Chapter 7: Neoclassical Benchmarks and Anomalies for Those with Access

If markets and institutions were perfect, and there were no policy distortions, then certain benchmark standards would be implied. This was apparent from the earlier models, for example: ideal financing across firms, efficient occupation choice, no one constrained, and pooling of idiosyncratic risk. Relative to these benchmarks, there are many anomalies in the Thai economy, even for those using formal credit and savings instruments, unlike the dual sector models. Initial wealth facilitates entry into business and facilitates investment for those in business. Many households and businesses appear to be constrained in occupation choice and investment. Estimated rates of return are high for constrained low wealth households and, equally telling, low for unconstrained high wealth households. Poor households and SME enterprises are particularly vulnerable in consumption and investment to variation in income and cash flow. Some villages and family related industrial groups offer protection. But some insurable shocks such as movement in international rubber prices are not covered.

7.1 Finance

Probit Estimates of having started a business between 1992 and 1997

Wealth Helps Businesses Start

	Whole Sample		Northeast		Central region	
	dF/dx*	Z-statistic	dF/dx*	Z-statistic	dF/dx*	Z-statistic
Age of head	-0.0105	-3.18	-0.0106	-3.01	-0.0111	-1.84
Age of head squared	0.0001	2.52	0.0001	2.68	0.0001	1.21
Years of schooling- head	0.008	3.01	0.0102	3.74	0.0034	0.67
Number of adult females in household	0.0013	0.15	0.0089	0.96	-0.0131	-0.85
Number of adult males in household	0.0158	2.03	0.0013	0.16	0.0345	2.41
Number of children (<18 years) in household	0.0045	-0.79	-0.0115	-1.8	0.0103	0.99
Wealth 6 years ago†	0.0276	3.25	0.0861	2.15	0.0246	2.82
Wealth squared‡	0.0000	-1.78	0.0000	-1.2	0.0000	-0.79
Member/customer in organization/institution 6 years ago						
Formal financial institution	0.0199	1.1	0.004	0.19	0.0314	1.03
Village institution/ organization	-0.0224	-1.05	-0.04	-1.96	0.0239	0.55
Agricultural lender	0.0278	1.39	0.0145	0.67	0.0511	1.4
BAAC group	0.0397	1.72	0.0519	2.06	0.0084	0.2
Moneylender	0.0014	0.04	0.013	0.36	-0.0176	-0.31
Observed frequency	0.1407		0.0915		0.207	
Predicted frequency at mean of X	0.1105		0.0699		0.172	
Log likelihood	-860.30		-363.62		-488.65	
X^2 for significance of fixed effects	152.96		28.83		85.69	
Prob > X^2	0.00		0.19		0	
Pseudo R-squared (%)	14.14		10.87		15.59	
Number of observations	2467		1333		1135	

The sample excludes the top 1% of households by wealth.

*dF/dx is equal to the infinitesimal change in each continuous independent variable. For dummy variables, it is equal to the discrete change in probability when the dummy variable changes from 0 to 1. Dummy variables are marked by an asterisk.

† Wealth 6 years ago is made up of the value of household assets, agricultural assets and land. Number in the table is the estimated coefficient multiplied by 1,000,000.

‡Number in the table is the estimated coefficient multiplied by 1,000,000.

[Table 7.1.1 a. Probit estimates of having started a business in the last 5 years. Source: Paulson and Townsend (2004)]

