Risk and Return in Village Economies

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February 19, 2013

Main Objectives

- Present a model for a study of risk and return of household's productive assets in developing economies

- Application: Measure risk-adjusted return, and use it to analyze productivity of assets of household enterprises

Contribution

- Some development economics literature considers risk faced by households and its enterprises but few (or none) does not consider household risks as a co-movement with the market or aggregate economy
  - This paper defines and measures risk of household assets in a way consistent with economic and finance theory

- Return to household enterprises estimated in many studies may incorporate risk premium as a part of the return, in addition to the measure of productivity
  - Households with higher return could be the households with risky production technology rather than with higher productivity
  - This paper uses risk-adjusted return as a measure of productivity

- In sum, this paper argues for the necessity of high-frequency household survey for the study of risk and return of household enterprises

Summary of Our Findings

- A major prediction from our model seems to hold in townships: Higher risk (as measured by beta) is associated with higher expected (average) return on assets
  - Robust when allowing for time-varying exposure to risk, human capital, and time-varying stochastic discount factor
- In contrary to the predictions from the model, idiosyncratic risk is positively associated with expected return on assets
- We find that exposure to both aggregate and idiosyncratic risks of the household is negatively correlated with average age of household members and initial wealth of the households, and positively associated with household head being male and initial leverage (debt to asset ratio) of the household.
- In addition, aggregate risks are also negatively correlated with the education attainment of the household heads
- Finally, adjusted for risks, the returns on household enterprises tend to be lower for the households with male head and with lower initial wealth

A Basic Model

- *J* households, indexed by *j* = 1, 2,... J
- *I* production activities, indexed by *i* = 1, 2,... I, that utilize capital as the only input
    - Each production technology delivering the same consumption good is linear in capital

- At the beginning of each period, the economy starts with aggregate wealth, *W*, which consists of:
    - The assets held from the previous period ("the trees")
    - The net income generated by all of the assets held by household j, net of depreciation, ("the fruit")

A Basic Model - 2

- The social planner then chooses current transfer to each household *j*,

- The current period consumption of household j is

$$c_j = \sum_{i=1}^{I} r_j^i k_j^i + \tau_j$$

- The social planner also chooses the assets to be allocated to each activity run by the household in the following period

A Basic Model - 3

- The value function of the social planner is

$$V(W) = \max_{\tau_j, k_j^{i\prime}} \left(\sum_{j=1}^{J} \lambda_j u_j \left(\sum_{i=1}^{I} r_j^i k_j^i + \tau_j \right) + \phi E\left[V\left(W^{\prime}\right) \right] \right)$$

subject to aggregate resource constraint

$$\sum_{j=1}^{J} \left(\sum_{i=1}^{I} r_j^i k_j^i + \tau_j \right) + \sum_{j=1}^{J} \sum_{i=1}^{I} k_j^{i\prime} = W,$$

W is the aggregate wealth of the whole economy at the beginning of the current period, i.e.

$$W = \sum_{j=1}^{J} \sum_{i=1}^{I} \left(1 + r_j^i\right) k_j^i$$

A Basic Model - 4

- Therefore, the value function can be rewritten as

$$V\left(\sum_{j=1}^{J}\sum_{i=1}^{I}\left(1+r_j^i\right)k_j^i\right)=\max_{\tau_j,k_j^{i\prime}}\left(\sum_{j=1}^{J}\lambda_j u_j\left(\sum_{i=1}^{I}r_j^i k_j^i+\tau_j\right)+\phi E\left[V\left(\sum_{j=1}^{J}\sum_{i=1}^{I}\left(1+r_j^{i\prime}\right)k_j^{i\prime}\right)\right]\right)$$

subject to the aggregate resource constraint

$$\sum_{j=1}^{J}\tau_j+\sum_{j=1}^{J}\sum_{i=1}^{I}k_j^{i\prime}=\sum_{j=1}^{J}\sum_{i=1}^{I}k_j^i.$$

A Basic Model - 5

- The first-order conditions imply

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

$$[k_j^{i/}] : \phi E\left[V_W\left(W^/\right)\left(1+r_j^{i/}\right)\right] = \mu \qquad \text{for all i and all j}$$

where μ is the shadow price of consumption in the current period

- Note that this setup assumes a close economy
  - We can generalize and allow the economy to have external borrowing and lending, i.e. small-open economy by redefining $\tilde{W} = W - (1+r)D + D^/$

A Basic Model - 6

- Finally, for each i and j, we get

$$1 = \frac{\phi E\left[V_W\left(W'\right)\left(1+r_j^{i'}\right)\right]}{\mu} = E\left[\frac{\phi V_W\left(W'\right)}{\mu}\left(1+r_j^{i'}\right)\right] = E\left[m' R_j^{i'}\right]$$

where $R_j^{i'} = 1 + r_j^{i'}$ and $m' = \dfrac{\phi V_W\left(W'\right)}{\mu}$

A Basic Model - 7

- Remarks:
  - m' is a stochastic discount factor, which is common across households and assets
  - This condition holds for each of the assets allocated to production activity i run by household j, for all i and all j. This equation is equivalent to the “pricing equation” derived in the consumption-based asset pricing model
  - This condition also holds for any of the portfolios constructed by any combinations of the assets for all i and all j
    - The production technology is linear in capital
    - This implication allows us to study the risk and return of household portfolio of assets instead of the risk and return of each individual assets

A Basic Model - 8

- Next, since $E\left[m' R_j^{i'}\right] = E\left[m'\right] E\left[R_j^{i'}\right] + \operatorname{cov}\left(m', R_j^{i'}\right)$, we have

$$1 = E\left[m'\right] E\left[R_j^{i'}\right] + \operatorname{cov}\left(m', R_j^{i'}\right)$$

$$E\left[R_j^{i'}\right] = \frac{1}{E\left[m'\right]} - \frac{\operatorname{cov}\left(m', R_j^{i'}\right)}{\operatorname{var}\left(m'\right)} \frac{\operatorname{var}\left(m'\right)}{E\left[m'\right]}$$

$$E\left[R_j^{i'}\right] = \gamma' + \beta_{m',ij} \lambda_{m',ij}$$

A Basic Model - 9

- We interpret $\beta_{m^{\prime},ij} = -\frac{\operatorname{cov}\left(m^{\prime}, R_j^{i\prime}\right)}{\operatorname{var}\left(m^{\prime}\right)}$ as the "quantity" of the risk of the assets used in activity i by household j that cannot be diversified

- In equilibrium, this risk is compensated by risk premium, which is proportional to the "price" of the risk. The price of the risk is in turn equal to the common (normalized) non-diversifiable aggregate volatility of the economy, as measured by the inverse of the Sharpe ratio of the economy's stochastic discount factor $\lambda_{m^{\prime}} = \frac{\operatorname{var}\left(m^{\prime}\right)}{E\left[m^{\prime}\right]}$

- $\gamma^{\prime}$ is the risk-free rate, i.e. the rate of return on zero-beta assets with $\operatorname{cov}\left(m^{\prime}, R_f^{\prime}\right) = 0$

$$R_f^{\prime} = \gamma^{\prime} = \frac{1}{E\left[m^{\prime}\right]}$$

A Basic Model - 10

- Interpretation:
  - $\beta_{M,ij} = \frac{\text{cov}\left(R_M^{/}, R_j^{i/}\right)}{\text{var}\left(R_M^{/}\right)}$ = "quantity" of the risk of the assets used in activity i by household j that cannot be diversified
  - $\lambda_M = E\left[R_i^{j/}\right] - \gamma^{/}$ = "price" of aggregate risk, as measured by market excess return
  - $\gamma^{/}$ = return on risk-free assets, i.e. the rate of return on zero-beta assets
- In equilibrium, aggregate risk is compensated by risk premium, which is proportional to the "price" of the risk. The price of the risk is in turn equal to the common (normalized) non-diversifiable aggregate volatility of the economy

