically, a financial autarky model that would simply adjust for total risk, that is, with equal weight on aggregate and idiosyncratic risk factors, is rejected in the data. Intermediate models which allow substantial though less than perfect risk sharing fit the data best.

This finding, derived entirely from production and rate of return data, is highly reminiscent of findings in the literature on risk sharing using consumption and income data (Townsend 1994). The full risk sharing benchmark is typically rejected, and so are the borrowing-lending or buffer stock financial regimes. The best fitting models typically lie between these extremes, sometimes closer the former than the latter. Here we take a direct look at this issue: we use the consumption as well as gifts and lending data from the same sample of households, and establish a consistent picture of what we are seeing on production and consumption sides. Idiosyncratic shocks to rates of return are positively correlated with gifts-out and lending as the full insurance benchmark would suggest. Still, in consumption risk sharing regressions, these same idiosyncratic shocks do nevertheless move consumption, with positive but quantitatively small coefficients. So indeed households do bear some of the idiosyncratic risk and that is why there is risk premium for idiosyncratic risk. Yet, the idiosyncratic risk premium is small relative to risk premium associated with aggregate shocks which in the data move both production and consumption. To the best of our knowledge, little previous work has analyzed risk sharing of the same households in the same sample using data from both consumption and production sides.

The results in this paper on risk premia are much like those of the standard capital asset pricing model, yet here, in these village economies, households infrequently trade their fixed business assets (machinery, livestock, and land).[2] The seeming puzzle is explained by the fact that these households have extensive family networks and engage actively in gifts and loans. This makes the economic mechanism in these village economies with informal markets and institutions close to complete market mechanism in the standard capital asset pricing model. The institutions are different but the predicted outcome is identical. More specifically, to determine the solution to one of benchmark models, the full risk sharing problem including an efficient allocation of assets across households and activities, we consider the social planning problem that delivers Pareto optimal allocations, namely the problem that maximizes a Pareto weighted sum of expected utilities subject to resource constraints. This is of course the same framework that led to the literature on consumption risk sharing, but we explicitly incorporate production into the analysis. At the beginning of each period, each household starts with initial resources that consist of two components: the assets held from the previous period over all production activities, and their realized, current output. The households may then pay or receive gifts and transfers to other households, as in a risk-sharing syndicate. The household then invests part of this interim wealth in terms of assets carried to the next period and consumes the rest. For this social planning problem interpretation, the planner (actually, of course, the community as a whole) retains full control over the projects, assigns them to households, chooses the current gifts and transfers to each household, and chooses the assets to be allocated to each activity run by each household in the following period. Alternatively, more intuitively, and less demanding in terms of actual implementation, we may assume that households fully commit to a date- and state-

[2] We emphasize the returns to the relatively illiquid real productive assets that are mainly from the output they produce. There are a few financial assets (such as deposits at financial institutions). The returns to these tradable liquid financial assets are from interest, dividends, or capital gains (and losses), but these assets and their returns are small in the data and are not driving the conclusion.

invariant risk-sharing rule that maps aggregate resources into a consumption allocation across the households. Knowing that this risk-sharing rule is locked in for the future, households choose, on their own, which projects to undertake.

What we study in this paper is related to recent, important literatures in both development and macroeconomics measuring rates of return. In development economics, there is a literature on the impact of interventions (De Mel, McKenzie, and Woodruff 2008; Evenson and Gollin 2003; McKenzie and Woodruff 2008; Udry and Anagol 2006). The impact on revenue of additional investments in agriculture can be high, particularly with respect to small investments, such as fertilizer and improved seeds. In a recent paper, Beaman, Karlan, Thuysbaert, and Udry (2015) demonstrate that the return to agricultural investment varies across farmers, farmers are aware of this heterogeneity, and farmers with particularly high returns self-select into borrowing. However, as they note, lending may not be sufficient to induce investments in the presence of other constraints. Related, the evidence from traditional microcredit, targeting micro enterprises, is mixed: some studies with randomized control trials find an increase in investment in self-employment activity (Crepon, Devoto, Duflo, and Pariente 2015; Angelucci, Karlan, and Zinman 2015) while others do not (Attanasio, Augsburg, de Haas, Fitzsimons, and Harmgart 2015; Augsburg, de Haas, Harmgart, and Meghir 2015; Banerjee, Dulfo, Glenerster, and Kinnan 2015; Tarozzi, Desai, and Johnson 2015). Evidently, farmers may be constrained by a lack of insurance (Karlan, Osei, Osei-Akoto, and Udry 2013), have time inconsistent preferences (Duflo, Kremer, and Robinson 2011), or face high costs of acquiring inputs (Suri 2011). In this paper, we add to this list an important consideration that measured rates of return may reflect a risk premium. Therefore, targeting without information on risk may blunt, if not seemingly eliminate real gains, in taking an average over individuals who vary in true underlying productivity (some are constrained and productive while others are not). Put differently, to the extent we can identify subgroups and their exposure to different kinds of risk, we would be better able to target the ones with genuinely high returns.

Likewise, in macroeconomics, Hsieh and Klenow (2009), Restuccia and Rogerson (2008), and Bartelsman, Haltiwanger, and Scarpetta (2013) study misallocation of resources. The essential idea is that an optimal allocation of capital (and other factor inputs) requires the equalization of marginal products. Deviations from this outcome represent a misallocation of resources and translate into sub-optimal aggregate outcomes. Typically, however, the literature does not examine the underlying causes. An important recent exception is David, Hopenhayn, and Venkateswaran (2014) in which firm's informational frictions drive capital decisions. Interestingly, loss of productivity in China and India is mitigated by connections to formal stock markets, as a source of more reliable signals or at least a better measure of the ex ante uncertainty faced by firms before making production decisions. Likewise, Midrigan and Xu (2013), Moll (2014), Buera and Shin (2013), and Asker, Collard-Wexler, and De Loecker (2012) study the role of financial frictions and capital adjustment costs, respectively. However, studies often take risk and return on the production side of the economy as exogenous. We add to these studies the role of risk aversion, the various types of risk faced by firms, and evidence that people can and do choose among potential projects based on a risk-return trade-off. For us, the market is crucial, but in our case informal markets, not the stock market, are the mechanism allowing mitigation of much of the idiosyncratic risk. In turn, adjustments of the measured rates of return to get at underlying productivity require different risk premium, varying with idiosyncratic versus aggregate risk.

Our study also differs from the standard empirical consumption-based asset pricing in macroeconomics and finance literature. The consumption-based finance literature typically relies on countrywide aggregate consumption to explain asset risk and return of financial assets. Our study is applied locally to collections of closely connected villages in which almost everyone is in a family network, allowing us to link asset returns of the households with panel data of relevant market participants, including household specific data on consumption, gifts, and loans.[3]

Our paper is intended as a contribution to a general audience, integrating finance, macroeconomics, and development literatures. Although the tradeoff between risk and return is extensively studied in finance, there is relatively sparse cross-referencing between these two concepts in development economics. On the one hand, there is a literature on returns on household enterprises as a source of household income, as noted earlier. On the other hand, there is also a literature on risk and the vulnerability of poor households.[4] One of the few studies that explicitly connects these two concepts together is Rosenzweig and Binswanger (l993) who test for the existence of a positive association between the average returns to individual production assets and their sensitivity to weather variability. Related, Morduch (1995) finds that poor households in villages in India have limited ability to smooth consumption ex post and tend to choose production activities with lower yields to give them smoother ex ante income. Our study in contrast finds that Thai households with lower initial wealth are more involved with risky activities, both aggregate and idiosyncratic, and for that reason have higher average returns. More recently, Karlan, Osei, Osei-Akoto, and Udry (2013), argue that risk is a constraint to agricultural investment in Ghana, as noted earlier. The point we are making however is that there is commonality across all these studies, in the linking of returns to risk.

In the finance literature, there are studies of risk and return to private enterprises but these are mainly in developed countries. For example, Moskowitz and Vissing-Jorgensen (2002) find that the rates of return on private equity in the US are not higher

[3] Campbell (2003) provides a review of the development of the consumption-based model. Cochrane (2001) discusses how the traditional capital asset pricing model (CAPM) and the consumption-based model are interrelated. For the literature on limited market participation in the developed economy context, see Mankiw and Zeldes (1991), Vissing-Jorgensen (2002), and Vissing-Jorgensen and Attanasio (2003).

[4] For literature on vulnerability, see Morduch and Kamanou (2003), Hoddinott and Quisumbing (2003), Ligon (2004), and Ligon and Schechter (2004). Related, there is an extensive literature on insurance against poverty; for example, see Dercon (2004).

than the returns to public equity even though private firms are seemingly more poorly diversified, raising this as a puzzle. Heaton and Lucas (2000) show that entrepreneurial risk is important for portfolio choice. In our village economies, at least, the limits to diversification at the household level are mitigated by risk sharing through informal networks of family in the community. Though it may be a stretch to imagine this is happening in the US, the point remains that in any given setting informal networks could potentially rationalize apparent risk return anomalies.

The paper proceeds as follows. Section 2 presents the two benchmark, the end-points, as it were that we use to study risk and return in village economies. The more realistic intermediate case lies between these two extremes. Section 3 describes the data from the Townsend Thai Monthly Survey that we use in our empirical work. Section 4 presents one of the main empirical results on the relationship between expected return and aggregate risk. As robustness checks, we also extend our analysis to incorporate human capital, time-varying risks, and time-varying stochastic discounts. We find that expected returns are positively associated with aggregate risks in our village economies. This is our first set of empirical findings. Section 5 quantifies idiosyncratic risk and analyzes its effect on risk premium and expected returns, as well. The main point though is the contributions of the aggregate and the idiosyncratic risk premium to the total risk premia as distinct from the contribution of aggregate risk and idiosyncratic risk to total risk. A nonparametric statistical test finds that the median percentage contribution of idiosyncratic risk to the total risk is statistically different from the median percentage contribution of idiosyncratic risk premium to the total risk premium. This is the second set of empirical results. Section 6 discusses and compares the empirical results from the production and asset return data in this paper with the results from the consumption and income data in earlier literature and complements this with a direct look in our panel data where both production and consumption are measured. This is our third set of empirical results. Section 7 distinguishes the risk premium from the productivity of household enterprises, computing the household's rate of return net of the risk premium. Section 8 presents our final set of empirical findings that there is heterogeneity across households in their exposure to aggregate and idiosyncratic risks, and discuss policy implications. Section 9 concludes.

2. Theoretical Framework

We start with an economy consisting of *J* households, indexed by *j* = 1, 2,..., *J*. There are *I* production activities, indexed by *i* = 1, 2,..., *I*, that utilize capital as the only input. Each production technology delivers the same consumption good. Let $k_{i,j}$ be the assets assigned to production activity *i* and operated by household *j* as of the end of the previous period, and let $f_{i,j}(k_{i,j})$ be their output, net of depreciation, realized at the beginning of the current period. The fluctuation and the pairwise comovement of the marginal returns, under a particular capital allocation $k_{i,j}$, namely $\frac{df_{i,j}(k_{i,j})}{dk_{i,j}} = f^{\prime}_{i,j}(k_{i,j})$, are represented by the variance-covariance matrix of the marginal returns. Various portfolios of assets can be formed by allocating assets to various households and to various activities. Varying the weights of the assets in a portfolio creates a feasible set of all possible returns that could be achieved by available current assets. Note that some of the elements in this set could have zero weight for some of the assets, i.e., it is not necessary to have all of the assets included in a particular portfolio. Also note that this feasibility set is derived from the production technology alone, without any assumptions on preferences or optimization.[5]

We present two polar benchmarks in this section. For expositional clarity, we begin with the first benchmark economy where full risk-sharing delivers Pareto optimal

[5] A familiar feasibility set derived from portfolios of assets is the mean-variance frontier. Any portfolio of assets delivers a coordinate in a mean-variance space that corresponds to the expected return and the variance of the constructed portfolio. Varying the weights allocated to available assets creates a feasibility set of means and variances that could be achieved by all available assets.

allocations of risk for the community as a whole. We show how technologies introduced in the underlying environment above are linked together when risks are pooled efficiently over all households and production technologies. Then, we discuss the second, opposite benchmark that considers an economy where each household absorbs risk in isolation. Note that the underlying technologies are the same in both benchmarks.