Probit Estimates of having started a business between 1992 and 1997

Business Starts; Wealth X access statistically significant

	Whole Sample		Northeast		Central region	
	dF/dx*	Z-statistic	dF/dx*	Z-statistic	dF/dx*	Z-statistic
Age of head	-0.0106	-3.2	-0.0107	-3.03	-0.0112	-1.85
Age of head squared	0.0001	2.56	0.0001	2.71	0.0001	1.25
Years of schooling- head	0.0080	3	0.0101	3.68	0.0035	0.68
Number of adult females in household	0.0009	0.11	0.0088	0.95	-0.0145	-0.93
Number of adult males in household	0.0154	1.96	0.0017	0.2	0.0336	2.3
Number of children (<18 years) in household	-0.0035	-0.61	-0.0114	-1.79	0.0121	1.15
Wealth 6 years ago‡	0.0279	3	0.0856	2.03	0.022	2.17
Wealth squared‡	0.0000	-1.74	0.0000	-0.98	0.0000	-0.63
(Wealth + inheritance) X member/customer in organization/institution 6 years ago						
Formal financial institution‡	-0.0126	-1.76	-0.0275	-0.66	-0.0098	-1.26
Village institution/ organization‡	0.0055	0.48	0.0287	0.53	-0.0020	-0.12
Agricultural lender‡	0.0085	1.07	-0.0292	-0.71	0.0082	1
BAAC group‡	0.0068	0.7	0.0207	0.49	0.0204	1.49
Moneylender‡	-0.0235	-1.09	-0.0041	-0.06	-0.0282	-0.93
Member/customer in organization/institution 6 years ago						
Formal financial institution*	0.0394	1.85	0.0198	0.65	0.0553	1.56
Village institution/ organization*	-0.0270	-1.18	-0.0477	-1.76	0.0186	0.39
Agricultural lender*	0.0161	0.72	0.0304	0.99	0.0350	0.93
BAAC group*	0.0320	1.24	0.0387	1.17	-0.0269	-0.56
Moneylender*	0.0210	0.56	0.0156	0.32	0.0145	0.22
Observed frequency	0.1407		0.0915		0.2070	
Predicted frequency at mean of *X*	0.1105		0.0695		0.1729	
Log likelihood	-856.43		-363.01		-484.71	
X^2 for significance of fixed effects	154.69		28.79		87.93	
Prob > X^2	0.00		0.19		0.00	
Pseudo R-squared (%)	14.53		11.02		16.27	
Number of observations	2467		1333		1135	

The sample excludes the top 1% of households by wealth.

*dF/dx is equal to the infinitesimal change in each continuous independent variable. For dummy variables, it is equal to the discrete change in probability when the dummy variable changes from 0 to 1. Dummy variables are marked by an asterisk.

‡Number in the table is the estimated coefficient multiplied by 1,000,000. [Table 7.1.1b Probit estimates of having started a business in the last 5 years (with wealth and inheritance). Source: Paulson and Townsend (2004)]

Paulson and Townsend (2004) use the Thai project data to examine the relationship between transitions into business and covariates such as wealth, education, demographics, and financial access. As anticipated, prior 1992 wealth is a consistent positive and significant covariate in probits of those going into business between 1992-1997. See Table 7.1.1a. The effect may decline with increasing wealth, suggesting diminishing returns. Years of schooling of the head are significant overall and in the Northeast, though curiously not in the Central region. Demographic effects such as the number of male family members are, on the other hand, significant overall and in the Central region, but not in the Northeast.

Access/use of the formal financial sector via the BAAC appears helpful overall. See again Table 7.1.1a. However, given that a household is in a BAAC joint liability group in the Northeast, increased household wealth is somewhat helpful at marginal significance levels as in Table 7.1.1b (but negative for the formal sector otherwise). This contradicts the prediction that occupation choice should be free from wealth effects for those with financial access. Evidently we need both a model of imperfect credit access and selection of occupation and finance. Strange at first sight in the Tables is the negative effect of village financial institutions onto business transitions in the Northeast. This too begs the issue of selection: those with access to and use of village funds may have other household/village characteristics negatively associated with business, e.g., village funds exist in predominately rural, agricultural areas where there is less likely to be a subsequent transition.