A Special Case: Quadratic Value Function

- We consider a special case of quadratic value function

$$V(W) = -\frac{\eta}{2}\left(W - W^*\right)^2,$$

which implies

$$V_W\left(W'\right) = -\eta\left(W' - W^*\right) = -\eta\left(\sum_{j=1}^{J}\sum_{i=1}^{I} R_j^{i\prime} k_j^{i\prime} - W^*\right) = -\eta\left(R_M' k_M' - W^*\right)$$

where

$$k_M' = \sum_{j=1}^{J}\sum_{i=1}^{I} k_j^{i\prime}$$

$$R_M' \equiv \frac{\sum_{j=1}^{J}\sum_{i=1}^{I} R_j^{i\prime} k_j^{i\prime}}{\sum_{j=1}^{J}\sum_{i=1}^{I} k_j^{i\prime}} = \frac{\sum_{j=1}^{J}\sum_{i=1}^{I} R_j^{i\prime} k_j^{i\prime}}{k_M'}$$

A Special Case: Quadratic Value Function - 2

- In this case, we have

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

or $m' = a - bR_M'$,

- Since $E\left[R_j^{i\prime}\right] = \frac{1}{E\left[m'\right]} - \frac{\operatorname{cov}\left(m', R_j^{i\prime}\right)}{\operatorname{var}\left(m'\right)} \frac{\operatorname{var}\left(m'\right)}{E\left[m'\right]}$

we have

$$E\left[R_j^{i\prime}\right] = \gamma' - \frac{\operatorname{cov}\left(a - bR_M', R_j^{i\prime}\right)}{\operatorname{var}\left(a - bR_M'\right)} \frac{\operatorname{var}\left(a - bR_M'\right)}{E\left[a - bR_M'\right]}$$

$$E\left[R_j^{i\prime}\right] = \gamma' + \frac{\operatorname{cov}\left(R_M', R_j^{i\prime}\right)}{\operatorname{var}\left(R_M'\right)} \left(\frac{b \operatorname{var}\left(R_M'\right)}{a - bE\left[R_M'\right]}\right)$$

A Special Case: Quadratic Value Function - 3

- Finally, in this case we have a linear relationship between the expected return of an asset and its risk as measured by the comovement with the aggregate return

$$E\left[R_i^{j\prime}\right] = \gamma^{\prime} + \beta_{M,ij}\lambda_M$$

where $\beta_{M,ij} = \dfrac{\operatorname{cov}\left(R_M^{\prime}, R_j^{i\prime}\right)}{\operatorname{var}\left(R_M^{\prime}\right)}$

- This condition is equivalent to the relationship between risk and expected return derived in the traditional Capital Asset Pricing Model (CAPM) in asset pricing literature

Complete Market Environments

- Mechanisms behind Complete Market Outcome: Tradable Assets versus Consumption Reallocation
  - Although our empirical counterpart is parallel to what has been done in traditional CAPM literature, the mechanisms that deliver the predicted allocation outcomes are different
  - Finance literature assumes that households (investors) have access to complete markets that allow them to trade their assets ex ante
    - Optimally allocated assets deliver the returns that the household uses to finance its consumption, ultimately maximizing its utility

Complete Market Environments - 3

- In this study, households do not necessarily trade their assets ex ante, but given asset holding, complete markets in this economy arise from transfers between households in the economy that result in optimal ex post consumption allocation across household, i.e. consumption allocation under full risk sharing
    - These transfers could be through formal or informal financial markets, or through gifts within social networks
    - As long as these mechanisms leading to full risk sharing exists, then the return on assets held by each household must satisfy the Euler equation

Complete Market Environments - 4

- Chiappori, Samphantharak, Schulhofer-Wohl, and Townsend (2012) find evidence of nearly complete risk sharing for households with relatives living in the same village
    - Consistent with studies by Samphantharak and Townsend (2010), and Kinnan and Townsend (2011)
    - Similar to the findings in Angelucci, De Giorgi, and Rasul (2011) for Mexico

- Evidently, informal village institutions in Thailand provide risk sharing similar to what is assumed in our model (and also implicitly assumed when researchers test capital asset pricing models using data from the modern financial markets)

Data

- Townsend Thai Monthly Survey
    - Monthly panel data
    - Integrated household survey in rural Thailand
    - 4 townships (each with 4 villages) from 4 different provinces
        - Chachoengsao and Lopburi provinces in the more-developed Central region near the capital Bangkok
        - Buriram and Srisaket provinces in the less-developed Northeastern region by the border of Cambodia

Data - 2

- Overall sample in the survey:
    - Survey started in August 1998 with a baseline survey; monthly updates began in September 1998 (month 1); still on-going (currently month 174)
    - About 45 households in each village
- Sample included in this paper:
    - Month 5 to month 160
        - 156 months (13 full years); Jan 1999-Dec 2011
    - Only households present for the entire 156-month period are included in this study: 541 households
- Salient feature of households: Pervasive networks of extended families

Table 1 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 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. The revenues are computed from all of the 156 months (January 1999 to December 2011).

Table 3 Descriptive Statistics of Household Characteristics, By Township

	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
Max 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
Max 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.

Return on Assets

- We use return on household total assets from all productive activities
  - Crop cultivation; livestock; fish & shrimp farming; and household business
  - Include both real and financial assets held by the households
  - Do not attempt to separate returns on different types of assets, i.e. consider household assets as portfolio of productive assets used in various activities

- We use average return on assets
  - Do not attempt to estimate production function in this paper
  - In effect assuming linear production technology, i.e. average return equals to marginal return

Return on Assets - 2

- Construction of ROA
  - Step 1: Construction of household financial accounts by household, by month
    - Samphantharak and Townsend, *Households as Corporate Firms*, 2010
  - Step 2: Compute "adjusted net income"
    - Net income subtracts compensation to household own labor
    - Townsend and Yamada, 2008
  - Step 3: Compute "adjusted ROA" = Adjusted net income divided by household total fixed assets
    - ROA is real return, adjusted for inflation using regional inflation rates from Bank of Thailand

Table 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***			
Unadjusted ROA								
Mean	129	-0.52	1.81	6.62	140	1.95	5.03	9.98
Standard Deviation	129	3.90	7.48	16.60	140	10.24	16.54	24.75
Sharpe Ratio	129	0.24	0.37	0.59	140	0.19	0.32	0.50
Adjusted ROA								
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
Sharpe Ratio	129	0.18	0.32	0.50	140	0.11	0.21	0.31
Region:	***Northeast***							
Province (Township):	***Buriram***				***Srisaket***			
Unadjusted ROA								
Mean	131	0.18	2.02	4.78	141	2.78	5.15	9.58
Standard Deviation	131	8.68	13.98	22.90	141	10.60	17.77	31.20
Sharpe Ratio	131	0.09	0.16	0.26	141	0.21	0.29	0.41
Adjusted ROA								
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
Sharpe Ratio	131	0.06	0.11	0.25	141	0.09	0.17	0.25

Remarks Unit of observations is households. Unadjusted ROA is return on total assets, not adjusted for household's labor contribution to their own business enterprises, reported in annualized percentage. Mean and standard deviation of ROA are computed from monthly adjusted ROA for each household over 156 months (January 1999 to December 2011). Sharpe ratio is computed as the standard deviation of ROA divided by absolute value of the mean ROA. Adjusted ROA is return on total assets, adjusted for household's labor contribution to their own business enterprises.