2.1 A Full Risk-Sharing Benchmark: A Pareto Optimal Allocation of Risk

First we consider a benchmark case in which all households in the economy are able to completely pool and share risk from their production. Let k_M be the total assets of the aggregate economy, *M*, and F_M be the total output produced from all assets in the aggregate economy. $F_M = F(\mathbf{k}) = \sum_{j=1}^{J}\sum_{i=1}^{I} f_{i,j}(k_{i,j})$ where **k** is a vector of capital allocation in the economy, $k_{i,j}$, for all *i* and all *j*. The marginal return of aggregate production, when an additional unit of capital is allocated proportionately to production activities based on their share in total capital, is $\sum_{j=1}^{J}\sum_{i=1}^{I}\theta_{i,j} f_{i,j}^{\prime}(k_{i,j})$ where $\theta_{i,j} = \frac{k_{i,j}}{k_M}$ and $k_M = \sum_{j=1}^{J}\sum_{i=1}^{I} k_{i,j}$. In this economy, the variance of the marginal aggregate return is therefore

$$\operatorname{var}\left(\sum_{j=1}^{J}\sum_{i=1}^{I}\theta_{i,j} f_{i,j}^{\prime}(k_{i,j})\right) = \operatorname{var}\left(\sum_{g=1}^{G}\theta_g f_g^{\prime}(k_g)\right) = \sum_{g=1}^{G}\theta_g^2\sigma_g^2 + \sum_{g=1}^{G}\sum_{g^{\prime}\neq g}\theta_g\theta_{g^{\prime}}\sigma_{g,g^{\prime}},$$

where *g* is an index for household-specific production activity (*i*, *j*), for all *i* and all *j*, and $G = I$ x J; σ_g^2 is the variance of the marginal return on activity *g*; and $\sigma_{g,g^{\prime}}$ is a pairwise covariance between the marginal return on activity *g* and another activity $g^{\prime}$ in the economy. As the number of activities, *G*, becomes larger, the first component (the variance term) of the aggregate fluctuation converges to zero and only the second component (the covariance term) determines the fluctuation of aggregate return. This is intuitive. As more activities are included in the risk-sharing syndicate, each activity-specific idiosyncratic fluctuation contributes less and less to the aggregate fluctuation. In the limit, idiosyncratic risk is completely diversified away and only covariate risk remains. This covariate risk is the non-diversifiable risk of the economy. Note that the diversification of idiosyncratic risk could be achieved by either increasing the number of activities performed by a particular household (i.e., increasing *I*), or increasing the number of households in the risk-sharing syndicate (i.e., increasing *J*), if not both.

To determine an efficient allocation of assets across households and activities, and consumption to the households, we consider a social planning problem that maximizes a Pareto-weighted sum of expected utilities subject to resource constraints. At the beginning of each period, each household j starts with initial resources that consist of two components. The first component is the assets held from the previous period, summing over all production activities, $k_j = \sum_{i=1}^{I} k_{i,j}$. The second component is the sum of the associated outputs (net of depreciation), $\sum_{i=1}^{I} f_{i,j}(k_{i,j})$. The household j may give out or receive gifts and transfers with other households, as in a risk-sharing syndicate.[6] The household then invests a part of this interim wealth in the form of assets carried to the next period. This is the usual neoclassical specification, putty-putty model as capital net of depreciation can be eaten.[7] For this social planning problem, the planner retains full control over the projects, assigns them to households, chooses the net current gifts and transfers to each household j, and chooses the assets to be allocated to each activity run

[6] Generally, households could make state-contingent lending and borrowing contracts, which could be incorporated into the gift term in this setup. For an example of this arrangement, see Udry (1994).

[7] The production function $f_{i,j}(k_{i,j})$ can be rewritten as $f_{i,j}(k_{i,j}) = \tilde{f}_{i,j}(k_{i,j}) - \delta_{i,j} k_{i,j}$. Generalizing, we can also subtract an adjustment cost term, $g_{i,j}(k_{i,j}, k'_{i,j})$, the derivative of which will enter into the first order conditions below. We maintain in the text subtraction of next period's capital separable from current capital.

by each household in the following period, $k'_{i,j}$. Effectively, the planner determines the current period consumption for each household *j*,

$$c_j = \sum_{i=1}^{I}\left(f_{i,j}(k_{i,j}) + k_{i,j}\right) - \sum_{i=1}^{I} k'_{i,j} + \tau_j .$$

The value function of the social planning problem is

$$V(W;\Lambda) = \max_{k_{i,j}{}',\tau_j}\left(\sum_{j=1}^{J}\lambda_j u_j\left(\sum_{i=1}^{I}\left(f_{i,j}(k_{i,j}) + k_{i,j}\right) - \sum_{i=1}^{I} k'_{i,j} + \tau_j\right) + \phi E\left[V(W';\Lambda)\right]\right)$$

subject to the aggregate resource constraint, i.e., aggregate consumption plus aggregate savings, in the form of next-period capital, equals wealth, $\sum_{j=1}^{J} c_j + \sum_{j=1}^{J} k'_j = W$, and the non-negativity constraint of capital, $k_{i,j}{}' \geq 0$, that is no project capital can go negative, i.e., households cannot short assets. Current state *W* denotes the aggregate wealth of the whole economy at the beginning of the current period, that is, $W = \sum_{j=1}^{J}\sum_{i=1}^{I}\left(f_{i,j}(k_{i,j}) + k_{i,j}\right)$.[8]

Here the parameter ϕ is a common preference discount factor; the parameter Λ is a time-invariant vector of the Pareto weights for the households, λ_j where *j =1, 2, .. J*; and the function $u_j(\cdot)$ is the within-period utility function of a risk-averse household *j,* which is strictly concave, continuously differentiable, increasing without satiation, and with infinite derivative at zero. Note that we are allowing in this general set up differential risk

[8] In the way this setup is written, it appears that the economy is closed, where the aggregate asset is identical to the aggregate wealth. The model can be extended and reinterpreted to allow external borrowing and lending, simply by subtracting any economy-wide debt, *D*, and interest from the previous period, and adding potential new borrowing (to be paid back next period). External borrowing can be negative, i.e., savings. Specifically, assuming that the external interest rate is *r*, the right-hand side of the resource constraint becomes $\widetilde{W} = W - (1+r)D + D'$. We can also allow outside stocks and mutual funds. What is important here is that these assets and liabilities are external to the small open economy under consideration and we take whatever they are as given, not included in our analysis of efficiency, the sub-program here. Further, stocks and bonds are not issues and traded on within village assets, so in that sense external assets markets are incomplete.

aversion. The solutions to this planning problem for fixed Pareto weights correspond to a particular Pareto optimal allocation, and all of the optima can be traced out as the Pareto weights are varied.

For a given Λ, the first-order conditions are that

$[\tau_j]: \lambda_j u_{jc}(c_j) = \mu$ for all *j*

$[k'_{i,j}]: -\lambda_j u_{jc}(c_j) + \phi E\left[V_W(W')(1+f^{/}_{i,j}(k'_{i,j}))\right] \le 0$ for all *i* and *j*, with equality for $k'_{i,j} > 0$,

where μ is the shadow price of consumption in the current period. Note that the first equation, i.e., equalized weighted marginal utilities, is the key equation in the study of consumption risk sharing, and it is an integral part of our framework here. The second equation is a standard Euler equation for investment. Finally, for each $k'_{i,j} > 0$, the technologies actually chosen, the first-order conditions imply

$$1 = \frac{\phi E\left[V_W(W')(1+f^{/}_{i,j}(k'_{i,j})\right]}{\lambda_j u_{jc}(c_j)} = E\left[\frac{\phi V_W(W')}{\mu}(1+f^{/}_{i,j}(k'_{i,j})\right] = E\left[m'R'_{i,j}\right], \qquad (1)$$

where $m' = \dfrac{\phi V_W(W')}{\mu}$ and $R'_{i,j} = 1 + f^{/}_{i,j}(k'_{i,j})$.

We focus in part on equation (1) but the other equations are also a key part of the system. Equation (1) has some important properties. First, m', the stochastic discount factor or the intertemporal marginal rate of substitution, is common across households and across assets. The model also implies that equation (1) holds for each of the assets actively allocated to production activity *i* and run by household *j*, for any *i* and any *j*. This equation is equivalent to the pricing equation derived in the Consumption-based Capital

Asset Pricing Model (CCAPM) in the finance literature.[9] However, it is important to reiterate that although our empirical counterpart will be similar to what is derived in the capital asset pricing literature, the mechanism that delivers the predicted allocation outcome is different. In the asset pricing literature, households (investors) trade their assets ex ante. Optimally allocated assets deliver the returns that the households in turn use to finance their consumption, or reinvest, ultimately maximizing their utility. Although asset reallocations across households are possible in our model environment, households do not typically trade their assets ex ante in some markets. The rate of return on an asset is simply the real yield from holding it.[10] Given asset holdings and given returns, transfers among households in the economy then give an optimal consumption allocation, i.e., the consumption allocation under the full risk-sharing regime where the marginal rates of intertemporal substitution are equalized across households. These inter-household transfers could be through formal securities or through informal financial markets, namely, gifts and transfers within social networks.

Second, the Pareto weights, λ_j, j = 1, 2,… , J, are implicit parameters in equation (1) as they are arguments in the value function. Intuitively, the marginal rates of substitution are common across households in any particular optimum but can vary across the many optima, as if moving along a (potentially nonlinear) contract curve, as the Pareto weights are varied, but we fix the weights as part of our specification. Our general analysis only requires that the risk sharing community be at one fixed social optimum, not at any particular optimal allocation per se. However, when preferences aggregate in a Gorman sense, then the Pareto weights can be dropped from the analysis, and it is as if a social planner were a "stand-in representative consumer" allocating assets among its various "selves".

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[9] For the derivation of this equation from consumer-investor's maximization problem, see Lucas (1978), Hansen and Singleton (1983), and Cochrane (2001), for example.

[10] In the empirical section, net profits include capital gain (or loss) when assets were sold at higher (lower) prices than purchased, adjusted for depreciation. These transactions are however not frequent.

Third, since $E[m'R'_{i,j}] = E[m']E[R'_{i,j}] + \text{cov}(m', R'_{i,j})$ equation (1) can be rewritten as

$$E[R'_{i,j}] = \frac{1}{E[m']} - \frac{\text{cov}(m', R'_{i,j})}{\text{var}(m')} \frac{\text{var}(m')}{E[m']}$$

$$E[R'_{i,j}] = \gamma' + \beta_{m',ij} \psi_{m'} . \qquad (2)$$

Specifically, $\beta_{m',ij} = -\frac{\text{cov}(m', R'_{i,j})}{\text{var}(m')}$ could be interpreted as the *quantity* of the risk of the assets used in activity i by household j that cannot be diversified, i.e., the risk implied by the comovement of the asset return and the aggregate return. Note that the sign is negative since high returns mean low marginal utility. Since this risk cannot be diversified away, even in the full risk-sharing environment, it must be compensated by a risk premium, which is a product of the quantity of risk and the price of the risk. The *price* of the risk is in turn equal to the volatility of the aggregate economy, $\psi_{m'} = \frac{\text{var}(m')}{E[m']}$. Finally, $\gamma' = \frac{1}{E[m']}$ is the risk-free rate, $R_f{}'$, since by definition the covariance of the risk-free rate and the aggregate economy return is zero.

Finally, the intuition behind this optimal allocation is straightforward. An optimal allocation of assets is a portfolio that delivers an aggregate consumption for the economy that maximizes the Pareto-weighted expected utility of the households. This optimal consumption allocation is stochastic, and its distribution is derived from the distribution of underlying assets in the optimal allocation. Since households are risk averse, the optimal aggregate consumption represents a tradeoff between expected return and risk. In the full risk-sharing environment, idiosyncratic risks are diversified away, and this optimal aggregate consumption consists of only the aggregate nondiversifiable component. Note that some of the optimal asset holdings could be zero if they are not needed for the construction of the portfolio that delivers this optimal aggregate consumption. However, for all of the assets that are positively allocated, an optimal allocation implies that the stochastic intertemporal rates of substitution are equalized, i.e., the marginal utility from the expected returns, net of disutility from risk, from the next period are equal across these assets. This equalized intertemporal rate of substitution condition across assets implies that the assets with lower expected return are held in this optimal portfolio because they are less risky than other assets. Since the only remaining risk in the full risk-sharing economy is the covariate risk, an optimal allocation implies the positive relationship between the expected return of the asset and its covariate, nondiversifiable risk, as represented by the asset's beta.[11]

2.2 A Financial Autarky Benchmark

The second, opposite benchmark case is an economy where households are in financial autarky and there is no risk sharing across households. The underlying environment, in terms of preferences, technologies, and initial conditions, is of course the same as in the full risk sharing benchmark. In particular, production technologies deliver returns that are still correlated across households and production activities. However, households absorb the risk in isolation from the rest of the community so that net incoming (or outgoing) transfers, τ_j , are zero for all *j*. In this benchmark, the value function of each household *j* is

$$V_j(W_j) = \max_{k'_{i,j}} \left(u_j \left(\sum_{i=1}^{I} \left(f_{i,j}(k_{i,j}) + k_{i,j} \right) - \sum_{i=1}^{I} k'_{i,j} \right) + \phi E[V_j(W'_j)] \right)$$

subject to the household's resource constraint,

[11] Our prediction from the full-risk sharing benchmark should be viewed as a necessary condition for the full risk sharing, but not a sufficient one. For example, if a household is endowed with a production technology that has returns comoving with the aggregate returns, there will be a positive relationship between expected return and household beta, even when this household is in autarky. However, we have a second necessary condition for optimality: not only is risk premium determined by comovement with the aggregate, but it is not determined by idiosyncratic risk as well. This is closely parallel to the consumption risk sharing literature: not only does consumption move with the aggregate but it also does not move with the idiosyncratic income risk.

$$W_j = \sum_{i=1}^{I} \left(f_{i,j}(k_{i,j}) + k_{i,j} \right)$$

and the nonnegativity constraint of asset holding, $k'_{i,j} \geq 0$.

Operationally, the Euler equation for asset allocation is of the same form for all activities *i* in which household *j* chooses to hold and operate. But in this environment, the stochastic discount factor is specific for household *j* and not equalized across all households in the economy. Since risk cannot be shared across households, the total fluctuation of the rate of return on asset for each household consists of both the household's idiosyncratic component and the comovement with the economy-wide return. Alternatively speaking, since there is no risk sharing, each household cannot and does not need to differentiate its idiosyncratic and aggregate risk, as both components of fluctuation in the rate of return are viewed and treated identically by the household. In financial autarky, their contribution to the household risk premium would be the same.