Wealth and Constraints are related- anticipate Gine

	Whole Sample		Northeast		Central region	
	dF/dx*	Z-statistic	dF/dx*	Z-statistic	dF/dx*	Z-statistic
Age of head	-0.0035	-0.21	0.0854	2.45	-0.0272	-1.37
Age of head squared	0.0000	-0.11	-0.0008	-2.62	0.0002	1.05
Years of schooling- head	0.0099	0.78	-0.0117	-0.47	0.0165	1.03
Number of adult females in household	0.0766	1.77	-0.0058	-0.06	0.1038	2.07
Number of adult males in household	-0.0216	-0.53	-0.104	-1.17	0.0257	0.55
Number of children (<18 years) in household	0.0157	0.53	-0.0087	-0.12	0.0201	0.60
Wealth 6 years ago‡	-0.0027	-0.08	-0.0829	-0.18	0.0056	0.23
Wealth squared‡	0.0000	0.49	0.0000	0.38	0.0000	-0.34
(Wealth + inheritance) X member/customer in organization/institution 6 years ago						
Formal financial institution‡	-0.0316	-1.07	0.7040	1.87	-0.0186	-1.08
Village institution/ organization‡	0.0393	0.84	0.2510	0.43	0.0382	1.63
Agricultural lender‡	0.0188	0.56	-0.4900	-1.20	-0.0099	-0.54
BAAC group‡	-0.0212	-0.61	-0.0729	-0.18	0.0068	0.32
Moneylender‡	-0.4040	-1.37			-0.335	-1.15
Member/customer in organization/institution 6 years ago						
Formal financial institution*	-0.0435	-0.48	-0.4472	-1.93	0.0038	0.04
Village institution/ organization*	-0.0467	-0.35	0.2861	0.80	-0.1745	-1.20
Agricultural lender*	0.1353	1.15	0.0600	0.22	0.2696	1.99
BAAC group*	-0.0454	-0.37	0.1485	0.52	-0.147	-1.03
Moneylender*	0.4438	2.00			0.4191	1.51
Observed frequency	0.5131		0.5870		0.4732	
Predicted frequency at mean of *X*	0.5131		0.6091		0.4461	
Log likelihood	-185.18		-51.17		-131.38	
X^2 for significance of fixed effects	32.00		9.26		26.11	
Prob > X^2	0.70		0.9		0.16	
Pseudo R-squared (%)	12.65		17.95		15.21	
Number of observations	306		92		224	

The sample excludes the top 1% of households by wealth.
*dF/dx is equal to the infinitesimal change in each continuous independent variable. For dummy variables, it is equal to the discrete change in probability when the dummy variable changes from 0 to 1. Dummy variables are marked by an asterisk.
‡Number in the table is the estimated coefficient multiplied by 1,000,000.
[Table 7.1.2 Constraints and Wealth Access. Source: Paulson and Townsend (2004)]

Households in the Townsend Thai project were also asked if they believe they could make more money if their business or farm could be expanded. Though an affirmative response would not be possible in a neo-classical world with perfect credit markets, if the question were correctly interpreted, an affirmative response is typical, for about half of the household sample. As for the individual financial sector providers, those borrowing from a moneylender are more likely to report being constrained, but given that they borrow, increases in wealth reduce constraints. See Table 7.1.2. The pattern is the opposite for those borrowing from the formal sector, that is, less likely to report being constrained, but given that they borrow, increases in wealth seem to increase constraints. There is variation in these patterns by region. All these responses beg again selection issues and causality. For example, those borrowing from the informal sector may be more productive, hence constrained, given their level of credit, though this is reduced with use of own wealth. Customers who borrow from commercial banks are ones who may have achieved lower rates of return, though the higher their wealth is, the more productive (and constrained) they may be. Needed of course are further models to get beneath the observed correlations and conjectures. The point here is only that the world is not neoclassical, not even for those with access/use.

Median Initial Investment in business by wealth and education

	Wealth			
	Lowest quartile	Second quartile	Third quartile	Fourth quartile
Whole Sample				
Business	17,053	12,317	16,917	30,585
Constrained	13,494	12,317	25,644	30,905
Unconstrained	20,257	12,536	11,658	29,636
Central				
Business	22,562	14,147	15,727	32,478
Constrained	13,603	18,191	19,130	43,000*
Unconstrained	38,504	10,926	13,970	28,695+
Northeast				
Business	12,732	12,313	5,205	21,705
Constrained	12,732	7,617	4,856	15,720
Unconstrained	11,614	21,202	5,877	33,343

	Education		
	0-3 years	4 years	5-16 years
Whole Sample			
Business	15,420	18,401	18,674
Constrained	9,920	25,664	14,211
Unconstrained	36,263	14,147+	23,467
Central			
Business	15,727	30,905	18,218
Constrained	7,710	32,478##	10,419#
Unconstrained	44,398	15,942++	33,478
Northeast			
Business	15,329	10,063	26,677
Constrained	12,131	11,600	30,844
Unconstrained	15,420	5,615	16,917#

*, **, *** indicate the significance of the difference in median initial investment for businesses, constrained businesses or unconstrained businesses when the lowest wealth quartile is compared to the highest wealth quartile at the 10%, 5% and 1% levels, respectively. #, ##, ### indicate the significance of the difference in median initial investment for businesses, constrained businesses or unconstrained businesses when the wealth quartile, or

the education category, indicated in the column heading is compared to the next lowest wealth quartile, or the next lowest education category, at the 10%, 5% and 1% levels, respectively. +, + +, + + + indicate the significance of the difference in median returns to investment, within the category indicated by the column heading, for constrained businesses and unconstrained businesses at the 10%, 5% and 1% levels, respectively.