Risk and Return: Township as Market

- Assumptions:
  - Risk-free rate = 0 (*Rf* = 1)
    - Assume that households hold assets with returns co-moving with inflation, i.e. assets with real zero return
    - Relax this assumption later
  - Expected returns computed from time-series average over 156 months
  - Market = Village
    - Market return Rm = Average township ROA
      - For each household, the corresponding average township ROA excludes household's own ROA (to minimize problem from measurement errors)
    - Extensions: Use province and entire sample as market instead

Risk and Return: Township as Market - 2

- Step 1: Compute household beta from a simple time-series regression for each HH

$$R^{l}_{j,t} = \alpha_j + \beta_j R_{M,t} + \varepsilon_{j,t}$$

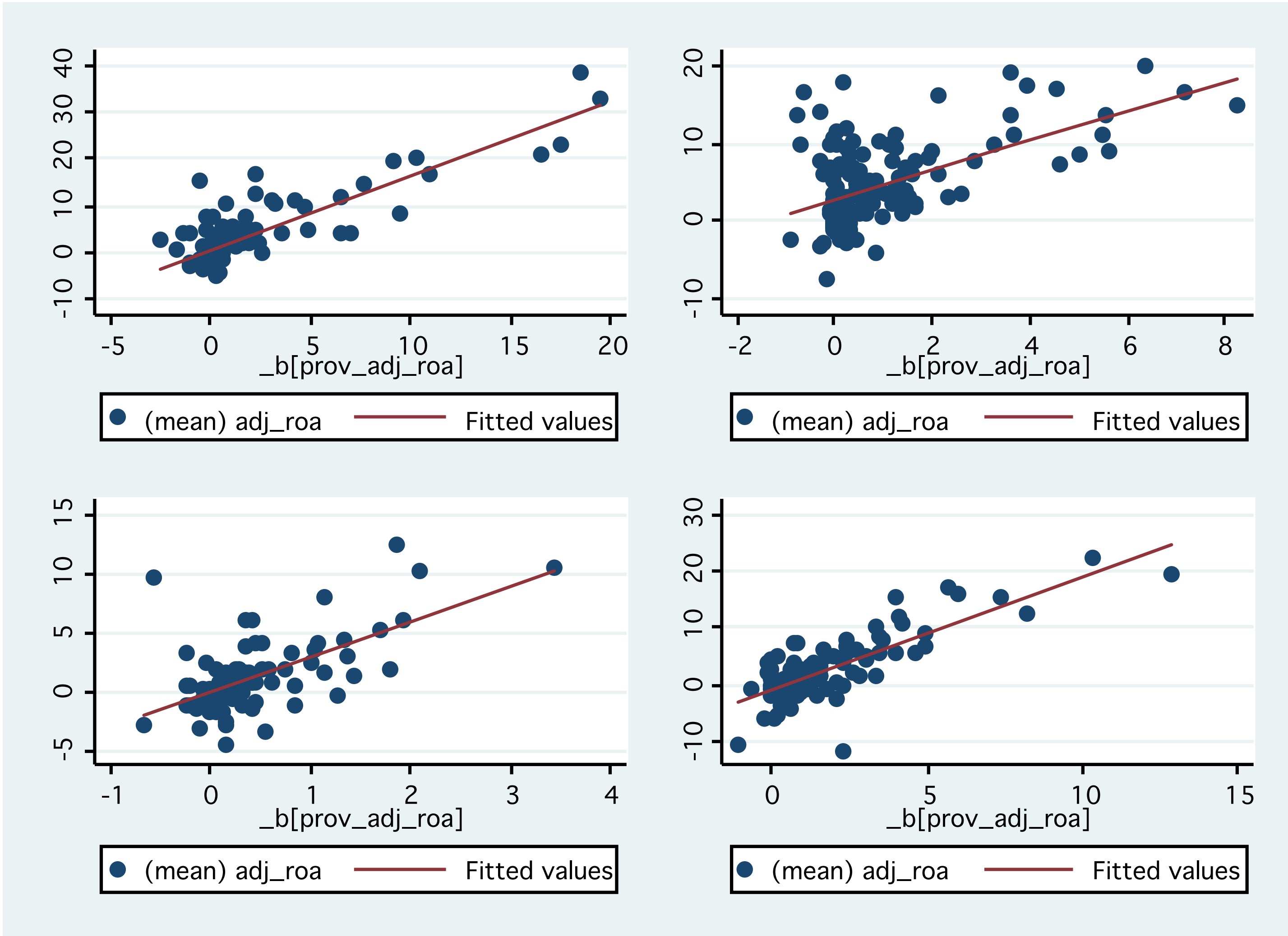
- Step 2: Cross-sectional regression for each township, using time-series average $\overline{R^{l}_{j}} = \sum_{t=1}^{T} R^{l}_{j,t}$ as proxy for expected return $E\left(R^{j}\right)$

$$\overline{R^{l}_{j}} = \alpha + \lambda \beta_j + \eta_j .$$

- In theory, the null hypotheses from the model are that , $\lambda = E\left(R_M\right)$ and that the constant term α is zero

Table 5 Risk and Return Regressions: Township as Market

	Household's Mean ROA			
	Panel A: Constant Beta			
Region:	***Central***		***Northeast***	
Township (Province):	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***
Beta	2.135***	2.465***	0.432	2.335***
	(0.271)	(0.266)	(0.316)	(0.337)
Constant	-0.535	-0.503	-0.122	-0.847
	(0.479)	(0.513)	(0.369)	(0.665)
Observations	129	140	131	141
R-squared	0.467	0.210	0.017	0.297
Township Returns:				
Monthly Average	1.68	2.49	0.15	0.80
Standard Deviation	0.07	0.10	0.10	0.10



Panel A: Township as Market

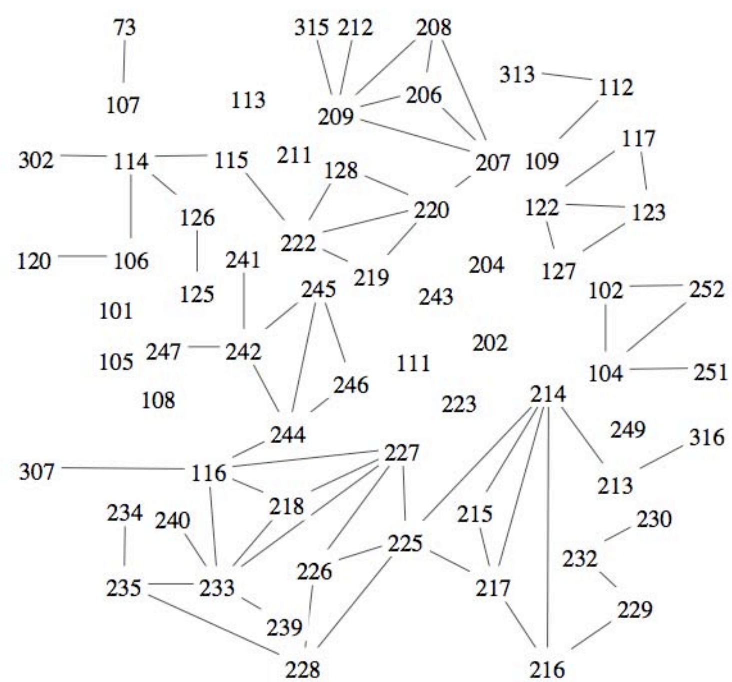
Remarks: Horizontal Axis = Beta; Vertical Axis = Expected Return. Each graph represents each of the four provinces. We treat each province as the market. Top left chart is Chachoengsao; top right is Buriram; bottom left is Lopburi; and bottom right is Srisaket.

Risk and Return: Township as Market - 5

- Findings:
  - A major implication of the model captures a substantial part of the data. In particular, higher risk, as measured by the co-movement of household ROA and village ROA, is associated with higher average return
  - The main results hold for 9 out of 16 when we re-define the “market” from township to village, and 5 out of 9 when we re-define the “market” from township to network
  - The results are robust when we extend the model to capture time-varying beta (exposure to risks), human capital, and time-varying stochastic discount factor

- Alternative definitions of “market”: Extended kinship networks between households within the same village

Figure 1 Example of Kinship Network Map from a Village in Buriram Province



Remarks: Numbers denote the structure number in which each household lives. Lines connecting numbers denote kinship relationship between households.