2.3 Empirical Implementation

For our empirical implementation, we impose two additional assumptions onto production technology and preference. The first assumption is a linear production technology: $f_{i,j}(k_{i,j}) = r_{i,j}k_{i,j}$, which implies that $f^{/}_{i,j}(k_{i,j}) = r_{i,j}$ and $R_{i,j} = 1 + r_{i,j}$. This assumption can be derived from a more general constant return to scale production function where optimal inputs are chosen sequentially. As is standard in many settings, e.g., Angeletos (2007) and Moll (2014), capital is predetermined at the beginning of the period. Technologies are then hit with productivity shocks and prices of input and output are determined. Finally households make input (such as labor) decisions and get output. This yields a linear technology mapping predetermined capital into output, an $A_{i,j}k_{i,j}$ model where productivity shocks and prices are embedded in the technology parameter

$A_{i,j}$. It is as if there were a single input, capital, and we focus on this technology henceforth, that is, a single factor production function in capital with random returns.

Due to the linear production technology, equation (1) also holds for any of the portfolios constructed by any combinations of the assets $k'_{i,j}$ for all i and all j. Specifically, if we consider a household as our unit of observation, equation (1) implies that

$$1 = E[m'R'_j], \text{ where } R'_j = \frac{\sum_{i=1}^{I} \theta'_{i,j} R'_{i,j}}{\sum_{i=1}^{I} \theta'_{i,j}}.$$

In other words, R'_j is the weighted average return to the portfolio of the assets operated by household *j*, where the weights are the shares of each asset in household *j*'s portfolio. This insight allows us to study the risk and return of a household's portfolio of assets instead of the risk and return of each individual asset. This implication is especially important in the empirical study where the classification of asset types and the income stream from each asset is problematic, as one asset may be used in various production activities or various types of assets are used jointly in a certain production activity.

The second assumption is that the value function of the social planning problem can be well approximated as quadratic in the total assets of the economy, $V(W) = -\frac{\eta}{2}(W - W^*)^2$, which implies that at W',

$$V_W(W') = -\eta(W' - W^*) = -\eta\left(\sum_{j=1}^{J}\sum_{i=1}^{I} R'_{i,j}k'_{i,j} - W^*\right) = -\eta\left(R'_M k'_M - W^*\right), \qquad (3)$$

where $R'_M = \frac{\sum_{j=1}^{J}\sum_{i=1}^{I} R'_{i,j}k'_{i,j}}{k'_M}$ and $k'_M = \sum_{j=1}^{J}\sum_{i=1}^{I} k'_{i,j}$. The first-order conditions from the value function (3) imply

$$m' = -\frac{\phi\eta\left(R'_M k'_M - W^*\right)}{\mu} = \frac{\phi\eta W^*}{\mu} - \frac{\phi\eta k'_M}{\mu} R'_M ,$$

$$m' = a - bR'_M , \tag{4}$$

where a and b are implicitly defined. Next, combining equation (4) with equation (2) derived earlier,

$$E[R'_{i,j}] = \gamma' - \frac{\operatorname{cov}(a - bR'_M, R'_{i,j})}{\operatorname{var}(a - bR'_M)} \cdot \frac{\operatorname{var}(a - bR'_M)}{E[a - bR'_M]}$$

$$E[R'_{i,j}] = \gamma' + \frac{\operatorname{cov}(R'_M, R'_{i,j})}{\operatorname{var}(R'_M)} \cdot \frac{b\operatorname{var}(R'_M)}{a - bE[R'_M]} .$$

In this case we have

$$E[R'_{i,j}] = \gamma' + \beta_{ij}\psi , \tag{5}$$

which is a linear relationship between the expected return of an asset, $E[R'_{i,j}]$, its nondiversifiable risk as measured by the comovement with the aggregate return, β_{ij} , and the price of the nondiversifiable risk, ψ . Note again that equation (5) holds for any assets or portfolios of assets, including the market portfolio, *M*, and the risk-free asset, *f*. Since $\beta_M = 1$ and $\beta_f = 0$, equation (5) also implies that $\gamma' = R'_f$ and $\psi = E[R'_M] - R'_f$. In other words, the price of the aggregate, nondiversifiable risk is equal to the expected return on the market portfolio in excess of the risk-free rate. This condition, presented in equation (5), is equivalent to the relationship between risk and expected return derived in the traditional Capital Asset Pricing Model (CAPM) in asset pricing literature. Finally, as discussed earlier, equation (5) also holds for any of the portfolios constructed by any combinations of the assets for any *i* and any *j* because the production technologies are assumed to be linear in capital. In other words, for each household *j*, we have

$$E[R'_j] - R'_f = \beta_j \left(E[R'_M] - R'_f \right), \qquad (6)$$

where R'_j is the return to household *j*'s portfolio and β_j is the beta for the return on household *j*'s assets with respect to the aggregate market return,

$$\beta_j = \frac{\mathrm{cov}(R'_M, R'_j)}{\mathrm{var}(R'_M)}. \qquad (7)$$

Finally, note that common quadratic utility functions do Gorman aggregate and we can drop the reference to Pareto weights. Also, the quadratic utility function is not the only setting that delivers this result. We can also arrive at the same linear relationship presented in equation (6) with other sets of assumptions.[12]

3. Data and the Village Environment

The data used in this study are from the Townsend Thai Monthly Survey, an on-going intensive monthly survey initiated in 1998 in four provinces of Thailand. Chachoengsao and Lopburi are semi-urban provinces in a more developed central region near the capital city, Bangkok. Buriram and Srisaket on the other hand are rural and located in the less developed northeastern region by the border of Cambodia. In each of the four provinces, the survey is conducted in four villages, chosen at random within a given township.[13]

[12] The linear relationship can be derived from various consumption-based models, including those with (1) two-period quadratic utility; (2) two periods, exponential utility and normal returns; (3) infinite horizon, quadratic utility and i.i.d. returns; or (4) log utility. It is also a linear approximation of the models with continuous time limit and normal distributions. See chapter 9 of Cochrane (2001) for detail.

[13] Townships, i.e., tambons, were chosen randomly, taking into account ecological considerations. See Binford, Lee, and Townsend (2004).

The analysis presented in this paper is based on 156 months from January 1999 to December 2011, which coincides with 13 calendar years. During this time, there were salient aggregate shocks and a plethora of repeated idiosyncratic shocks in these village economies. For example, seasonal variation in the amount and timing of rainfall and temperature can be crucial in rice cultivation. Shrimp ponds were hit with both diseases as well as restrictions on exports to the EU. At the micro level, milks cows varied in their productivity, i.e., the flow was quite irregular over time for a given animal and over the heard.

We include in this study only the households that were present in the survey throughout the 156 months. Since we compute our returns on assets from net income generated from cultivation, livestock, fish and shrimp farming, and non-agricultural business, we also include in this study only the households that generated income from farm and non-farm business activities for at least 10 months during the 156-month period (on average about one month per year). In other words, we drop the households whose income was mainly exclusively from wage earnings. In the end, there are 541 households in the sample: 129 from (the sampled township in) Chachoengsao and 140 from Lopburi provinces in the central region, and 131 from Buriram and 141 from Srisaket provinces in the northeast. Table A.1 in the appendix presents descriptive statistics of household characteristics. Table A.2 shows the revenue (gross of cost of production) of the occupations in the sample.

3.1 Networks

We use a township as the aggregate market for empirical analysis in this paper for two reasons. First, the four villages from the same province in our sample are from the same township and therefore located close to each other. There are likely economic transactions across these villages. Second, one of the salient features of the households in the Townsend Thai Monthly Survey is the pervasive kinship network with extended families. Table A.3 in the appendix shows that almost all households in our sample have at least one relative living in the same township.

3.2 Construction of Variables

We use a household as our unit of analysis and consider the return on the household's total assets instead of the return on specific assets. As noted earlier, we consider the total assets as a *portfolio* that is composed of multiple individual asset classes (including both financial and fixed assets), and apply the predictions from our framework to study the risk and return of this portfolio. It is difficult and arbitrary to assign the percentage use of each asset in each distinct activity. Imposing additional assumptions on the data to disaggregate assets into subcategories would likely induce measurement errors that could bias our empirical analysis.[14] The rate of return on assets (ROA) is calculated as household's accrued net income divided by household's total asset, the conventional financial accounting measure of performance of productive assets.

Net Income: Income is accrued household enterprise income, which is the difference between the enterprise total revenue and the associated cost of inputs used in generating that revenue. Revenue is realized at the time of sale or disposal. Associated cost could be incurred earlier, in the periods before the sale or disposal of outputs. Total revenue includes the value of all outputs the household produces for sale (in cash, in kind, or on credit), own consumption (imputed value), or given away. Revenue also includes rental income from fixed assets. Revenue does not include wages earned outside the household or gifts and transfers received by the household. Cost includes the value of inputs used in the production of the outputs, regardless of the method of their acquisition, i.e., purchase (in cash, in kind, or on credit) or gifts from others or transfers from government. Costs

[14] For similar reasons, we do not distinguish well the use of assets for production activity versus consumption activity. This could lead to a downward bias of our estimates on return to assets, as some of the assets that we include in the calculation were not used in production. Samphantharak and Townsend (2012) provide an exercise that classifies total assets into subcategories based on additional assumptions on production and consumption of the households, and analyze the sensitivity of the rate of return. The ROA measure we use here is shown there to be robust.

includes the wage paid to labor provided by non-household members as well as imputed compensation to the labor provided by household members.[15] Cost includes all utility expenses of the household regardless of the purposes of their uses and also includes depreciation of fixed assets.

Total Assets: Assets include all assets, i.e., fixed assets, inventories, and financial assets. *Fixed assets* are surveyed in the Agricultural Assets, Business Assets, Livestock, Household Assets, and Land Modules of the survey. In the Agricultural Assets Module, fixed assets include walking tractor, large four-wheel tractor, small four-wheel tractor, aerator, machine to put in seeds and pesticides, machine to mix fertilizer and soil, sprinkler, threshing machine, rice mill, water pump, rice storage building, other crop storage building, large chicken coop, other buildings for livestock, and other buildings. In the Household Assets Module, assets include car, pick-up truck, long-tail boat with motor, large fishing boat, bicycle, air conditioner, regular telephone, cellular telephone, refrigerator, sewing machine, washing machine, electric iron, gas stove, electric cooking pot, sofa, television, stereo, and VCR.[16] Due to the variety in non-agricultural businesses, in the Business Module, we do not list the specific name of the assets, but instead ask the household to report the fixed assets they use in their business enterprises. In the Land Module, assets include land and building at acquisition value, the value of land and building improvement, and the appreciation of land when major events occurred (such as an addition of new public roads). In all of the modules, assets that are not explicitly listed but have value more than 2,000 baht are also asked and included. We also adjust the value of fixed assets with monthly depreciation. *Inventories* include raw material, work in progress, finished goods for cultivation, fish and shrimp farming, livestock activities (such as milk and eggs), and manufacturing non-farm businesses. For merchandizing

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15 For the detailed procedure how we impute the compensation to household's own labor, See Samphantharak and Townsend (2010).

16 Note that we decide to include all household assets in our calculation. This is mainly because some of these assets were used by the households in their production activities as well and it would be arbitrary to include certain household assets while excluding others. However, the value of these assets was relatively small compared to the value of total assets (which was largely determined by land and other fixed assets). See Samphantharak and Townsend (2012) for the sensitivity analysis of ROA on household assets.

non-farm businesses, inventories are mainly goods for resale. Animals from the Livestock Inventory Module, which include young meat cow, mature meat cow, young daily cow, mature dairy cow, young buffalo, mature buffalo, young pig, mature pig, chicken, and duck, are accounted as either inventories or fixed assets, based on their nature. *Financial assets* include cash, deposits at financial institutions, other lending, and net ROSCA position. These line items are computed from the Savings Module, the Lending Module, and the ROSCA Module. The stock of cash is not asked directly but can be imputed from questions about each and every transaction that each households had since the last interview. Finally, the total asset used in the calculation of rate of return is *net* of liabilities. We use the information from the Borrowing Module to calculate the household's stock of total liabilities.

Rate of Return: The rate of return on assets (ROA) is defined as household's accrued net income divided by household's average total assets (net of total liabilities) over the period from which that the income was generated, i.e., one month in this paper. The average total asset is the sum of total assets at the beginning of the month and total assets at the end of the month, divided by two. We use the real accrued net income and the real value of household's total assets in the ROA calculation. The real variables were computed using the monthly Consumer Price Index (CPI) at the regional level from the Bank of Thailand. The rate is then annualized (multiplied by twelve). We assume that the real risk-free rate is zero for all of the periods and for all of the townships.[17] Table A.4 in the appendix presents descriptive statistics of the ROA. The median of the annualized average ROA was 0.38% for Chachoengsao and 1.46% for Lopburi in the central region,

[17] The rationale for zero risk-free rate is based on the assumption that households have access to storage technology. If the nominal return on stored inventory is the same as inflation rate (which is likely the case for food crop storage), then the real rate of return is zero. We also perform a robustness check with different risk-free rates. The overall conclusion does not change, which is what we expect because the shift in both excess asset return and excess market return does not affect the covariance between these two variables. Note that in the earlier versions of this paper, we also used alternative calculations of ROA in the analysis, namely, ROA computed only from fixed assets (i.e., excluding financial assets) and nominal ROA (i.e., not adjusted for inflation). Again, the main conclusions did not change. We also used ROA computed from total assets without subtracting liabilities; the overall conclusions were robust (which is sensible, given that liability to asset ratios for most households are relatively small).

and 0.28% for Buriram, and 1.99% for Srisaket in the northeast. Excluding land and building structure from total assets, the median ROA is 1.27 for Chachoengsao and 4.55 for Lopburi in the Central region, and 1.11 for Buriram and 4.23 for Srisaket in the Northeast.