[Table 7.1.3. Source: Paulson and Townsend (2004)]

Regression estimates of initial investment in business, business started in last 5 years

	Whole sample		Northeast		Central region	
	Coefficient	*T*-statistic	Coefficient	*T*-statistic	Coefficient	*T*-statistic
Age of head	−0.0132	−0.23	−0.0261	−0.27	−0.0577	−0.83
Age of head squared	−0.0001	−0.15	0.0000	0.01	0.0003	0.54
Years of schooling—head	0.1208	3.13	0.1376	2.36	0.1321	2.67
Number of adult females in household	0.1250	0.89	0.2621	1.06	0.0810	0.52
Number of adult males in household	0.2007	1.55	0.3608	1.48	0.1212	0.81
Number of children (<18 years) in household	−0.0318	−0.34	−0.0497	−0.26	−0.0144	−0.14
Wealth 6 years ago†	0.3390	3.13	−0.3100	−0.31	0.1230	1.68
Wealth squared‡	0.0000	−2.51	0.0000	1.24	0.0000	−1.82
Constant	10.2197	6.71	9.6242	3.87	11.8264	6.31
Adjusted *R*-squared (%)	8.52		11.77		5.38	
Number of observations	252		83		177	

The sample excludes the top 1% of households by wealth and initial investment.

† Wealth 6 years ago is made up of the value of household assets, agricultural assets and land. Number in table is estimated coefficient multiplied by 1,000,000.

‡ Number in table is estimated coefficient multiplied by 1,000,000.

[Table 7.1.4. Source: Paulson and Townsend (2004)]

Related also, those who report themselves as constrained in running businesses in the Central region tend to have investment in business startups that is increasing in wealth. See Table 7.1.3. This would be consistent with some of the simple models of imperfect credit, both as described earlier and as modified below. More generally, business starts are related to wealth in the Central region and whole sample, and related to education, presumably an indicator of talent. Likewise, according to the JBIC survey, many SME's are constrained in the sense that they would like more credit for working capital and equipment. See Table 7.1.4.

This declines apparently with size (the value of fixed assets). In sum, smaller businesses in both the household and SME surveys seem to be more constrained.

Financial Demand by the amount of fixed assets:

		Total	≤ 10m Baht	11-50m Baht	51-100m Baht	101-200m Baht	201-500m Baht	NA
		Paid-Up Capital						
Yes, urgently	N	61	48	6	4	1	1	1
	%	6.5	11.9	4.4	10.5	5.8	25	2.2
Yes, urgently	N	186	122	39	14	5		6
	%	28.9	30.2	28.8	36.8	29.4		13.3
No	N	394	232	90	20	11	3	38
	%	61.3	57.5	66.6	52.6	64.7	75	84.4
No answer	N	1	1					
	%	0.1	0.2					
Base all respondents		642	403	135	38	17	4	45

		Total	≤ 10m Baht	11-50m Baht	51-100m Baht	101-200m Baht	NA
		Paid-Up Capital					
Yes, urgently	N	61	24	17	9	3	8
	%	9.5	10	10.8	20.4	7.3	5
Yes, urgently	N	186	77	46	12	11	40
	%	28.9	32	29.3	27.2	26.8	25
No	N	394	139	94	23	26	112
	%	61.3	57.9	59.8	52.2	63.4	70
No answer	N	1				1	
	%	0.1				2.4	
Base all respondents		642	240	157	44	41	160

[Table 7.1.5. Note: The smaller the assets, the greater the demand. Source: JBIC]