Table A.2 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***
	(5.808)	(5.023)	(2.304)	(0.976)
Constant	0.433	1.523	0.123	-1.655
	(1.394)	(1.222)	(0.816)	(1.908)
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**
	(1.019)	(1.335)	(0.693)	(1.653)	(0.614)
Constant	-0.249	-0.460	-2.205*	-0.452	0.554
	(0.702)	(0.875)	(1.128)	(1.932)	(0.984)
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

Table A.1 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***
	(0.375)	(0.418)	(2.672)	(1.034)	(2.919)	(1.963)	(1.040)	(0.810)
Constant	-1.105	-0.333	-0.739	1.162	-0.827	0.312	0.257	-1.629
	(0.867)	(0.679)	(0.790)	(1.097)	(1.131)	(0.886)	(0.612)	(1.438)
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**
	(1.263)	(1.114)	(0.737)	(1.508)	(0.450)	(1.265)	(0.658)	(0.934)
Constant	-0.628*	0.346	0.684	-0.541	-2.407**	-0.558	0.735	-1.748
	(0.370)	(0.996)	(0.843)	(0.780)	(1.094)	(1.525)	(1.035)	(1.870)
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. Each column reports a regression result for each village in the four province. Household's mean adjusted ROA is the average of household adjusted ROA over the 156 months from January 1999 to December 2011. Adjusted 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. The adjusted ROA is then annualized and presented in percentage points. Beta is computed from a simple time-series regression of household adjusted ROA on village ROA over the 156 months. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Critique: Time-Varying Exposure to Risks

- Households in our sample likely changed the (composition of) assets and production activities during the 156-month period
  - Consequently, the risks faced by households (betas) were not constant
- We allow for time-varying beta by using an empirical strategy similar to Black, Jensen and Scholes (1972)
  - Perform our empirical analysis on the subsamples of 60 months (5 years) at a time
  - Specifically, we estimate household's and expected return using the time-series data from month 5 to month 64 (years 1-5) for all households; 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 all of the estimated and expected return from all of the 9 sub-periods, we finally estimate the risk-expected return equation

Table 5 Risk and Return Regressions: Township as Market

	Household's Mean ROA			
	Panel B: Time-Varying Beta			
Region:	***Central***		***Northeast***	
Township (Province):	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***
Beta	1.250***	2.307***	0.530***	1.888***
	(0.0988)	(0.126)	(0.121)	(0.191)
Constant	-0.325*	-0.631***	-0.782***	-1.114***
	(0.197)	(0.215)	(0.152)	(0.350)
Observations	1,161	1,260	1,179	1,269
R-squared	0.330	0.204	0.019	0.260
Township Returns:				
Monthly Average	1.19	2.40	-0.07	1.04
Standard Deviation	0.75	1.47	0.54	0.75

Critique: Return to Aggregate Human Capital

- The model presented earlier in this paper implies that household beta captures all of the aggregate, non-diversifiable risk faced by the household
- It is possible that there is an 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
- We address this issue by computing an additional household beta with respect to return to aggregate human capital, *h*, proxied by the change in aggregate labor income of all households in the economy (Jagannathan and Wang 1996)

Critique: Return to Aggregate Human Capital - 2

- Step 1: Compute household beta from a simple time-series regression for each household

$$R^{l}_{j,t} = \alpha_{j} + \beta^{a}_{j} R^{a}_{M,t} + \beta^{h}_{j} R^{h}_{M,t} + \varepsilon_{j,t}$$

- Step 2: Cross-sectional regression for each township, using time-series average $\overline{R^{l}_{j}} = \sum_{t=1}^{T} R^{l}_{j,t}$ as proxy for expected return $E\left(R^{j}\right)$

$$\overline{R^{l}_{j}} = \alpha + \lambda^{a}\widehat{\beta^{a}_{j}} + \lambda^{h}\widehat{\beta^{h}_{j}} + \eta_{j}\,.$$

Critique: Time-Varying Stochastic Discount Factor

- Similar to the traditional CAPM in finance literature, our model assumes that parameters that determine stochastic discount factors are time-invariant when we take the model to the empirical analysis
- However, parameters are in theory determined by the shadow price of consumption goods, which likely moves over time as the aggregate consumption of the economy changes
- In order to capture this time-varying stochastic discount factor, we follow a strategy introduced by Lettau and Ludvigson (2001a and 2001b) who show that the stochastic discount factor is a function of 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*

$$cay_t = c_t - w_t = c_t - \omega a_t - (1-\omega) y_t ,$$

Critique: Time-Varying Stochastic Discount Factor - 2

- Step 1: Estimate *cay* from a time-series regression of aggregate variable for each township

$$\widehat{cay}_t = c_t^* - \widehat{\omega} a_t^* - \hat{\theta} y_t^* - \hat{\delta},$$

- Step 2: Compute household beta from a simple time-series regression for each household

$$R_{j,t}^{l} = \alpha_j + \beta_j^a R_{M,t}^a + \beta_j^h R_{M,t}^h + \beta_j^{cay} \widehat{cay}_t + \beta_j^{cay*a} (\widehat{cay}_t \cdot R_{M,t}^a) + \beta_j^{cay*h} (\widehat{cay}_t \cdot R_{M,t}^h) + \varepsilon_{j,t}$$

- Step 3: Cross-sectional regression for each township, using time-series average $\overline{R_j^l} = \sum_{t=1}^{T} R_{j,t}^l$ as proxy for expected return $E\left(R^j\right)$

$$\overline{R_j^l} = \alpha + \lambda^a \widehat{\beta_j^a} + \lambda^h \widehat{\beta_j^h} + \lambda^{cay} \widehat{\beta_j^{cay}} + \lambda^{cay*a} \widehat{\beta_j^{cay*a}} + \lambda^{cay*h} \widehat{\beta_j^{cay*h}} + \eta_j.$$

Table 6 Risk and Return Regressions with Human Capital and Time-Varying Stochastic Discount Factor: Township as Market

Dependent Variable:	***Household's Mean ROA***							
Region:	***Central***		***Northeast***		***Central***		***Northeast***	
Province:	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***	***Chachoengsao***	***Lopburi***	***Buriram***	***Srisaket***
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)	(0.0840)	(0.139)	(0.131)	(0.162)	(0.0755)	(0.151)	(0.0971)	(0.169)
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)	(0.0182)	(0.0223)	(0.0454)	(0.0615)	(0.0166)	(0.0210)	(0.0334)	(0.0469)
Beta with respect to					-0.00441	0.00246	0.0333**	0.0789***
residual log consumption (cay)					(0.0138)	(0.00797)	(0.0150)	(0.0188)
Beta with respect to					-0.00533	-0.0304	-0.131***	-0.101**
the interaction cay*ra					(0.0220)	(0.0448)	(0.0392)	(0.0425)
Beta with respect to					0.00134	-0.000574	0.0109	-0.0130
the interaction cay*rh					(0.00176)	(0.00187)	(0.00712)	(0.00839)
Constant	-0.307*	-0.584***	-0.757***	-1.080***	-0.156	-0.464*	-0.589***	-1.164***
	(0.181)	(0.223)	(0.169)	(0.288)	(0.169)	(0.242)	(0.156)	(0.294)
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

Idiosyncratic Risk

- Our model and empirical strategy allow us to decompose total risks faced by the households and their enterprises into two components: aggregate (nondiversifiable) risk and idiosyncratic (diversifiable) risk

$$R_{j,t}' = X_{M,t}'\beta_j + \varepsilon_{j,t}$$

$$\mathrm{var}(R_j') = \beta_j'\Omega_M\beta_j + \mathrm{var}(\varepsilon_j),$$

Risk Premium and Risk-Adjusted Returns - 2

- In effect, non-zero alpha is a part of expected return that is not explained by household's exposure to aggregate risk (as measured by household beta)

- We use household alpha as our measure of beta-adjusted return to compare productivity of assets across household enterprises
  - Parallel to Jensen's alpha in finance, used by financial practitioners as a measure of "abnormal" returns
  - Measure of performance of securities or fund managers

- Empirically, we compute 2 versions of household alpha
  - Expected return adjusted for aggregate risk (beta)
  - Expected return adjusted for aggregate risk (beta) AND idiosyncratic risk (sigma)