3.3 Measurement Errors

For the aggregate risk, the positive relationship between beta and expected (or mean) return could be driven by measurement error if the measurement errors of household ROAs are positively correlated with the measurement errors of the aggregate ROA. However, for most production activities, we use direct answers on revenue from those production activities from each household to compute that household's ROA. Constructing price indices from these data reveals that prices in a given month can vary considerably over households. This may be due in part to the fact that we did not try to distinguish within village versus farm gate prices, i.e., we have revenue and price at the point of sale, wherever that might be. Actual and imputed wages also vary enormously over households at a point in time. There are also likely measurement errors in idiosyncratic returns but detailed studies of rice production show that yields can be explained beyond rainfall but measured differences in soil moisture, soil type, elevation, and timing of rain, which are household specific, and the heterogeneity across households is real and not necessary measurement error (Tazhibayeva and Townsend 2012). Some other measurement errors are intrinsic to any survey. However, as we will discuss later in this paper, our findings from the analyses that use the data from the production modules are largely consistent with the findings from the consumption, gifts, and loan modules of the same survey.

4. Aggregate Risk and Return on Assets

Baseline Specification

In the first stage of our empirical analysis, we compute the asset beta of each household's portfolio of assets to get household beta, β_j, for all household *j*. We define a township as the aggregate economy and use township average real returns on assets as aggregate return, $\bar{R}_M$, computed as the total net income in the township divided by the township's total assets. To avoid the effect of each household's return on the township return, for each household we do not include the household's own net income and assets in the calculation of its corresponding township return, i.e., we compute and use instead a leave-out mean. As shown in equation (7), an asset beta of household *j* is defined as $\beta_j = \frac{\text{cov}(R'_M, R'_j)}{\text{var}(R'_M)}$, which is the key ratio of moments we need. Operationally, it is identical and conveniently computed as a regression coefficient from a simple regression of $R'_{j,t}$ on $R'_{M,t}$. Specifically, in the first stage, for each household *j* we estimate β_j from a time-series regression

$$R'_{j,t} = \alpha_j + \beta_j R'_{M,t} + \varepsilon_{j,t}. \qquad (8)$$

In the second stage, we study the expected return and beta relationship derived earlier in equation (5). With the assumption that the real return on risk-free asset is zero, we compute the expected rate of return on assets of household *j*, $E[R'_j]$. Empirically, the expected return is computed as a simple time-series average of monthly rates of return, $\bar{R}'_j = \frac{\sum_{t=1}^{T} R'_{j,t}}{T}$, where *T* is the number of months (156 months in the baseline specification).

We run a cross-sectional regression of household's average asset returns on the betas estimated earlier in equation (8) across all households in each township, one township at a time.

$$\bar{R}'_j = \alpha + \psi \hat{\beta}_j + \eta_j . \tag{9}$$

With the assumption that the real risk-free rate is zero, the null hypotheses from equation (9) are that $\psi = E[R'_M]$ and that the constant term α is zero. Note that we report the regression coefficient with the standard error corrected for generated regressor and heteroskedasticity, following Shanken (1992) and Cochrane (2001).

The results in Panel A of Table 1 show that the regression coefficient on households' beta is positive for all of the regressions except for the township in Buriram. We then look at a stronger null hypothesis that $\psi = E[R'_M]$ comparing the magnitude of the estimated regression coefficient $\hat{\psi}$ with the township expected return, estimated by the time-series average $\bar{R}'_M = \frac{\sum_{t=1}^{T} R'_{M,t}}{T}$. The table also provides each township's aggregate expected return. For the two townships in the central region (Chachoengsao and Lopburi), the regression coefficients are not statistically different from the township average return (at 10% level of significance), consistent with the prediction from our model. However, the coefficients are different from the township average return for the township in Srisaket. The zero constant implication is also satisfied.

[Table 1]

To illustrate our results graphically, Figure 1 plots the beta of household *j* on the horizontal axis against the expected return on household *j*'s assets on the vertical axis for each of the four townships. In general, the figures show a positive relationship between households' beta and expected returns. Thus a major implication of the model is capturing a substantial part of the data. In particular, higher risk, as measured by the comovement of household ROA and township ROA, is associated with higher average return. The positive ψ implication from the model is pervasive in the data at various levels of aggregation. The more stringent test of $\psi = \overline{R}'_M$ is more difficult to satisfy.[18] Note that this baseline specification is subject to some critiques. We now perform robustness checks that address these issues below.

[Figure 1]

Time-Varying Risk

Similar to the traditional CAPM in the finance literature, our empirical strategy assumes that household betas are time-invariant. This assumption allows us to estimate household betas from time-series regressions. In reality, household betas could be time-varying. Our sample consists of households engaged in multiple occupations over the period of 13 years. It is likely that the composition of household occupations (and hence assets and their associated risks) of some of our sampled households had changed during this period. Similarly, the expected aggregate returns $E[R'_M]$ could change over time as well, not least from changes in conditioning factors.

We explore this issue by conducting our empirical analysis on the subsamples of 60 months (5 years) at a time. Specifically, we first estimate household's β_j and expected return using the time-series data from month 5 to month 64 (years 1-5) for all households. We then perform a similar exercise using the time-series data from month 17 to month 76 (years 2-6), and so on until the five-year window ends in month 160 (years 9-13). With

[18] One may argue that kinship networks are local and operate better at the village or network levels than at the township level. We present a similar analysis at the village and network levels in Appendix B, with the results shown in Tables A.5 and A.6. Overall conclusions remain for most, but not all, of the villages and networks, suggesting that networks may extend beyond the boundary of villages.

all of the estimated $\hat{\beta}_{j,s}$ and expected return from all of the nine subperiods s for all households j, we finally estimate equation (5) using the pooled household-subperiod data.[19] Panel B of Table 1 presents the second-stage regression results. The table shows that the main prediction of our model still holds, i.e., higher beta is associated with higher expected (average) return. Note that allowing for time-varying risk (beta), the prediction from the model is also satisfied for Buriram. However, the null hypothesis that the constant term is equal to risk-free rate (assumed to be zero in this paper) is rejected in all of the four provinces.

Aggregate Human Capital

The model presented earlier in this paper implies that a household's beta captures all of the aggregate, non-diversifiable risk faced by the household. It is possible that there is omitted variable bias in the estimation of beta if the average return on township total assets is not the only determinant of the aggregate risk. Aggregate wealth, W, in the economy-wide resource constraint likely comes from other assets in addition to tangible capital held by the households in the economy. As shown in Table A.2, labor income contributes a large share of household income in our sample. Omitting human capital from the resource constraint implies that the economy-wide average return on physical assets (both financial and non-financial) might not capture the aggregate non-diversifiable risk of the economy. We address this issue by performing a robustness check. Specifically we compute an additional household beta with respect to return to

[19] This empirical strategy is similar to the empirical CAPM literature by Black, Jensen, and Scholes (1972). The difference is that instead of moving the window month by month, we move the window 12 months (1 year) at a time.

aggregate human capital, proxied by the change in aggregate labor income of all households in the economy.[20] In particular, the first-stage time-series regression becomes

$$R_{j,t} = \alpha_j + \beta_j^a R'^a_{M,t} + \beta_j^y R'^y_{M,t} + \varepsilon_{j,t}$$

where $R'^a_{M,t}$ represents the return to aggregate physical (non-human) asset and $R'^y_{M,t}$ is the return to aggregate human capital. The second-stage cross-sectional regression is

$$\bar{R}'_j = \alpha + \psi^a \hat{\beta}_j^a + \psi^y \hat{\beta}_j^y + \eta_j .$$

[Table 2]

We then extend our previous empirical analysis to include human capital. The first four columns of Table 2 show that the regression coefficient of beta with respect to human capital is not statistically significant in our sample. However, after controlling for the township return to human capital, the regression coefficients of beta with respect to total tangible capital (financial, inventory, and fixed assets) remain positive and significant in all of the four townships.

Time-Varying Stochastic Discount Factor

Similar to the traditional CAPM in the finance literature, parameters that determine stochastic discount factors are assumed to be time-invariant when we take the full risk-sharing benchmark to the empirical analysis. In theory, however, they are determined by the shadow price of consumption goods, which likely moves over time as

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[20] This approximation strategy is used in the finance literature by Jagannathan and Wang (1996). Their strategy is based on a simplified *ad hoc* assumption that labor income, *L*, follows an autoregressive process $L_t = (1+g)L_{t-1} + \varepsilon_t$. Therefore, human capital, *H*, defined as the discounted present value of the labor income stream, is approximated by $H_t = \frac{L_t}{r-g}$ where *r* is the discount rate on human capital, and both *r* and *g* are taken as constants. In this case, the realized capital-gain part of the rate of return on human capital (not corrected for additional investment in human capital made during the period) will be the growth of the stock of human capital, which is also the realized growth rate in per capita labor income.

the aggregate consumption of the economy changes.[21] In order to capture this time-varying stochastic discount factor, we provide a further robustness check following a strategy introduced by Lettau and Ludvigson (2001a and 2001b) who show that these time-varying parameters are functions of aggregate consumption-wealth ratio. The log consumption-wealth ratio, *cay*, in turn depends on three observable variables, namely log consumption, *c*; log physical (non-human) wealth, *a*; and log labor earnings, *y*. For each household, we compute five betas with respect to: (1) the aggregate return on tangible capital, $R'^{a}_{M,t}$; (2) the aggregate return on human capital (as computed in the previous analysis), $R'^{y}_{M,t}$; (3) the predicted value of $\widehat{cay}_t$; (4) the interaction between $R'^{a}_{M,t}$ and $\widehat{cay}_t$; and (5) the interaction between $R'^{y}_{M,t}$ and $\widehat{cay}_t$.[22]

$$R'_{j,t} = \alpha_j + \beta_j^a R'^{a}_{M,t} + \beta_j^y R'^{y}_{M,t} + \beta_j^{cay}\widehat{cay}_t + \beta_j^{cay\cdot a}\left(\widehat{cay}_t \cdot R'^{a}_{M,t}\right) + \beta_j^{cay\cdot y}\left(\widehat{cay}_t \cdot R'^{y}_{M,t}\right) + \varepsilon_{j,t} \quad (10)$$

In the final stage we run a cross-sectional regression of households' average return on the five betas estimated in equation (10). Namely,

$$\bar{R}'_j = \alpha + \psi^a \hat{\beta}_j^a + \psi^y \hat{\beta}_j^y + \psi^{cay} \hat{\beta}_j^{cay} + \psi^{cay\cdot a} \hat{\beta}_j^{cay\cdot a} + \psi^{cay\cdot y} \hat{\beta}_j^{cay\cdot y} + \eta_j \quad (11)$$

The results are shown in the last four columns of Table 2. Overall, with the additional factors in this robustness check, the regression coefficient of market non-human, physical assets, the main variable from our model, remains positive and significant for all of the four townships.

5. Idiosyncratic Risk and Return on Assets

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[21] This point is illustrated clearly in the derivation of equation (4). In this case, the stochastic discount factor, $m' = a - bR'_M$, is assumed to depend on the time-invariant parameters *a* and *b*. However, parameters *a* and *b* are determined by the shadow price of the consumption good, μ.

[22] Appendix C provides more information on the estimation procedure of log consumption-wealth ratio.

The empirical work thus far has abstracted from the presence of idiosyncratic risk and focused on the implications from the full risk-sharing benchmark. However, there are reasons why idiosyncratic risk may matter. With any of the departure from complete risk sharing, the expected return on assets may contain a risk premium that compensates for residual exposure to idiosyncratic risk.[23] We wish to know if this is true for the households in our sample, and if so, how large that residual exposure is, quantitatively. In addition, as mentioned earlier, households may be endowed with production technology that generates the positive relationship between expected return and beta, even in autarky without risk sharing. We seek to disentangle this.

We follow Fama and Macbeth (1973) and compute idiosyncratic risk from the variance of the residuals from each of the household's time-series regressions in the first step, i.e., the residuals from equation (8).[24] This strategy is consistent with the decomposition of total risk, as measured by the variance of the return on assets, into aggregate (non-diversifiable) and idiosyncratic (diversifiable) components. Since equations (8) could be rewritten in a matrix form as $R'_{j,t} = \mathbf{X}'_{M,t}\beta_j + \varepsilon_{j,t}$, we have

$$\mathrm{var}(R'_j) = E[\beta'_j \Omega_M \beta_j] + \mathrm{var}(\varepsilon_j) \qquad (12)$$

where Ω_M is the variance-covariance matrix of the aggregate variables and β_j is a vector of the regression coefficients from equation (8). The first term of the right hand side of equation (12) is therefore the aggregate risk while the second term is the variance of the residual. We consider this variance of the residual, σ_j^2, henceforth simply referred as household sigma, as our measure of household specific idiosyncratic risk because it summarizes the volatility of the returns that are not captured by aggregate factor

[23] In finance literature, Merton (1987) shows that under-diversified investors demand a return compensation for bearing idiosyncratic risk. Using the exponential GARCH models to estimate expected idiosyncratic volatilities, Fu (2009) finds a significant and positive relation between the estimated conditional idiosyncratic volatilities and expected returns.