Rates of Returns Decline with Wealth for Constrained Business

	Wealth			
	Lowest quartile	Second quartile	Third quartile	Fourth quartile
Whole Sample				
Business	56.7%	38.4%	20.7%	16.2%**
Constrained	96.9%	67.2%	13.8%	16.4%***
Unconstrained	10.5%++	31.2%	32.3%	16.1%
Central				
Business	80.8%	48.8%	39.1%	16.0%***
Constrained	98.2%	79.3%	28.2%	14.4%***
Unconstrained	48.0%	34.8%	56.6%	21.0%
Northeast				
Business	21.2%	12.7%	6.6%	10.0%
Constrained	57.9%	35.7%	23.2%	17.1%
Unconstrained	4.0%+	8.9%	3.2%	0.0%
	Education			
	0-3 years	4 years	5-16 years	
Whole Sample				
Business	5.80%	28.54%	22.77%	
Constrained	32.59%	30.44%	25.63%	
Unconstrained	2.90%	28.46%	19.37%	
Central				
Business	6.42%	38.99%	25.63%	
Constrained	21.84%	37.84%	25.63%	
Unconstrained	6.42%	43.89%	24.98%	
Northeast				
Business	4.10%	12.71%	21.40%	
Constrained	35.59%	18.69%	26.52%	
Unconstrained	-5.43%++	4.32%	4.53%	

*, **, *** indicate the significance of the difference in median initial investment for businesses, constrained businesses or unconstrained businesses when the lowest wealth quartile is compared to the highest wealth quartile at the 10%, 5% and 1% levels, respectively. +, + +, + + + indicate the significance of the difference in median returns to investment, within the category indicated by the column heading, for constrained businesses and unconstrained businesses at the 10%, 5% and 1% levels, respectively.

[Table 7.1.6. Median Returns to Business Investment in Business by Wealth and Education %. Source: Paulson and Townsend (2004)]

In the household enterprise data, as in Table 7.1.6, rates of return do seem to decline with wealth or size. For constrained households, as wealth increases from the lowest to the highest quartile, income to asset ratios decline. Strikingly, the rates of return on apparently constrained businesses reaches 96.9% in the low wealth quartile, declining to 16.4% in the high wealth quartile. Rates of return within each wealth quartile are with rare exception higher for the constrained households than for unconstrained households. Rates of return for unconstrained high wealth households are among the lowest in the sample, especially in the Northeast, as if alternative use of funds were restricted. A related regional disparity: rates of return are higher in the Central region.

From the income and balance sheets of households in the monthly micro project data we surmise that rates of return on household wealth and on assets are nontrivial. There are preliminary indications that ROA declines with wealth and also declines with debt. They appear unrelated to underlying risk.

	1st Quartile	4th Quartile
All observations		
Number of observations	604	563
Production (millions)		
Mean	9.31	241
SD	1.28	612
Sales (millions)		
Mean	11.5	308
SD	16.4	764
Domestic Sales (% of Total Sales)		
Mean	89.95	60.59
SD	27.06	37.59
Profit Margin (%): *Profit to Cost of Production Ratio*		
Mean	45.95	64.53
SD	203.40	334.03
ROA (%)		
Mean	32.51	13.26
SD	434.90	237.90
Truncated Sample (Only firms with positive equities)		
Number of observations	497	484
Production (millions)		
Mean	9.44	248
SD	1.33	609
Sales (millions)		
Mean	1.14	317
SD	1.53	740
Domestic Sales (% of Total Sales)		
Mean	89.62	58.86
SD	27.48	37.80
Profit Margin (%): *Profit to Cost of Production Ratio*		
Mean	36.51	69.65
SD	120.72	359.06
ROA (%)		
Mean	43.48	13.39
SD	105.40	256.51

Regressions of ROA on Firm's Size

Dependent Variable: ROA	**All Firms**			**Truncated Sample (Only firms with positive equities)**	
Total Assets (million Baht)	Not significant (p = 0.997)	Not significant (p = 0.82)	-	Not significant (p = 0.98)	-
Total Asset Quartile (1, 2, 3, or 4)	-	-	-0.12* (p = 0.06)	-	-0.13** (p=0.03)
Industry Fixed Effects	Not controlled	Controlled	Controlled	Controlled	Controlled
No of Observations	2,352	2,352	2,352	1,989	1,989