Idiosyncratic Risk

- Recall that the model implies that only aggregate risk matters for expected return, and idiosyncratic risk is completely shared across households and is not priced

$$R'_{j,t} = X'_{M,t}\beta_j + \varepsilon_{j,t}$$

- However, if complete market assumption does not hold, then idiosyncratic risk is not completely shared and could be compensated
  - Empirically, compute idiosyncratic risk as the standard deviation of $\widehat{\varepsilon_{j,t}}$ from the time-series regression above, called it household sigma, σ_j
  - (Cross-sectional) test whether expected return is associated with σ_j

$$\overline{R'_j} = \alpha + \lambda'\beta_j + \theta\sigma_j + \eta_j.$$

Table 7 Decomposition of Risks

	Number of Observations	Percentiles 25th	50th	75th	Number of Observations	Percentiles 25th	50th	75th
Region:				***Central***				
Township (Province):		Chachoengsao					Lopburi	
Systematic Risk	1,161	0.072	0.135	0.242	1,260	0.057	0.109	0.216
Idiosyncratic Risk	1,161	0.758	0.865	0.928	1,260	0.784	0.891	0.943
Region:				***Northeast***				
Township (Province):		Buriram					Srisaket	
Systematic Risk	1,179	0.086	0.164	0.293	1,269	0.194	0.428	0.670
Idiosyncratic Risk	1,179	0.707	0.836	0.914	1,269	0.330	0.572	0.806

Table 8 Aggregate Risk, Idiosyncratic Risk, and Rate of Return: Township as Market

Dependent Variable:	*Household's Mean ROA*			
Region:	*Central*		*Northeast*	
Township (Province):	*Chachoengsao*	*Lopburi*	*Buriram*	*Srisaket*
Beta with respect to	0.274***	1.063***	-0.00632	1.228***
return on market physical capital (ra)	(0.0970)	(0.148)	(0.116)	(0.122)
Beta with respect to	-0.00129	0.0617***	-0.0389	0.0850**
return on market human capital (rh)	(0.0134)	(0.0142)	(0.0322)	(0.0353)
Beta with respect to	-0.00616	-0.00201	0.0199*	0.0484***
residual log consumption (cay)	(0.00997)	(0.00654)	(0.0116)	(0.0159)
Beta with respect to	-0.00388	0.0107	-0.0955***	-0.0641*
the interaction cay*ra	(0.0128)	(0.0435)	(0.0274)	(0.0388)
Beta with respect to	0.000155	-0.00143	0.00725	-0.0126
the interaction cay*rh	(0.00113)	(0.00137)	(0.00616)	(0.00844)
Sigma	0.319***	0.256***	0.172***	0.202***
	(0.0305)	(0.0158)	(0.0207)	(0.0211)
Constant	-2.198***	-3.667***	-2.422***	-2.728***
	(0.204)	(0.240)	(0.193)	(0.217)
Observations	1,161	1,260	1,179	1,269
R-squared	0.478	0.325	0.166	0.406

Risk Premium and Risk-Adjusted Returns

- Although empirical tests of CAPM yield less than satisfactory results, practitioners use CAPM to compute risk premium and risk-adjusted return

- We apply similar idea to our study

- Recall the cross-sectional regression

$$R'_{j,t} = \alpha_j + \beta_j R'_{M,t} + \varepsilon_{j,t}$$

- One of the null hypotheses of is that, for all HH *i*,

$$\alpha_j = 0$$

Risk Premium and Risk-Adjusted Returns - 2

- In effect, non-zero alpha is a part of expected return that is not explained by household's exposure to aggregate risk (as measured by household beta)

- We use household alpha as our measure of beta-adjusted return to compare productivity of assets across household enterprises
  - Parallel to Jensen's alpha in finance, used by financial practitioners as a measure of "abnormal" returns
  - Measure of performance of securities or fund managers

- Empirically, we compute 2 versions of household alpha
  - Expected return adjusted for aggregate risk (beta)
  - Expected return adjusted for aggregate risk (beta) AND idiosyncratic risk (sigma)

Table 9 Descriptive Statistics of Household Alpha: Township as Market

Province	Number of Observations	Mean	Standard Deviation	Percentiles			Spearman's Rank Correlation with Simple ROA
				25th	50th	75th	
				Panel A: ROA, Adjusted for Aggregate Risks			
Central							
Chachoengsao	129	-0.21	4.87	-2.03	-0.38	1.30	0.8765***
Lopburi	140	-0.57	5.63	-2.78	0.08	2.22	0.7606***
Northeast							
Buriram	131	-0.22	4.14	-1.96	-0.26	1.47	0.8539***
Srisaket	141	1.43	5.93	-0.64	0.87	2.67	0.9663***
				Panel B: ROA, Adjusted for Aggregate and Idiosyncratic Risks			
Central							
Chachoengsao	129	-3.28	4.94	-4.55	-1.93	-0.79	0.3609***
Lopburi	140	-4.35	5.58	-6.81	-3.14	-0.72	0.4812***
Northeast							
Buriram	131	-2.52	4.05	-4.36	-1.95	-0.61	0.7585***
Srisaket	141	-2.20	4.81	-3.33	-1.14	-0.02	0.7727***

Remarks Unit of observations is households. ROA adjusted for aggregate risks is a household average of a time-varying constant terms from the regressions of household's ROA on market's mean ROA (ra), market return on human capital (rh), residual consumption (cay), and their interactions cay*ra and cay*rh over 156 months from January 1999 to December 2011. ROA adjusted for aggregate and idiosyncratic risks is the ROA adjusted for aggregate risks as described above, and further adjusted for the standard deviation of the error terms in the first-stage regressions.

Risk Premium and Risk-Adjusted Returns - 4

- Findings:
  - Exposure to both aggregate and idiosyncratic risks of the household is negatively correlated with average age of household members and initial wealth of the households, and positively associated with household head being male and initial leverage (debt to asset ratio) of the household.
  - Aggregate risks are also negatively correlated with the education attainment of the household heads
  - Adjusted for risks, the returns on household enterprises tend to be lower for the households with male head and with lower initial wealth

Table 10 Determinants of Rate of Returns and Risks

Dependent Variable:	**Rate of Return**				**Risk**	
Adjusted for Household's Own Labor	**No**	**Yes**	**Yes**	**Yes**	**Beta**	**Sigma**
Adjusted for Aggregate Risk	**No**	**No**	**Yes**	**Yes**	**(Aggregate Risk)**	**(Idiosyncratic Risk)**
Adjusted for Idiosyncratic Risk	**No**	**No**	**No**	**Yes**		
Household Size (Aged 15-64)	0.203	-0.154	-0.190	-0.280	0.00465	0.433
	(0.353)	(0.323)	(0.307)	(0.277)	(0.0936)	(0.577)
Average Age of Household Members	-0.0413	-0.00938	0.00136	0.0246	-0.0170*	-0.0925**
	(0.0296)	(0.0254)	(0.0234)	(0.0215)	(0.00877)	(0.0464)
Education of Household Head	-0.374***	-0.287**	-0.230*	-0.174	-0.0722**	-0.203
	(0.126)	(0.145)	(0.135)	(0.122)	(0.0296)	(0.182)
Household Head Gender (Male=1)	0.877	0.258	-0.155	-0.854*	0.771***	2.191*
	(0.727)	(0.565)	(0.505)	(0.467)	(0.195)	(1.149)
Initial Wealth	-0.0586*	0.00206	0.0234	0.0664*	-0.0219**	-0.139**
	(0.0306)	(0.0167)	(0.0206)	(0.0352)	(0.0105)	(0.0618)
Initial Leverage	9.661**	3.823	2.377	-5.061	2.165*	28.95***
	(4.325)	(3.045)	(2.945)	(3.915)	(1.267)	(9.632)
Constant	6.628***	2.528	1.442	-1.753	1.475***	12.84***
	(2.097)	(1.807)	(1.739)	(1.591)	(0.526)	(2.958)
Township Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	483	483	483	483	483	483
R-squared	0.111	0.032	0.035	0.079	0.098	0.147

Remarks Beta is with respect to aggregate return on physical assets. Initial wealth is in baht. Initial leverage is initial total liabilities divided by initial total assets.