[24] In addition to Fama and MacBeth (1973), a recent study by Calvet, Campbell, and Sodini (2007) also uses the same risk decomposition strategy as the one in this paper.

(aggregate return on assets). We emphasize that this is a household-by-household calculation.

[Table 3]

Table 3 presents the decomposition of the total risk faced by the median household in each of the provinces in our sample, based on equation (12). Panel A.1 of the table uses the beta estimated earlier from the simple specification in equation (8). Similarly, Panel B.1 uses the betas from the robustness specification in equation (10). The results shows that a large part of the volatility of the return to enterprise assets comes from the idiosyncratic component, in all four townships. The orders of magnitude are large, with the idiosyncratic component capturing at least 80-90% of the risk decomposition of the median households in three out of four provinces (the exception being Srisaket). Likewise, the aggregate component can be as low as 2% to 20% in these three provinces. Of course this finding per se is not inconsistent with the model, which allows for idiosyncratic risk in the technologies. Indeed it is good in the sense that it allows us to study the impact of aggregate risk, which one might presume from these numbers to be small, and of idiosyncratic risk, which one might presume to be large.

We take the first step and add household sigma computed from regressions (8) and (10), $\widehat{\sigma_j^2}$, as an additional explanatory variable to equations (9) and (11), respectively.

$$\bar{R}'_j = \alpha + \psi^a \widehat{\beta_j^a} + \psi^\sigma \widehat{\sigma_j^2} + \eta_j, \tag{13a}$$

$$\bar{R}'_j = \alpha + \psi^a \widehat{\beta_j^a} + \psi^y \widehat{\beta_j^y} + \psi^{cay} \widehat{\beta_j^{cay}} + \psi^{cay\cdot a} \widehat{\beta_j^{cay\cdot a}} + \psi^{cay\cdot y} \widehat{\beta_j^{cay\cdot y}} + \psi^\sigma \widehat{\sigma_j^2} + \eta_j \tag{13b}$$

The results in Table 4 show that, in both baseline and robustness specifications, higher idiosyncratic risks as measured by household sigma are associated with higher average returns in all of the four townships.[25] Note, however, that the coefficients for the beta

[25] Though this violates the exclusion restriction of the full risk sharing benchmark, we are now in a position to compute risk premium for each type of risk and compare.

with respect to the market return on physical assets still remain positive and significant in three of the townships, with Buriram as the only exception.

[Table 4]

Indeed, though both aggregate and idiosyncratic risk are positively correlated with higher expected return, the "prices" of these risks, i.e., their contribution to risk premia, is now shown to be different. We compute aggregate and idiosyncratic risk premia from equations (13a) and (13b) as empirically estimated in Table 4. Specifically, for the simple specification, we have:

$$\text{Aggregate Risk Premium} = \widehat{\psi^a}\widehat{\beta_j^a} \tag{14a}$$

$$\text{Idiosyncratic Risk Premium} = \widehat{\psi^\sigma}\widehat{\sigma_j^2}\ , \tag{15a}$$

and for the robustness specification, we have:

$$\text{Aggregate Risk Premium} = \widehat{\psi^a}\widehat{\beta_j^a} + \widehat{\psi^y}\widehat{\beta_j^y} + \widehat{\psi^{cay}}\widehat{\beta_j^{cay}} + \widehat{\psi^{cay\cdot a}}\widehat{\beta_j^{cay\cdot a}} + \widehat{\psi^{cay\cdot y}}\widehat{\beta_j^{cay\cdot y}} \tag{14b}$$

$$\text{Idiosyncratic Risk Premium} = \widehat{\psi^\sigma}\widehat{\sigma_j^2} \tag{15b}$$

In the financial autarky benchmark, households would not differentiate the idiosyncratic component and the aggregate component of the total fluctuation of the rate of return. In this case, the risk premia from both components should be proportional to the contribution of each component's contribution to the total fluctuation. Panels A.2 and B.2 of Table 3 present the decomposition of total risk premium (the sum of the aggregate risk premium and idiosyncratic risk premium) for the simple and the robustness specifications, respectively. The result shows that, with the exception of Buriram, the contribution of the idiosyncratic risk premium to the total risk premium is lower than the contribution of idiosyncratic risk to the total risk (as discussed earlier in Panels A.1 and B.1 of the same table). Specifically, for the robustness specification, although idiosyncratic risk accounts for 86.5% and 89.1% of the total risk of the median households in Chachoengsao and Lopburi, it contributes to only 23.6% and 52.9% of the total risk premium. Likewise, for the median household in Srisaket, idiosyncratic risk accounts for 57.2% of the total risk while its premium contributes for only 16.7% of the total risk premium. We also perform a nonparametric statistical test for the difference in medians and find that the median percentage contribution of idiosyncratic risk to the total risk is statistically different from the median percentage contribution of idiosyncratic risk premium to the total risk premium at 1% level of significance in all provinces except for Buriram.[26] The pattern for lower and upper quartiles is also similar to the median. Finally, it is important to note that omitted variables could lead to a positive relationship between expected return and sigma if a component of aggregate risk were mistakenly in sigma. However, this would work against us. Our empirical results suggest the impact of sigma is largely diversified, anyway.

In sum, we cannot treat aggregate and idiosyncratic risks identically when we analyze risks and returns of household enterprises in developing economies. A household with high total risk (high variance) may have lower risk premium than another household if the higher risk is idiosyncratic and diversifiable. Likewise, a household with low total risk (low variance) could require a higher risk premium if most of the risk is covariate and non diversifiable.

To illustrate this point, let us consider two households from Lopburi province in our sample. During the period of this study, household A's main occupation was livestock farming while household B grew beans and sunflowers. Household A's return on assets fluctuated far relatively more; the variance of the rate of return on assets for household A was 1.23 times higher than the variance of household B's return. The coefficient of variation was even higher, 2.72 times. However, 99% of the variance of the rate of return on household A's assets was from the idiosyncratic component while in contrast

[26] One possible explanation for Buriram is that it is the place with the most transition of occupations (toward higher return) and we have shorter period to use our method. See Pawasuttipaisit and Townsend (2010).

idiosyncratic risk contributed to only 63% for household B. Consequently, we find that the risk premium for household A, facing mostly diversified risk was only 0.008 (annualized) percentage point while for B with more aggregate risk it was 1.394, despite household B's less volatile return. This example, though deliberately dramatic, is not an outlier. Below we return to an analysis of risk premia and associated characteristics of enterprises that deliver statistically significant variation.

6. Risk Sharing: Connecting the Production Approach to the Consumption Approach

Reassuringly, our main findings on the production side are largely consistent with earlier studies on the consumption side that idiosyncratic risk is considerably shared across households in the these villages. Using consumption data from the same sample as in this paper, Chiappori, Samphantharak, Schulhofer-Wohl, and Townsend (2014) use variation in aggregate shocks to estimate the degree of heterogeneity in risk tolerance among the households and find evidence for full risk sharing. Likewise, Karaivanov and Townsend (2014) find that the consumption and income data of those in family networks is consistent with full risk sharing, though tied with moral hazard as best fitting models. Kinnan and Townsend (2012) show that households linked to one another by gifts of loans, and hence indirectly if not directly connected to outside financial institutions, achieve full risk sharing; in contrast, isolated households, especially the poor, are vulnerable to idiosyncratic income risk. Our larger point is that idiosyncratic risk in most of these studies is partially, though not completely, insured and this is consistent with what we are finding in this paper with the data on risk premia from the production side.

Regarding the actual mechanisms used for smoothing, i.e., financing a deficit or saving a surplus, households may buy and sell their assets (though this is rare) or use crop storage inventories (more common). They can also borrow or lend money formally through financial institutions or informally through village moneylenders, friends, or relatives. Samphantharak and Townsend (2010) provide quantification for these various smoothing mechanisms using the same Thai data and document the role of gifts among social networks.[27] Our conceptual framework in this paper both combines the production and consumption sides, as the first-order conditions have made clear, and features the role of gifts as the primary smoothing mechanism.

[INSERT Table 5]

We perform further analyses that directly connect production and smoothing mechanism. For each household, we compute the residual from equation (8) as month by month idiosyncratic shocks. Then, as reported in Table 5, we regress household's net gifts (i.e., gift outflows minus gift inflows) on these idiosyncratic shocks, controlling for aggregate shocks (capturing common township-time dummies) and household fixed effects (capturing diverse Pareto weights). Since gifts could also be disguised in the form of state-contingent loans (as in Udry 1994), we also regress household's net lending (i.e, lending minus borrowing), as well as household's net gifts plus net lending, on the same set of explanatory variables. The coefficients are all statistically significant at the 1% level. Finally, we also run the standard risk-sharing regressions with the consumption data (Townsend 1994). Controlling for aggregate shocks and household fixed effects, we regress monthly consumption on the same idiosyncratic shocks and find a low but significant coefficient, significant at 5% level.

To summarize, the results in Table 5 show that once we control for province-month fixed effects, which capture the provincial aggregate shocks, household consumption is positively correlated with household-specific, idiosyncratic shocks. Thus

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[27] The risk sharing implications of networks have been studied in other economies as well. For example, using data from the randomized evaluation of *PROGRESA* program in Mexico, Angelucci, De Giorgi, and Rasul (2011) find that members of an extended family share risk with each other but not with households without relatives in the village. They also find that connected households achieve almost perfect insurance against idiosyncratic risk. Recently, Attanasio, Meghir, and Mommaerts (2015) study group risk sharing in extended family networks in the US. They find that majority of shocks to household income are potentially insurable within family networks but they find, in contrast, little evidence that the extended family provides insurance for such idiosyncratic shocks.

risk sharing is imperfect and households do bear some of their idiosyncratic risk. That is consistent with the fact that idiosyncratic risk is showing up in the risk premium on the production side. On the other hand, the coefficient is small. Evidently, much, though not all, of the movement in idiosyncratic shocks is absorbed by net gifts and lending across households, so its impact on household consumption and risk premia is dissipated.

Finally, we note that the consumption, gift, and lending-borrowing data used in the analysis in this section are from different modules of the questionnaire than what we use in the calculation of ROA. Consistency in the empirical findings reassures us that the main conclusions in this paper are unlikely driven by measurement error in the data.

7. Returns Net of Risk Premia

In the development and macroeconomics literatures mentioned earlier in the introduction, rates of return on assets are usually used as a measure of performance or productivity of a firm or a household enterprise. These returns to assets however typically do not take into account that different household enterprises are involved in different risks and so higher average returns could result from compensation for higher risk and not productivity.

Another comparison of two households, C and D, from our sample illustrates this argument. Both households lived in Srisaket province. The main occupation of both households was cultivation, although they grew different crops. Household C's main crop was rice while household D grew cassava. During the period of our study, the average annualized monthly real rate of return on assets for household C was 9.06% while the average rate for household D was at 3.93%, i.e., less than half of the rate for household C. However, looking closely, our analysis shows that household C's higher return was largely due to the higher risk and the types of risk it faced. First, household C was engaged in production activity whose return fluctuated more than household D. In particular, the variance of the rate of return for household C was 2.26 times higher than that of household D. Second, while 70% of the total risk faced by household C was idiosyncratic and could be (partially) diversified away, the diversifiable risk component accounted for an even greater percentage, 89%, for household D. As a result, the risk premium of household C was 8.25 percentage points while it was only 1.11 percentage points for household D. In other words, household C's higher average return was mainly the compensation for higher risk exposure that the household faced, both in terms of the total and in terms of a greater share of nondiversifiable risk. In the end, household C actually had a lower return net of risk, i.e., after subtracting risk premia, a net of 0.81%, in comparison to household D at 2.82%.

The framework in this paper gives us a practical way to compute the risk premia that contribute to the return on assets and hence the residual return, after adjusting for the premium, as in the example just given. In the conventional CAPM context, Jensen (1967) argues that intercepts α_j in equations (10) α_j can be interpreted as the abnormal return of an asset, and financial analysts use Jensen's *alpha* as a measure of performance of an asset or a fund manager. We follow this tradition, thinking of α_j as how well household *j* manages its assets in generating income in excess of risk-free rate adjusting for measured risk premia.

[Figure 2]

Figure 2 shows the histograms comparing the return on assets that is not adjusted for risks with the return adjusted for both aggregate and idiosyncratic (based on the robustness specification). Though risk adjusted returns are naturally shifted to the left, other aspects of the distribution also change. The modes receive high mass consistently in the risk-adjusted returns. Further in two provinces the adjusted returns have more mass in the left tail, and in the other two provinces, in the right tail. The overall point is that the distributions of the rate of return do change when we adjust for risks, as evident from the differences in the skewness and the kurtosis of the returns. Table A.7 in the appendix presents selected descriptive statistics of household alpha.

8. Household Characteristics Associated with Risk Exposure and Return on Assets

Figure 3 presents a scatter plot displaying for each household its aggregate risk premium and idiosyncratic risk premium. The figure shows that some households in our sample were exposed to both high aggregate and idiosyncratic risks (those in the upper-right corner) while many faced little of both risks (those in the lower-left corner). Still, there are a large number of households that were mainly exposed to one type of risk, but not the other (those in the upper-left and in the lower-right corners).[28]

[Figure 3]

Table 6 presents correlations in the data, with different measures of return and risk of assets as the dependent variable and household's initial wealth and other demographic characteristics on the right hand side. Specifically, Panel A presents regression results when we us the simple measured rate of return on assets (not adjusted for risk) as the dependent variable. In three out of four provinces, we find that poor households (as measured by initial wealth) tend to have higher average return on assets. This result might prompt us to conclude that households in these provinces are financially constrained. However, the results in Panel B reveal a different story. Once adjusted for risk, poorer households in the central region tend to have a lower return on assets while there is no relationship between wealth and return on assets for the two provinces in the northeast.