Note: Significance levels * = 10%; ** = 5%; and *** = 1%

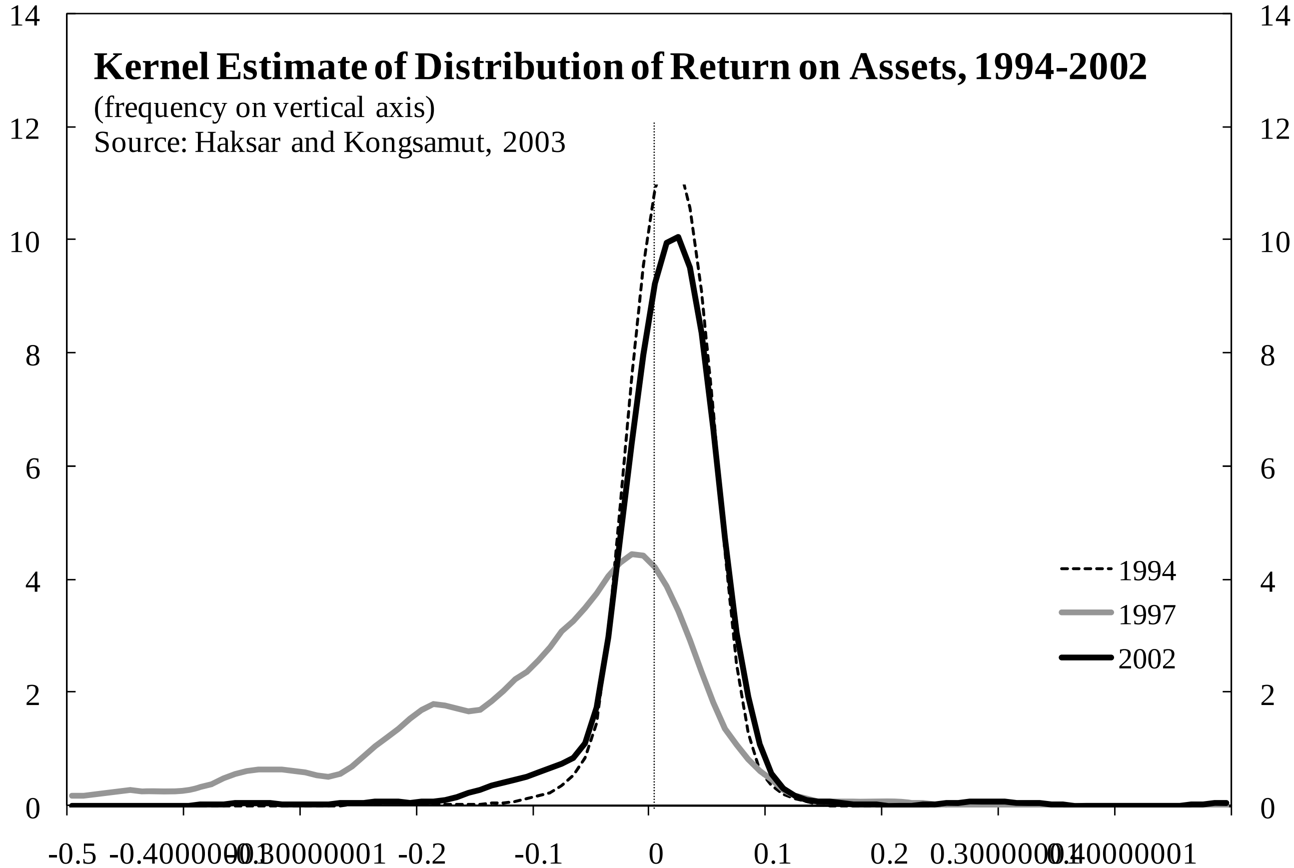
[Table 7.1.7. Performance. Source: Adapted from Thai Ministry of Industry data with Samphantharak tabulations]

	(1)	(2)	(3)	(4)
Dependent variable	Net ROA	Net ROA	Gross ROA	Gross ROA
Independent variables				
Log(sales)	0.007 (3.16)	0.006 (3.68)	0.014 (8.09)	0.008 (5.81)
Debt/assets	-0.026 (-17.05)	-0.03 (-3.25)	-0.012 (-10.38)	-0.018 (-1.98)
ST liab./Total liab.	-0.017 (-2.27)	0.0001 (0.02)	0.016 (2.88)	0.018 (3.43)
Market share	0.114 (4.6)	-0.0002 (-0.02)	0.094 (4.90)	-0.002 (-0.20)
Current ratio	0.002 (2.35)	0.002 (2.29)	0.0007 (1.35)	0.001 (1.87)
Input cost ratio	-0.004 (-4.01)	-0.005 (-3.05)	-0.003 (-3.88)	-0.005 (-2.79)
Constant	-0.071 (-2.42)	-0.054 (-2.21)	-0.177 (-7.85)	-0.091 (-3.96)
Number of firms Total number of obs.	362 13,720	362 13,720	362 13,720	362 13,720
Number of quarters (average)	37.9	37.9	37.9	37.9
R-squared	0.04	0.05	0.03	0.04
Hausman test (p-value)	110.10 (0.00)		175.41 (0.00)	
Breusch Pagan LM test (p-value)	16.71 (0.00)		57.68 (0.00)	