Conclusion

- A major prediction from our model seems to hold in townships: Higher risk (as measured by beta) is associated with higher expected (average) return on assets
    - Main result holds in several subsamples when using village and kinship network as definition of market
    - Main result is robust when allowing for human capital and time-varying stochastic discount factor
- In contrary to the predictions from the model, idiosyncratic risk is positively associated with expected return on assets
- Exposure to both aggregate and idiosyncratic risks of the household is negatively correlated with average age of household members and initial wealth of the households, and positively associated with household head being male and initial leverage (debt to asset ratio) of the household.
- Aggregate risks are also negatively correlated with the education attainment of the household heads
- Adjusted for risks, the returns on household enterprises tend to be lower for the households with male head and with lower initial wealth

Down or Out:

Assessing the Welfare Costs of Household Investment Mistakes

Laurent Calvet, John Y. Campbell, and Paolo Sodini

Outline

- Household Finance: The Measurement Challenge
- Our Unique Dataset
- Who Participates and How Much?
- How Well Diversified Are They?
- Mean-Variance Analysis for Household Portfolios
- Who Diversifies?
- Conclusions

Investment Mistakes

- Our approach: gaps between standard models and observed decisions are investment mistakes.
- Households may make them, but can (we hope) be educated out of them.
- Major examples:
  - Underdiversification (“Down”)
  - Nonparticipation (“Out”)
- We will measure the welfare costs of these mistakes at the household level.

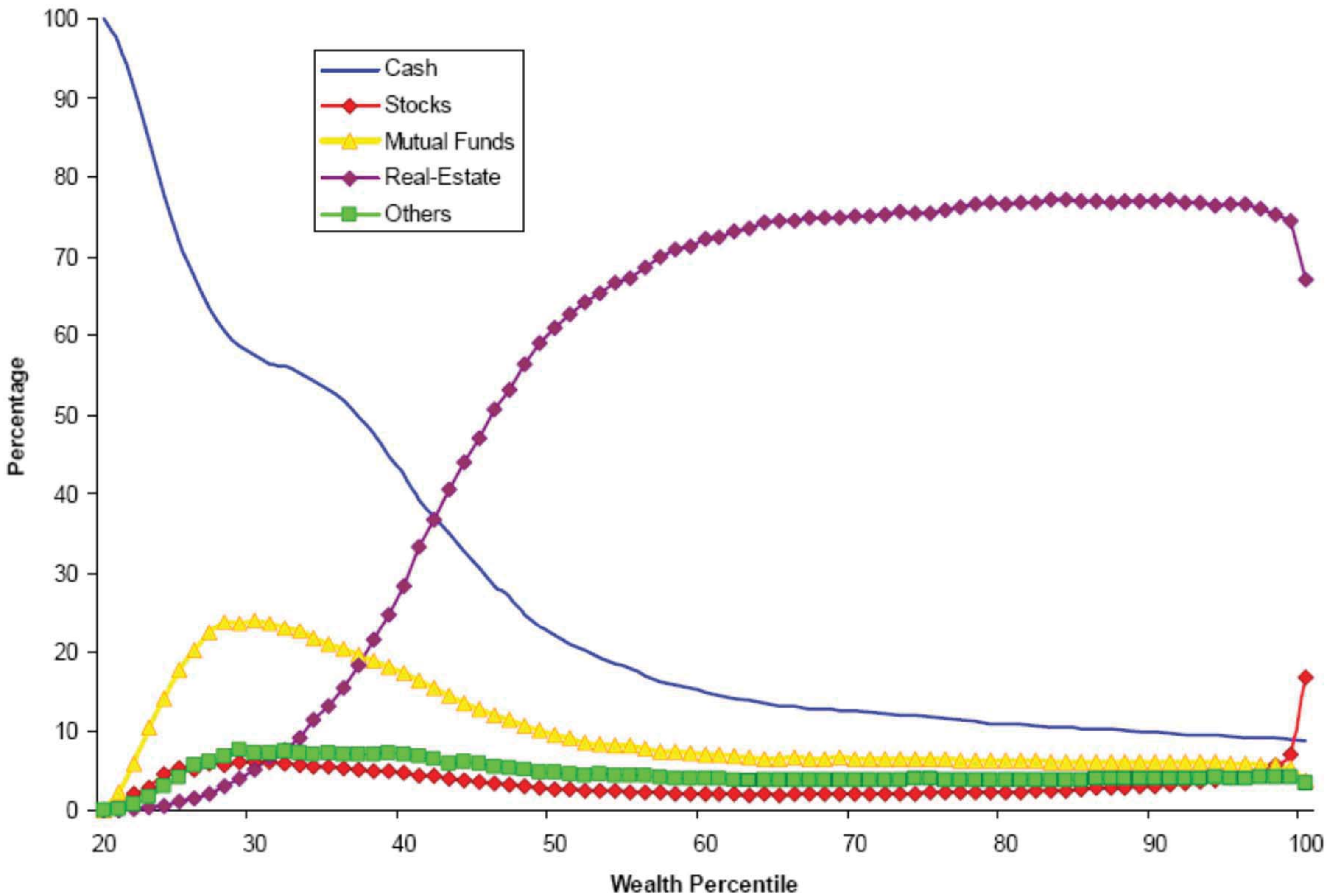
Data Coverage

For each household, we have

- Demographic data (age, gender, marital status, household size, education, birthplace, residence)
- Asset data (holdings at the end of the year and sales during the year), coded by ISIN
- Flow data (labor income, pension income, welfare payments, capital income by assets, interest paid, and private pension savings).