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[28] Figure 3 also presents two salient findings from our sample. First, there is a positive correlation between aggregate risk premium and idiosyncratic risk premium (the correlation coefficient is 0.49 and statistically significant at 1%). Second, there is a large portion of our sampled households with low risk (those near the origin in Figure 3). In particular, there is variation in aggregate risk premium while the idiosyncratic part is near zero. This produces a cluster of points on the x-axis.

The explanation for these findings is shown in Panels C and D where we examine the relationship between household characteristics and household beta (aggregate risk with respect to the market return on physical assets) and household sigma (idiosyncratic risk). The results highlight the heterogeneity in the risk exposure of households in our sample. Controlling for household demography, poorer households tend to be more involved with risky activities, both aggregate (in 3 out of 4 provinces) and idiosyncratic (in all 4 provinces). We also find that households with younger, less educated, and male head tend to have more exposure to both aggregate and idiosyncratic risks (although specific results vary across provinces).

[Table 6]

One might well ask, what is the mechanism that households choose to make their income smooth or risky? We further explore the sources of this household risk exposure (results not shown here). Using the data on the shares of household total revenue from each production activity as well as the data on each household's main occupation (cultivation, livestock, fish and shrimp farming, and non-farm business). We find that cultivation and non-farm business activities are associated with higher aggregate and idiosyncratic risk (these are statistically significant at 1%). Cultivation and non-farm business activities are common in our sample (hence aggregate risk), but at the same time, there is heterogeneity in the variability of returns within cultivation and within business activities (hence idiosyncratic risk). Finally, we find that poorer households are more likely to participate in cultivation and non-farm business activities (again, statistically significant at 1%). Note also that this finding is unlikely driven by the difference in risk preferences between rich and poor households as Chiappori, Samphantharak, Schulhofer-Wohl, and Townsend (2014), using the data from the same household survey as this paper, find that risk aversion was not correlated with household wealth. This is related to the underlying force of the full risk sharing benchmark, under which production and consumption activities are separated.

The result shows how easily one could misinterpret data, if one did not adjust for risk. One might have impression that relatively poor households have high returns on assets (as shown in Panel A for all of the provinces except for Lopburi) and thus suffer from financial constraints. The results here show that the reason why these poor households have a higher simple rate of return to their business enterprises is from the fact that they take more risk in their production activities and get compensated accordingly. Controlling for risks, household enterprises of the poor in the northeast are not productively different those of the rich, while the poor in the central region tend to have lower return on assets that the rich. Thus some poor households in our sample, those of the central region, do seem constrained, but not in the usual, stereotypical sense. Poor households seem limited in their choices of production activities, as if constrained away from the activities that have high return net of risk premia and are available only for richer households.[29]

9. Conclusion

We have studied the risk and return of farm and non-farm business enterprises in village economies with illiquid capital asset markets and limited formal financial securities. Using data from the Townsend Thai Monthly Survey, conducted in rural and semi-urban villages, we find a stark contrast between the quantity of risk, on the one hand, and the impact of risk on risk premia, on the other. Although idiosyncratic risk is the dominant factor in the total risk, it is diversified away to a large extent, and so bears a

[29] Our findings do not necessarily contradict existing literature that analyzes the gross rate of return, unadjusted for risk premia, and financial constraints. If all households are in the same occupation or a sector that has identical aggregate risk, and if idiosyncratic risk is fully diversified, then actual net returns, adjusted for risk, are simply a downward shifted version of the unadjusted returns. Some on the right tail of this distribution may have high net returns and thus may be constrained. More generally, however, with different occupations and differential exposure to risk, high returns on the right tail of the distribution may be simply the compensation for high risk. Likewise, high rates of growth of net worth for poor households with high rates of return does not necessarily indicate the presence of financial constraints, as those with high expected returns, however risky, will on average as a group, experience high growth.

low risk premium. In contract, aggregate risk cannot be diversified away and likewise it captures a much larger share of the total risk premia.

How is this reversal in quantities and valuations possible? The answer is that the Thai households in the sample have extensive family networks and engage actively in gifts and loans, making the economic environment in these village economies with informal markets and institutions close to the outcome of the standard capital asset pricing model, even though, again, there are no formal markets and actively traded assets. With risk sharing conventions in place, idiosyncratic risk is largely, though not entirely, pooled away. Indeed, we have confirmed active transactions in these networks as an underlying mechanism. Controlling for aggregate risk, when residual idiosyncratic returns are low, gifts are incoming, as is borrowing; and when idiosyncratic returns are high, gifts are outgoing, as is lending.

Our results, using data on the rates of return from production side, are thus parallel to those in the consumption risk sharing literature. The latter uses income and consumption as key variables, showing consumption is largely, though not entirely, smoothed against idiosyncratic income shocks, once one controls for aggregate shocks. Gifts and risk sharing networks have been shown in other work to be a key mechanism. Here in this paper we use the profits from production and the assets used to generate those profits, to calculate the rates of return. We then show that in the data the comovement in the rates of return requires compensation in the form of higher expected return, so that one infers exposure to that aggregate risk. Our analysis allows us to infer exposure to the idiosyncratic risk in the rate of return as well. This risk requires lower compensation, so one infers, indirectly, the lower exposure to idiosyncratic shocks.

We also provide an analysis that jointly makes use of production and consumption panel data, at the level of individual households over time. We use the same idiosyncratic shocks inferred on the production side in rate of return data in the standard risk sharing regression for consumption, and examine how consumption moves with these shocks, controlling for common aggregate shocks and household specific fixed effects. We show that idiosyncratic shocks do impact household consumption, as we surmise indirectly by looking risk premia on the production side. This confirms directly that some of the idiosyncratic risk is borne by the households. However the coefficient of sensitivity to this idiosyncratic risk, though statistically significant, is estimated to be small. The impact of an idiosyncratic shock on household's response through gifts and lending is larger. In sum, the work here with production data, consumption data, and network transactions paints a common, confirmatory picture of economic life in these villages.

Our framework and results have important policy implications: when inferring the degree of financial constraints and possible targeting, and when inferring underling productivity and possible misallocation, we need to consider not only the returns but also risk and risk premia. In particular, as we have emphasized in this paper, we need to distinguish aggregate and idiosyncratic risk, and how these two components can vary substantially across households running diverse businesses in different production sectors. When risk adjustments are common across household, as when there are common aggregate returns in a sector and idiosyncratic risk is entirely pooled away, then the distribution of net returns is simply a downward shift of the distribution of returns. However, when comparing business across sectors or production across different activities, the adjustments for aggregate and idiosyncratic risks can vary and there is potentially little association between high returns and underlying productivity. One might infer that poor households with high returns are financially constrained, but this result can disappear with risk adjustment. Indeed, the richer households may emerge as the ones with higher net returns, suggesting obstacles for the poor to leave their current occupation.

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Appendix

Appendix A: Descriptive Statistics

[Tables A.1-A.4]

Appendix B: Alternative Definitions of the Aggregate Economy

One may argue that kinship networks are local and operate better at the village or network levels than at the township level. Table A.5 reports the second-stage regression results when we use villages as aggregates. Despite the smaller number of observations, the results show that the regression coefficient of household beta is significantly positive at 10% (or lower) level of significance for 9 of the 16 villages in our sample, with the only exception of all four villages in Buriram province, two villages in Lopburi, and one village in Chachoengsao. The result also shows that we cannot reject the null hypothesis that $\psi = \overline{R}_M$ at 10% level of significance for 5 out of those 9 villages in the sample (Village 7 in Chachoengsao; Village 4 in Lopburi; and Villages 6, 9, and 10 in Srisaket).

[Tables A.5]

We also perform a similar analysis at the network level. In order to analyze the risk and return at the network level, we construct kinship network maps for the households in the Townsend Thai Monthly Survey. Specifically, for each of the relatives of the household head and the spouse (parents and siblings of the head, parents and siblings of the spouse, and their children) who was still alive and lived within the village, the survey recorded which building structure as recorded in the initial census he or she lived. With this information, we constructed a kinship network map for each village by drawing a link between two households that were family-related related. We present in Table A.6 the regressions using network as our definition of aggregate economy. We present only the results for the networks with more than 15 households. There are nine of them. All are from different villages (four from Lopburi in the central region; two from Buriram and three from Srisaket in the northeast). Table A.6 shows that the regression coefficient of household beta is significantly positive for 5 of the 9 networks. For 2 of the 9 networks, we however cannot reject the null hypothesis that the regression coefficient is equal to the network's average return (Networks 602 and 902 in Srisaket).

[Tables A.6]

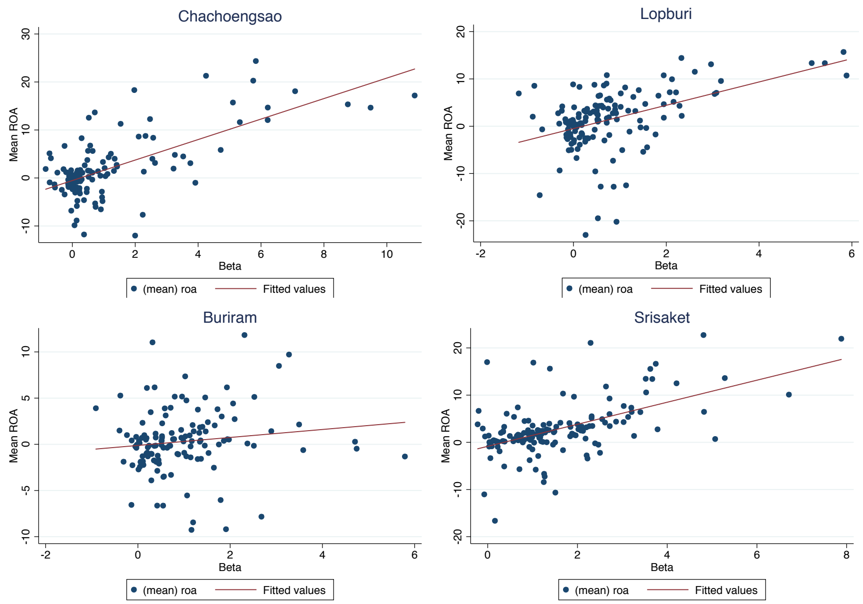
Appendix C: Time-Varying Stochastic Discount Factor

To show that the consumption-wealth ratio summarizes the expectation of future returns, Lettau and Ludvigson (2001a) start from the resource constraint in period *t* analogous to what presented in Section 2 of this paper, $W_{t+1} = (1 + r_{M,t+1})(W_t - C_t)$, where W_t, C_t, and $r_{M,t+1}$ are wealth, consumption, and market rate of return in period *t*. Following Campbell and Mankiw (1989), the log-linear approximation of this constraint yields $c_t - w_t \approx E_t\left[\sum_{s=1}^{\infty} \rho_w^s (r_{M,t+s} - \Delta c_{t+s})\right]$, where $\rho_W = \frac{W - C}{W}$ or the steady-state investment to wealth ratio. Define $cay_t = c_t - w_t = c_t - \omega a_t - (1-\omega) y_t$, where ω is the share of physical wealth in total wealth. Since we do not observe the share of non-human wealth, ω, we cannot directly compute the log consumption to wealth ratio, cay_t. Instead, we follow Lettau and Ludvigson (2001a) and obtain the value of cay_t from $\widehat{cay}_t = c_t^* - \hat{\omega} a_t^* - \hat{\theta} y_t^* - \hat{\delta}$, where the starred variables are the observed quantities from our data and the hatted values are the estimated coefficients from the township time-series regression $c_t^* = \delta + \omega a_t^* + \theta y_t^* + \varepsilon_t$.

Appendix D: Risk-Adjust Return

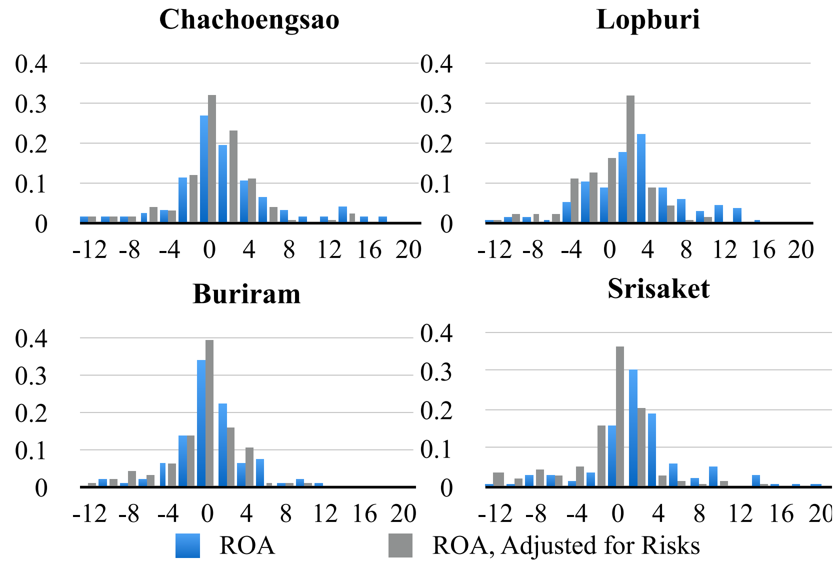
[Table A.7]

Figure 1 Risk and Return: Township as Market



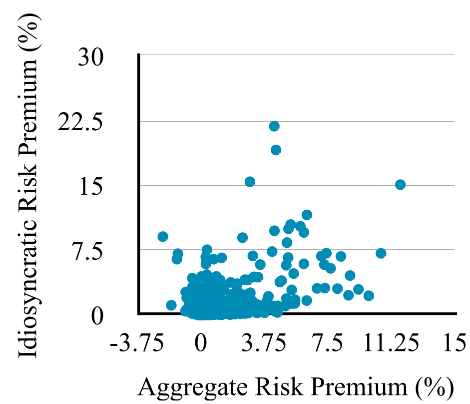
Remarks Unit of observation is household. There are 129 households in Chachoengsao, 140 in Lopburi, 131 in Buriram, and 141 in Srisaket. The fitted lines correspond to regression results presented in Columns (1)-(4) in Table 1.