FIGURE 2. COMPOSITION OF FINANCIAL AND REAL ESTATE PORTFOLIO

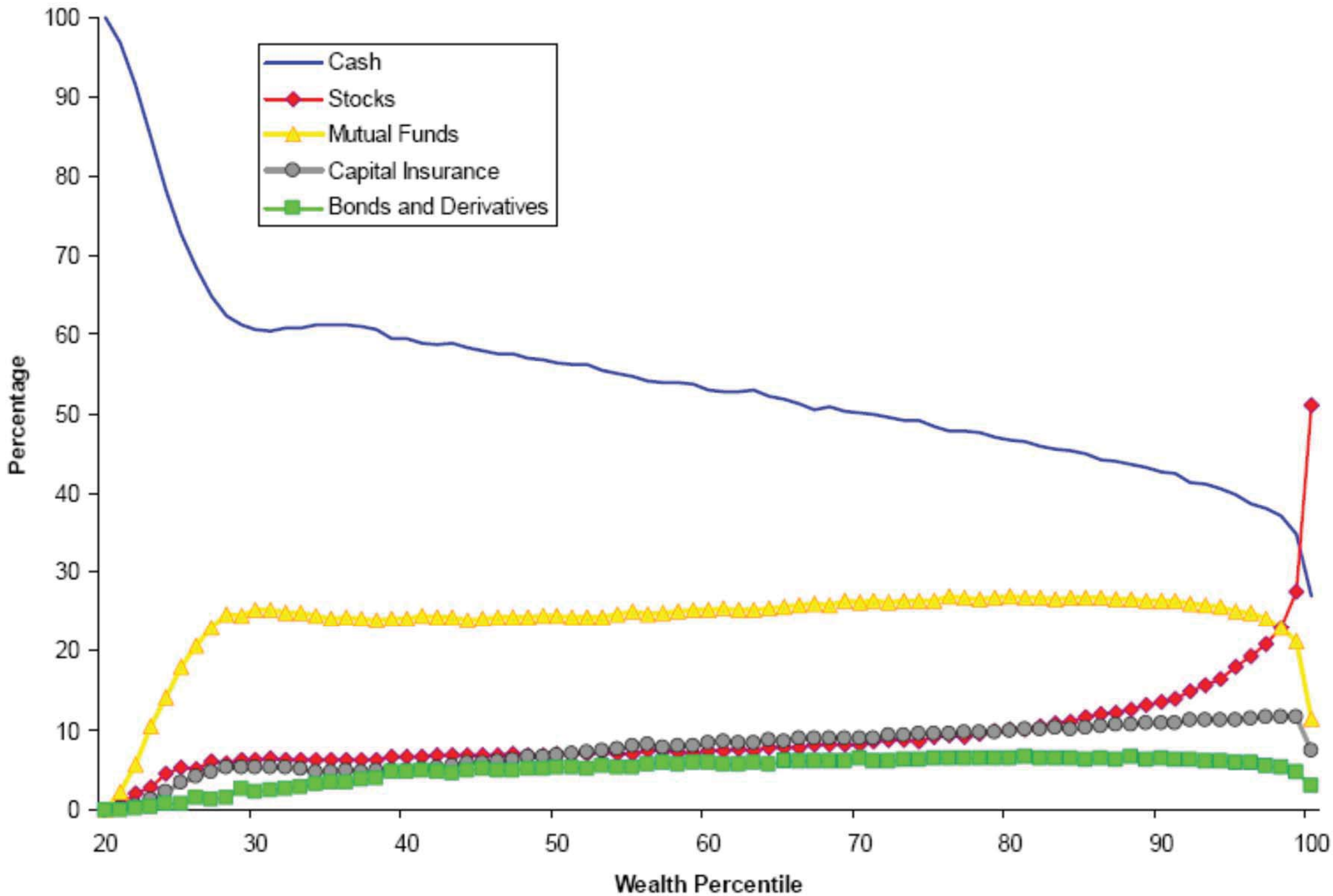
A. Variation with Gross Wealth



Courtesy of Laurent E. Calvet, John Y. Campbell, and Paolo Sodini. Used with permission.

FIGURE 3. COMPOSITION OF FINANCIAL PORTFOLIO

A. Variation with Gross Wealth



Courtesy of Laurent E. Calvet, John Y. Campbell, and Paolo Sodini. Used with permission.

Asset Allocation in Sweden

- There are four main types of households in Sweden:
  - Poor households with only cash
  - Households saving to buy a house, using both safe and risky assets
  - Homeowners with few financial assets
  - Rich households

Sources of Idiosyncratic Risk

Equal Treatment of All Assets

- We can log-linearize the equation to get

$$\ln(\sigma_{i,h}) \approx \ln(\sigma_{a,h}) + \frac{1}{2}\ln(C_{a,h}) + \frac{1}{2}\left(\frac{1}{\overline{C_a}} - 1\right)\rho_{a,h}$$

(R^2 = 98%)

- Households who fail to diversify might fail by:
  - picking volatile assets
  - holding a concentrated portfolio
  - picking correlated assets.

Sources of Idiosyncratic Risk

Separate Treatment of Stocks and Mutual Funds

- Assume mutual funds have no idiosyncratic risk

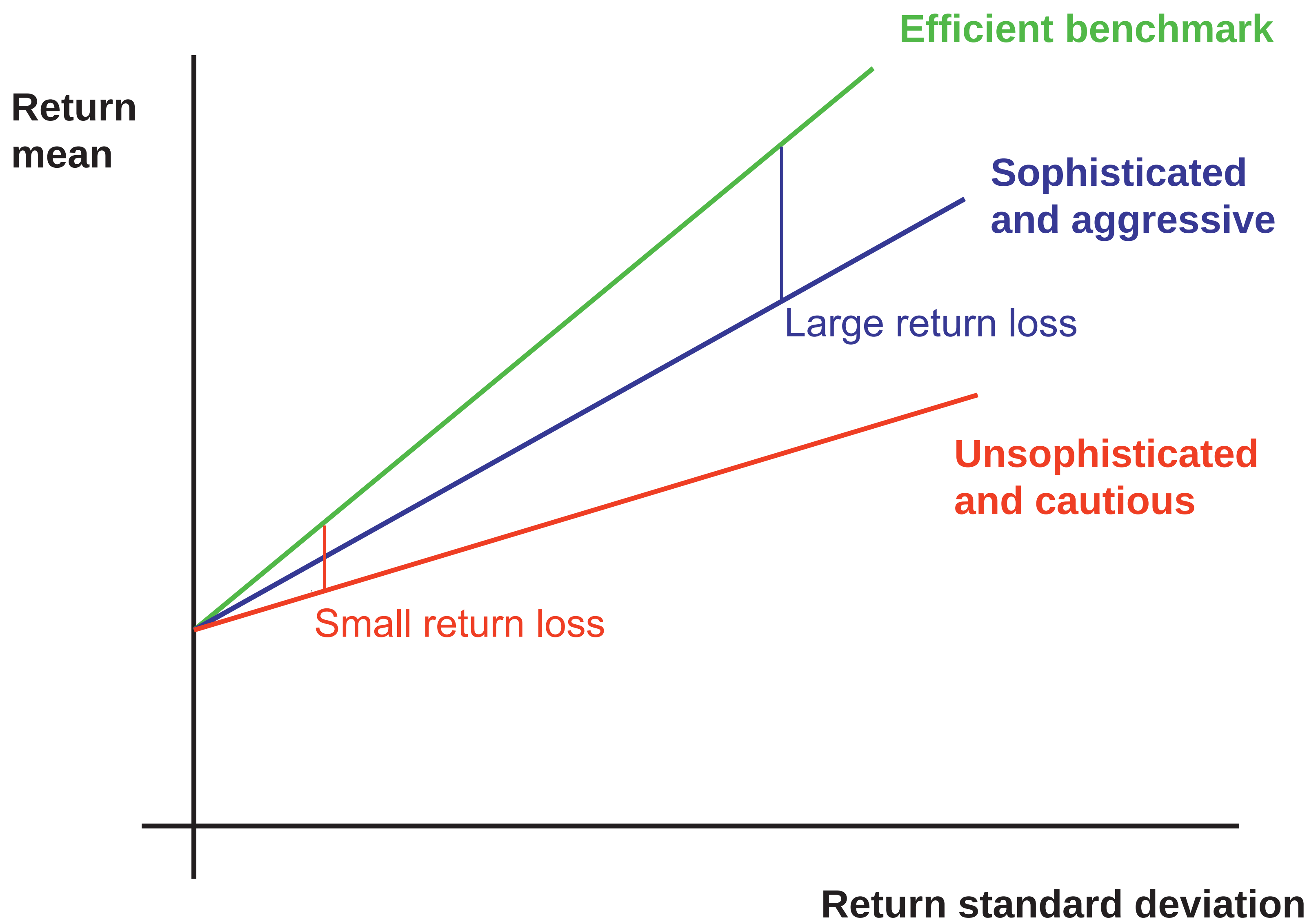
  D_h = share of stocks in the risky portfolio

  $C_{s,h} = C_{a,h} / D_h^2$ = concentration in the stock portion of the portfolio

$$\ln(\sigma_{i,h}) \approx \ln(D_h) + \ln(\sigma_{s,h}) + \frac{1}{2}\ln(C_{s,h}) + \frac{1}{2}\left(\frac{1}{\overline{\overline{C}}_s} - 1\right)\rho_{s,h}$$

(R^2 = 71%)

- Households who fail to diversify might fail by:
  - holding a high share of individual stocks
  - picking volatile stocks
  - holding a concentrated portfolio of stocks
  - picking correlated stocks.


Efficient benchmark
Return
mean
Sophisticated
and aggressive
Large return loss
Unsophisticated
and cautious
Small return loss
Return standard deviation

Dynamic Risk Management

Adriano A. Rampini, Duke University
Amir Sufi, University of Chicago
S. Viswanathan, Duke University

Finance Seminar
Stanford Graduate School of Business

Stanford, CA
October 26, 2011

Understanding Risk Management

Rationale for corporate risk management: financial constraints

- Financing constraints render firms effectively risk averse
  - See Froot, Scharfstein, and Stein (1993)

- Empirical prediction
  - More financially constrained firms are more likely to manage risk

Evidence does not support theory

- "The actual corporate use of derivatives, however, does not seem to correspond closely to the theory." – Stulz (1996)

Risk Management – Theory

Rethinking risk management

- We theoretically and empirically challenge the notion that financial constraints and risk management should be positively related.

Basic theoretical insight

- **Financing risk management trade-off**
  - Collateral constraints link availability of financing and risk management
  - When net worth is low, firms use net worth for investment at expense of risk management
- Prediction: **More financially constrained firms hedge less**

Risk Management – Evidence

Revisiting evidence

- **Evidence on fuel price risk management** by airlines
  - More constrained airlines hedge less both ...
    - in cross-section and ...
    - in time series
  - Risk management drops substantially as airlines approach distress

- Anecdotal evidence: American Airlines 2009 10-K

  "[a] deterioration of the Company's financial position could negatively affect the Company's ability to hedge fuel in the future."

Model (Cont'd)

Limited enforcement

- Firm can default on ...
  - state-contingent promises to pay Rb' and ...
  - promise to take delivery on forward purchases $p'_f x'_f$ ...
    - in which case counterparty keeps inputs x'_f

Collateralize all promises (repayment) and forward purchases

- Promises cannot exceed fraction θ of resale value of (depreciated) capital

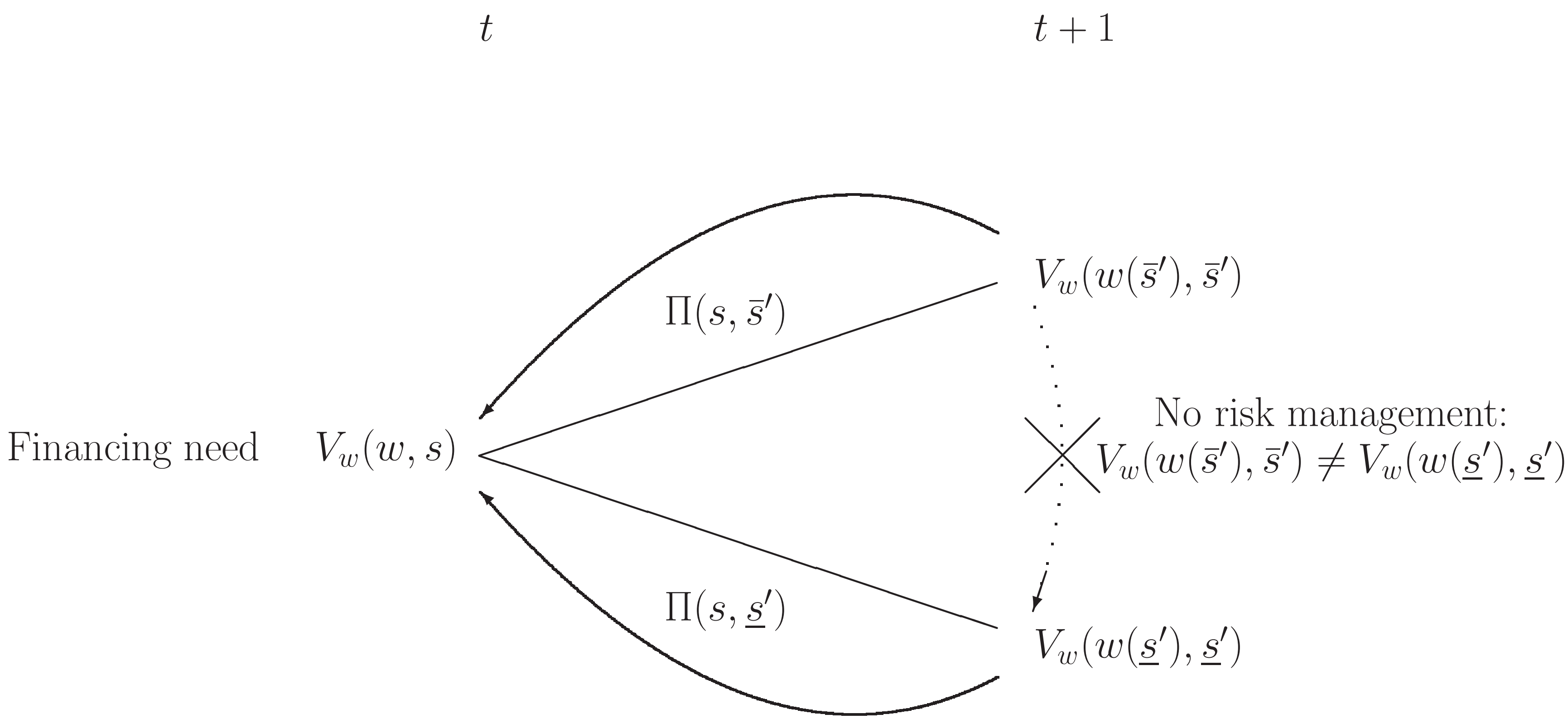
$$\theta k(1-\delta) \geq \underbrace{Rb'}_{\textbf{financing}} + \underbrace{(p'_f - p')x'_f}_{\textbf{risk management}}$$

- Endogenous, state-contingent collateral constraints
  - Related Kiyotaki/Moore (1997)

Financing Risk Management Trade-off (Cont'd)

Basic trade-off

- Financing need can override hedging concern



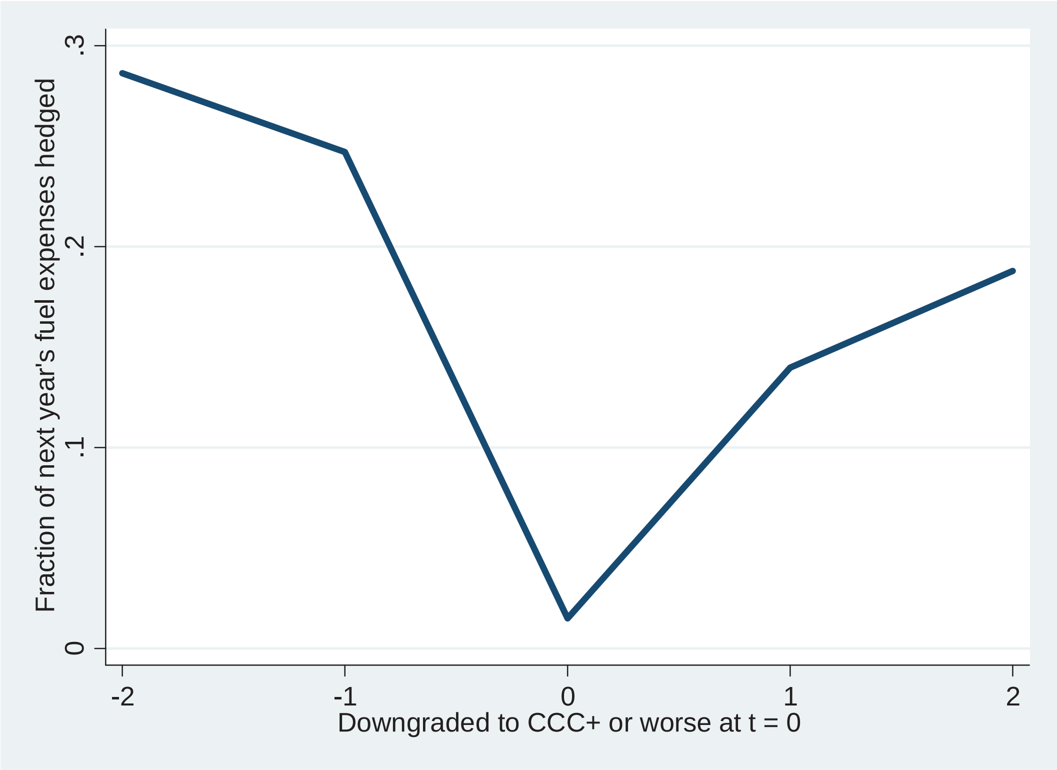
Empirical Lab: Airline Fuel Price Risk Management

Image removed due to copyright restrictions. To see the photograph, visit the Getty Images website.

Hedging around Distress (Cont'd)

Fuel hedging around airline distress

- Dramatic decline in hedging as airlines approach distress; slow recovery



14.772 Development Economics: Macroeconomics
Spring 2013