Figure 2 Histograms of Rate of Return on Assets, Unadjusted and Adjusted for Risk



Remarks Unit of observation is household. ROA is the annualized monthly rate of return on asset in percentage. ROA adjusted for risk is the rate of return adjusted for both aggregate and idiosyncratic components of the total risk faced by the households.

Figure 3 Scatter Plots Aggregate Risk Premium and Idiosyncratic Risk Premium



Remarks Unit of observation is household. The observations are from all of the four townships. Aggregate risk premium is computed from equation (14b) while idiosyncratic risk premium is computed from equation (15b), both using estimates from Table 8. The premia are presented in annualized monthly percentage return.

Table 1 Risk and Return Regressions: Township as Market

Dependent Variable:	***Household's Mean Return on Assets***							
	Panel A: Constant Beta				***Panel B: Time-Varying Beta***			
Region:	***Central***		***Northeast***		***Central***		***Northeast***	
Township (Province):	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Beta	2.135***	2.465***	0.432	2.335***	1.250***	2.307***	0.530**	1.888***
	(0)	(1)	(0)	(1)	(0)	(0)	(0)	(0)
Constant	-0.535	-0.503	-0.122	-0.847	-0.325*	-0.631***	-0.782***	-1.114***
	(0.412)	(0.561)	(0.364)	(0.668)	(0.176)	(0.235)	(0.162)	(0.304)
Observations	129	140	131	141	1,161	1,260	1,179	1,269
R-squared	0.467	0.210	0.017	0.297	0.330	0.204	0.019	0.260
Township Returns:								
Monthly Average	1.68	2.49	0.15	0.80	1.19	2.40	-0.07	1.04
Standard Deviation	0.07	0.10	0.10	0.10	0.75	1.47	0.54	0.75

Remarks For columns (1)-(4), unit of observations is household. Beta is computed from a simple time-series regression of household's adjusted ROA on township's ROA over the 156 months from January 1999 to December 2011. Household's mean adjusted ROA is the time-series average of household adjusted ROA over the same 156 months. For columns (5)-(8), unit of observation is household-time window. Each time window consists of 60 months. The window shifts 12 months (1 year) at a time. There are 9 moving windows in total for each household. Beta is computed from a simple time-series regression of household's adjusted ROA on township's ROA in each corresponding time window. Household's mean adjusted ROA is the time-series average of household adjusted ROA over the corresponding time window. Robust standard errors corrected for generated regressors (Shanken 1992) are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2 Risk and Return Regressions with Human Capital and Time-Varying Stochastic Discount Factor: Township as Market

Dependent Variable:	***Household's Mean Return on Assets***							
Region:	***Central***		***Northeast***		***Central***		***Northeast***	
Township (Province):	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Beta with respect to	1.242***	2.233***	0.564***	1.813***	1.094***	2.005***	0.392	1.893***
return on market physical capital (ra)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Beta with respect to	0.00177	0.0217	-0.0524	0.149	-0.00542	0.0375	-0.0310	0.179
return on market human capital (rh)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Beta with respect to					-0.00441	0.00246	0.0333	0.0789
residual log consumption (cay)					(0)	(0)	(0)	(0)
Beta with respect to					-0.00533	-0.0304	-0.131	-0.101
the interaction cay*ra					(0)	(0)	(0)	(0)
Beta with respect to					0.00134	-0.000574	0.0109	-0.0130
the interaction cay*rh					(0)	(0)	(0)	(0)
Constant	-0.307*	-0.584**	-0.757***	-1.080***	-0.156	-0.464**	-0.589***	-1.164***
	(0.176)	(0.232)	(0.164)	(0.310)	(0.178)	(0.223)	(0.162)	(0.268)
Observations	1,161	1,260	1,179	1,269	1,161	1,260	1,179	1,269
R-squared	0.329	0.203	0.021	0.270	0.315	0.203	0.049	0.306

Remarks Unit of observation is household-time window. For Columns (1)-(4), beta's are computed from a multivariate time-series regression of household's monthly adjusted ROA on township's monthly return on market physical capital (ra) and township's return on human capital (ry), which is proxied by the monthly growth rate of township's total labor income. Regressions are performed on moving windows of 60 months. The window then shifts 12 months (1 year) at a time and there are 9 moving windows in total for each household. Household's mean adjusted ROA is the time-series average of household adjusted ROA over the corresponding time window. For Columns (5)-(8), similar analysis is performed, with additional explanatory variables. Residual log consumption is the residual computed from time-series regression of township's monthly log food consumption on township's total physical asset at the beginning of the month and township's total labor income during that month. Interaction terms are then defined accordingly. Robust standard errors corrected for generated regressors (Shanken 1992) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3 Decomposition of Risk and Risk Premium (Median Households by Province)

Region:	Central						Northeast					
Township (Province):	Chachoengsao			Lopburi			Buriram			Srisaket		
	p25	p50	p75	p25	p50	p75	p25	p50	p75	p25	p50	p75
Panel A: Baseline Specification												
A.1: Decomposition of Risk (Variance)												
Aggregate Risk	0.3%	1.9%	6.1%	0.5%	2.4%	7.7%	1.8%	6.0%	16.0%	11.1%	34.1%	56.2%
Idiosyncratic Risk	93.9%	98.1%	99.7%	92.3%	97.6%	99.5%	84.0%	94.0%	98.2%	43.8%	65.9%	88.9%
A.2: Decomposition of Risk Premium												
Aggregate Risk	54.6%	78.4%	95.3%	11.3%	38.5%	58.3%	-52.8%	-18.7%	-5.6%	46.1%	71.2%	86.7%
Idiosyncratic Risk	4.7%	21.6%	45.4%	41.7%	61.5%	88.7%	105.6%	118.7%	152.8%	13.3%	28.8%	53.9%
Panel B: Robustness Specification												
B.1: Decomposition of Risk (Variance)												
Aggregate Risk	11.0%	15.1%	22.6%	8.4%	12.0%	19.8%	12.9%	20.3%	26.6%	31.1%	45.0%	59.1%
Idiosyncratic Risk	77.4%	84.9%	89.0%	80.2%	88.0%	91.6%	73.4%	79.7%	87.1%	40.9%	55.0%	68.9%
B.2: Decomposition of Risk Premium												
Aggregate Risk	43.4%	67.4%	93.7%	-2.2%	45.1%	78.8%	-47.0%	11.6%	64.6%	66.7%	80.5%	90.9%
Idiosyncratic Risk	6.3%	32.6%	56.6%	21.2%	54.9%	102.2%	35.4%	88.4%	147.0%	9.1%	19.5%	33.3%
Number of Observations	129	129	129	140	140	140	131	131	131	141	141	141

Remarks Unit of observation is household. Panel A presents the results from a baseline specification, as shown in equation (8), using the empirical results from Columns (1)-(4) of Table 1. Panel B presents the results from a full robustness specification, as shown in equation (10), using the empirical results from Columns (5)-(8) of Table 2. The numbers for each household are the average across estimates from nine different time-shifting windows.

Table 4 Aggregate Risk, Idiosyncratic Risk, and Rate of Return: Township as Market

	Panel A: Baseline Specification				*Panel B: Robustness Specification*			
Dependent Variable:	***Household's Mean ROA***				***Household's Mean ROA***			
Region:	***Central***		***Northeast***		***Central***		***Northeast***	
Township (Province):	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Beta with respect to	0.903***	1.518***	-0.181	1.334***	0.487***	1.105***	0.0137	1.331***
return on market physical capital (ra)	(0.311)	(0.305)	(0.349)	(0.354)	(0)	(0)	(0)	(0)
Beta with respect to					0.00598	0.06	-0.0411	0.0799
return on market human capital (rh)					(0)	(0)	(0)	(0)
Beta with respect to					-0.0117	-0.00401	0.0106	0.0376
residual log consumption (cay)					(0)	(0)	(0)	(0)
Beta with respect to					-0.0117	0.0245	-0.0686	-0.0560
the interaction cay*ra					(0)	(0)	(0)	(0)
Beta with respect to					-0.00166	-0.000644	0.00392	-0.0127
the interaction cay*rh					(0)	(0)	(0)	(0)
Sigma	0.216***	0.184***	0.131***	0.205***	0.00428***	0.00467***	0.00389***	0.00367***
	(0.0499)	(0.0362)	(0.0432)	(0.0361)	(0.000689)	(0.000400)	(0.000435)	(0.000296)
Constant	-1.999***	-3.132***	-1.576***	-2.745***	-0.489***	-1.535***	-1.356***	-1.491***
	(0.433)	(0.695)	(0.509)	(0.589)	(0.171)	(0.214)	(0.151)	(0.237)
Observations	129	140	131	141	1,161	1,260	1,179	1,269
R-squared	0.558	0.280	0.114	0.459	0.433	0.330	0.196	0.446

Remarks Unit of observation is household-time window. Beta's are computed from a multivariate time-series regression of household's monthly adjusted ROA on township's monthly return on market physical capital (ra) and township's return on human capital (rh), and township's residual log consumption (cay). Township's return on human capital (ry) is proxied by the monthly growth rate of township's total labor income. Township's residual log consumption is the residual computed from time-series regression of township's monthly log food consumption on township's total physical asset at the beginning of the month and township's total labor income during that month. Interaction terms are then defined accordingly. Sigma is the variance of error terms from regressions used to estimate beta's for each household-time window. Robust standard errors corrected for generated regressors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5 Idiosyncratic Income, Consumption, Gift, and Lending

Dependent Variable:	**Net Gift Outflow**	**Net Lending**	**Net Gift Outflow Plus Net Lending**	**Consumption**
Idiosyncratic Income	13.02***	27.67***	40.66***	4.857**
	(4.795)	(7.507)	(9.000)	(2.081)
Province-Month Fixed Effects	Yes	Yes	Yes	Yes
Household Fixed Effects	Yes	Yes	Yes	Yes
Observations	81,664	81,712	81,664	81,712
R-squared	0.011	0.009	0.009	0.014
Number of Households	541	541	541	541

Remarks: Unit of observation is household-month. Net gift outflow is defined as gift outflow minus gift inflow. Net lending is defined as lending minus borrowing. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6 Determinants of Rate of Returns and Risks

Region	Central		Northeast		Central		Northeast	
Province	Chachoengsao	Lopburi	Buriram	Srisaket	Chachoengsao	Lopburi	Buriram	Srisaket
	Panel A: Simple Rate of Return				*Panel B: Risk-Adjusted Rate of Return*			
Total Initial Wealth	-0.0140**	0.534***	-0.594**	-2.149***	0.0287***	0.711***	-0.323	-0.109
	(0.00694)	(0.0791)	(0.255)	(0.323)	(0.00806)	(0.0691)	(0.262)	(0.192)
Household Size	-0.0868	-0.729***	-0.0651	-0.144	0.182	-0.872***	-0.239	-0.577***
	(0.177)	(0.249)	(0.169)	(0.228)	(0.123)	(0.205)	(0.146)	(0.166)
Age of Household Head	-0.0417**	0.00155	0.00627	0.00231	0.0217	0.0338*	0.0257**	0.0550***
	(0.0201)	(0.0211)	(0.0142)	(0.0209)	(0.0133)	(0.0174)	(0.0125)	(0.0148)
Education of Household Head	-0.115	-0.469***	0.128	-0.492***	0.209*	-0.368***	0.0896	-0.252**
	(0.136)	(0.120)	(0.0823)	(0.133)	(0.108)	(0.106)	(0.0746)	(0.108)
Household Head Gender (Male=1)	0.590	-0.597	-0.997**	1.710***	-1.580***	-0.291	-0.685*	-0.0355
	(0.444)	(0.510)	(0.415)	(0.510)	(0.345)	(0.369)	(0.386)	(0.401)
Constant	4.434**	4.472**	0.101	4.636***	-2.320*	-0.815	-1.911**	-2.299*
	(1.815)	(1.766)	(1.103)	(1.791)	(1.204)	(1.494)	(0.964)	(1.233)
R-squared	0.014	0.078	0.022	0.084	0.026	0.128	0.027	0.080
	Panel C: Aggregate Risk				*Panel D: Idiosyncratic Risk*			
Total Initial Wealth	-0.0261***	-0.00532	-0.178***	-0.831***	-6.902***	-34.73***	-68.39***	-239.2***
	(0.00397)	(0.0148)	(0.0572)	(0.0935)	(1.087)	(7.917)	(17.98)	(35.16)
Household Size	-0.141**	0.0543	0.0622	0.224***	-51.43***	23.16	43.24**	27.56
	(0.0695)	(0.0491)	(0.0444)	(0.0526)	(19.67)	(17.68)	(18.51)	(26.59)
Age of Household Head	-0.0482***	-0.0152***	-0.00635	-0.0115**	-9.930***	-1.943	-4.848***	-9.827***
	(0.0108)	(0.00479)	(0.00432)	(0.00540)	(2.391)	(1.529)	(1.549)	(2.270)
Education of Household Head	-0.266***	-0.0172	0.000534	-0.111***	-49.46***	-8.927	9.993	-21.49*
	(0.0529)	(0.0158)	(0.0187)	(0.0225)	(10.47)	(5.995)	(6.210)	(11.86)
Household Head Gender (Male=1)	1.766***	0.0687	0.304***	0.789***	319.9***	-109.6	-63.05	153.8***
	(0.212)	(0.122)	(0.0936)	(0.117)	(48.73)	(77.08)	(46.39)	(58.81)
Constant	4.888***	1.574***	0.847***	2.326***	1,081***	648.4***	505.1***	1,038***
	(0.918)	(0.366)	(0.313)	(0.429)	(216.8)	(141.2)	(105.9)	(190.6)
R-squared	0.080	0.164	0.043	0.169	0.072	0.050	0.041	0.109
Observations	1,082	1,195	1,100	1,172	1,082	1,195	1,100	1,172

Remarks Unit of observation is household-round (shifting time window). For each household, beta and sigma are estimated from the regression in equation (6). Beta is the regression coefficient with respect to aggregate return on physical assets (ra). Sigma is the variance of the error terms from the regression. Household size is the number of household members aged 15-64. Age of household head was as of the end of December 1998. Initial wealth is in million baht. All regressions include village fixed effects. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.1 Descriptive Statistics of Household Characteristics

	Number of Observations	Percentiles 25th	50th	75th	Number of Observations	Percentiles 25th	50th	75th
Region	***Central***							
Township (Province)	***Chachoengsao***				***Lopburi***			
As of December 1998:								
Household size	129	3.0	4.0	6.0	140	3.0	4.0	5.0
Male	129	1.0	2.0	3.0	140	1.0	2.0	3.0
Female	129	1.0	2.0	3.0	140	1.0	2.0	3.0
Male, age 15-64	129	1.0	1.0	2.0	140	1.0	1.0	2.0
Female, age 15-64	129	1.0	1.0	2.0	140	1.0	1.0	2.0
Average age	129	29.3	36.3	44.5	140	25.6	32.3	42.0
Maximum years of education	129	6.0	9.0	12.0	140	4.2	6.0	9.0
Total Assets (Baht)	129	380,465	1,109,228	3,636,334	140	336,056	1,074,082	2,387,329
156-Month Average (January 1999-December 2011):								
Monthly Income (Baht)	129	7,561	13,696	23,637	140	5,836	10,486	20,765
Total Assets (Baht)	129	857,892	1,745,109	4,275,229	140	653,339	1,645,757	3,052,390
Fixed Assets (% of Total Assets)	129	37%	61%	80%	140	40%	59%	71%
Total Liability (Baht)	129	8,470	31,455	105,216	140	34,595	121,412	285,300
Liability to Asset Ratio	129	0%	2%	6%	140	4%	8%	16%
Region	***Northeast***							
Township (Province)	***Buriram***				***Srisaket***			
As of December 1998:								
Household size	131	3.0	4.0	5.0	141	4.0	5.0	6.0
Male	131	1.0	2.0	3.0	141	2.0	2.0	3.0
Female	131	1.0	2.0	3.0	141	2.0	2.0	3.0
Male, age 15-64	131	1.0	1.0	2.0	141	1.0	1.0	2.0
Female, age 15-64	131	1.0	1.0	2.0	141	1.0	1.0	2.0
Average age	131	20.9	27.6	39.3	141	25.2	32.0	36.3
Maximum years of education	131	4.0	6.0	8.3	141	5.3	7.0	10.3
Total Assets (Baht)	131	356,201	572,491	947,314	141	156,313	387,634	881,455
156-Month Average (January 1999-December 2011):								
Monthly Income (Baht)	131	2,073	3,677	5,584	141	2,160	3,672	5,276
Total Assets (Baht)	131	503,434	741,882	1,114,981	141	317,444	577,064	1,048,213
Fixed Assets (% of Total Assets)	131	39%	57%	69%	141	35%	63%	75%
Total Liability (Baht)	131	24,316	56,805	109,264	141	23,471	42,932	75,531
Liability to Asset Ratio	131	3%	8%	17%	141	4%	9%	17%

Remarks The unit of observations is household. Average age and maximum years of education across household members within a given household. Assets, liabilities, and income are in nominal value. Fixed assets include equipment, machinery, building, and land.

Table A.2 Revenue from Production Activities (% by Township)

Region:	***Central***		***Northeast***	
Township (Province):	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***
Production Activities				
Cultivation	13.2%	39.4%	13.5%	33.7%
Livestock	21.0%	22.8%	1.0%	1.1%
Fish and Shrimp	17.6%	0.0%	0.3%	1.6%
Non-farm Business	28.8%	19.7%	59.2%	28.6%
Wage Earning	18.4%	15.2%	22.6%	27.9%
Number of Sampled Households	129	140	131	141

Remarks The unit of observations is township. The percentage of revenue is the revenue of each production activity from all households in our sample divided by the total revenue from all activities in the township. The revenues are computed from all of the 156 months (January 1999 to December 2011).

Table A.3 Descriptive Statistics of Networks in Village and Township

Region	***Central***		***Northeast***	
Township (Province)	**Chachoengsao**	**Lopburi**	**Buriram**	**Srisaket**
Number of Observations	129	140	131	141
% of Households with relatives living in the same...				
Village	50.4%	76.4%	80.9%	87.9%
Township	87.8%	88.4%	97.1%	94.0%

Remarks The unit of observation is household. Relatives are defined as parents of household head, parents of household head's spouse, siblings of household head or of household head's spouse, or children of household head. Network variables are computed as of August 1998 (the initial baseline survey, i.e. Month 0).

Table A.4 Descriptive Statistics of Return on Assets: Quartiles by Township

	Number of Observations	Percentiles 25th	50th	75th	Number of Observations	Percentiles 25th	50th	75th
Region:	***Central***							
Province (Township):	***Chachoengsao***				***Lopburi***			
Mean	129	-1.72	0.38	3.99	140	-1.67	1.46	4.53
Standard Deviation	129	4.38	7.56	16.61	140	10.16	16.51	24.77
Coefficient of Variation	129	2.02	3.14	5.46	140	3.27	4.65	8.85
Region:	***Northeast***							
Province (Township):	***Buriram***				***Srisaket***			
Mean	131	-1.32	0.28	1.56	141	0.21	1.99	4.29
Standard Deviation	131	8.38	13.92	22.59	141	10.16	16.78	26.87
Coefficient of Variation	131	4.03	8.70	17.48	141	4.03	5.92	11.52

Remarks Unit of observations is households. ROA is rate of return on household's total asset, computed by household's net income (net of compensation to household labor) divided by household's average total assets over the month. ROA is real return, adjusted by regional Consumer Price Index from the Bank of Thailand, and reported in annualized percentage. Mean, standard deviation, and coefficient of variation of ROA are computed from monthly ROA f*or each household* over 156 months (January 1999 to December 2011). The percentiles are *across households* in each township.

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Table A.5 Risk and Return Regressions: Village as Market

Dependent Variable:	*Household's Mean ROA*							
Province:	*Chachoengsao*				*Lopburi*			
Village:	*02*	*04*	*07*	*08*	*01*	*03*	*04*	*06*
Beta	2.473***	3.232***	6.741***	0.720	2.163	3.185	4.399***	4.884***
	(0)	(1)	(2)	(1)	(4)	(3)	(1)	(1)
Constant	-1.105	-0.333	-0.739	1.162	-0.827	0.312	0.257	-1.629
	(0.899)	(0.756)	(0.821)	(0.984)	(1.434)	(0.873)	(0.572)	(1.503)
Observations	35	36	27	31	34	29	37	40
R-squared	0.449	0.702	0.446	0.036	0.012	0.126	0.472	0.337
Village Returns:								
Monthly Average	1.09	1.48	4.13	0.73	2.03	2.49	2.48	2.85
Standard Deviation	0.14	0.08	0.50	0.12	0.17	0.34	0.14	0.33
Province:	*Buriram*				*Srisaket*			
Village:	*02*	*10*	*13*	*14*	*01*	*06*	*09*	*10*
Beta	0.827	0.547	0.217	0.697	2.759***	3.680***	1.557**	1.902*
	(1)	(2)	(1)	(1)	(1)	(2)	(1)	(1)
Constant	-0.628	0.346	0.684	-0.541	-2.407**	-0.558	0.735	-1.748
	(0.417)	(1.197)	(0.831)	(0.688)	(1.172)	(1.661)	(1.001)	(1.907)
Observations	34	28	34	35	38	42	39	22
R-squared	0.022	0.010	0.003	0.014	0.510	0.387	0.114	0.149
Village Returns:								
Monthly Average	-0.14	1.56	0.36	-0.52	-0.57	1.88	0.87	0.95
Standard Deviation	0.11	0.14	0.23	0.17	0.16	0.12	0.13	0.15

Remarks Unit of observations is household. Beta is computed from a simple time-series regression of household adjusted ROA on village ROA over the 156 months from January 1999 to December 2011. Household's mean adjusted ROA is the time-series average of household adjusted ROA over the same 156 months. Standard errors corrected for generated regressors (Shanken 1992) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.6 Risk and Return Regressions: Network as Market

Dependent Variable:	***Household's Mean ROA***			
Region:	***Central***			
Province:	***Lopburi***			
Village:	***01***	***03***	***04***	***06***
Network:	***03***	***03***	***06***	***01***
Beta	-3.088	3.265	7.366***	5.189***
	(4.302)	(4.033)	(2.383)	(0.881)
Constant	0.433	1.523	0.123	-1.655
	(1.448)	(1.244)	(0.865)	(1.799)
Observations	16	18	20	33
R-squared	0.012	0.041	0.464	0.345
Network Returns:				
Monthly Average	2.03	2.46	2.52	2.85
Standard Deviation	0.20	0.41	0.13	0.35

Region:	***Northeast***				
Province:	***Buriram***		***Srisaket***		
Village:	***13***	***14***	***01***	***06***	***09***
Network:	***03***	***03***	***03***	***02***	***02***
Beta	1.373	0.728	2.842***	3.832**	1.540**
	(0.988)	(1.046)	(0.722)	(1.484)	(0.618)
Constant	-0.249	-0.460	-2.205*	-0.452	0.554
	(0.694)	(0.794)	(1.226)	(1.845)	(1.025)
Observations	23	27	23	37	36
R-squared	0.184	0.015	0.365	0.374	0.134
Network Returns:					
Monthly Average	0.38	-0.52	-0.58	1.88	0.87
Standard Deviation	0.20	0.16	0.14	0.13	0.13

Remarks Unit of observations is household. Beta is computed from a simple time-series regression of household's adjusted ROA on network's ROA over the 156 months from January 1999 to December 2011. Household's mean adjusted ROA is the time-series average of household adjusted ROA over the same 156 months. Standard errors corrected for generated regressors (Shanken 1992) are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.7 Descriptive Statistics of Household Alpha: Township as Market

Province	Number of Observations	Mean	Standard Deviation	Skewness	Kurtosis	Percentiles		
						25th	50th	75th
			Panel A: Return on Assets, Not Adjusted for Risks					
Central								
Chachoengsao	129	1.90	6.51	1.14	4.64	-1.72	0.38	3.99
Lopburi	140	1.37	6.31	-0.93	5.46	-1.67	1.46	3.16
Northeast								
Buriram	131	0.30	3.49	0.24	4.79	-1.32	0.28	1.39
Srisaket	141	2.83	5.87	0.75	5.53	0.21	1.99	4.29
			Panel B: Return on Assets, Adjusted for Aggregate Risks					
Central								
Chachoengsao	129	0.68	5.52	0.44	5.17	-1.75	-0.15	2.59
Lopburi	140	0.28	5.81	-1.47	7.05	-1.98	1.00	3.16
Northeast								
Buriram	131	-0.28	3.60	-0.02	4.54	-1.94	-0.27	1.39
Srisaket	141	-0.11	4.84	0.24	5.76	-1.43	-0.08	1.18
			Panel C: Return on Assets, Adjusted for Aggregate and Idiosyncratic Risks					
Central								
Chachoengsao	129	-0.49	4.52	-0.305	6.09	-2.21	-0.42	1.469
Lopburi	140	-1.54	5.27	-1.87	8.12	-3.49	-0.12	1.493
Northeast								
Buriram	131	-1.36	3.52	-0.73	4.38	-2.75	-0.75	0.54
Srisaket	141	-1.49	4.16	-0.677	5.70	-2.55	-0.72	0.313

Remarks Unit of observations is households. Panel A reports descriptive statistics of rate of return without adjusting for any risk (but adjusted for household's own labor). Panel B report rate of return adjusted for aggregate risks, where risk premium is computed from market's mean ROA (ra), market return on human capital (ry), residual consumption (cay), and their interactions cay*ra and cay*rh, as defined in equation (24) in the text. Panel C report rate of return adjusted for aggregate risks, where risk premium is computed from market's mean ROA (ra), market return on human capital (ry), residual consumption (cay), and their interactions cay*ra and cay*rh, as defined by equation (14b), as well as idiosyncratic risk from sigma, as defined by equation (15b) in the text. For each household, the return in Panels B and C is averaged across 9 shifting time windows. *** $p<0.01$.