* t-ratios in parentheses

[Table 7.1.8. Fixed-Effect Panel Model Results. Note: t-ratios in parentheses. Source: Haksar & Kongsamut (2003)]

Similarly, rates of return on assets among firms in a Ministry of Industry survey decline with asset quartile, significantly, though it is necessary to control for industry type, Table 7.1.7. In addition, larger firms in an IMF study often have proportionately more debt, and ROA declines with debt. But again, the direction of causality is not clear, Table 7.1.8. One hypothesis is that the financial system may be “overlending” to the larger firms, driving down their rates of return relative to “underfinanced” smaller firms with little debt. This happens in the dual sector models as firms without debt tend to be constrained, hence high rates of return. It will happen below in models with limited liability even for those with access to loans. As wealth increases, so do loans, driving down rates of return. There are other explanations: despite early indications, risk may be higher for smaller firms, so that higher average returns come with higher risk of default that lenders seek to avoid. But the relationship of loan size to risk can be complicated. In various models below, higher loans lead to higher risk, not lower, as borrowers choose riskier projects, for example. In an adverse selection model below, the riskier households are more likely to be borrowing, and those with no loans are the safest type.



[Figure 7.1.9. Source: Haksar & Kongsamut (2003)]

The role of supply side distortions and the hypothesis of "overlending" are given some credence in recent history. That is, there are indicators in an IMF study of increasing inefficiency in the banking system prior to the financial crisis. The histogram of ROA among firms' shifts left rather dramatically from 1994 to 1997.

7.2 Risk Sharing

The benchmark standard for the optimal allocation of risk in an economy, or risk sharing group, can be derived from the sub problem of maximizing a λ^i-weighted sum of discounted expected utilities of individuals in the risk-sharing group, by choice of state contingent consumption $c_t^i(\varepsilon_1,...,\varepsilon_t)$ and leisures $l_t^i(\varepsilon_1,...,\varepsilon_t)$.

$$\max \sum_{i=1}^{N} \lambda^i \sum_{t=1}^{T} \beta^t \sum_{\varepsilon_1 \ldots \varepsilon_t} \text{prob } (\varepsilon_1, \ldots, \varepsilon_t) W^i \left[c_t^i(\varepsilon_1, \ldots, \varepsilon_t), l_t^i(\varepsilon_1, \ldots, \varepsilon_t), A_t^i \right] \qquad (7.2.1)$$

subject to constraints defining aggregate, group consumption and leisure.

$$\sum_i c_t^i(\varepsilon_1, \ldots, \varepsilon_t) \leq \overline{c}_t(\varepsilon_1, \ldots, \varepsilon_t) \quad \forall t, \varepsilon_1, \ldots, \varepsilon_t \qquad (7.2.2)$$

$$\sum_i l_t^i(\varepsilon_1, \ldots, \varepsilon_t) \leq \overline{l}_t(\varepsilon_1, \ldots, \varepsilon_t) \quad \forall t, \varepsilon_1, \ldots, \varepsilon_t \qquad (7.2.3)$$

The term A_t^i is a household i demographic, age, and gender index over number of household members. Now let $h_t = (\varepsilon_1, \ldots, \varepsilon_t)$ denote the history of shocks before t and the realized shock ε_t at t. These include shocks to production and technology. The maximum problem thus delivers familiar first-order conditions

$$\lambda^i W_c^i \left[c_t^i(h_t), l_t^i(h_t), A_t^i \right] = \lambda^j W_c^j \left[c_t^j(h_t), l_t^j(h_t), A_t^j \right] = \mu_c(h_t) \quad \forall i, j \qquad (7.2.4)$$

and

$$\lambda^i W_l^i \left[c_t^i(h_t), l_t^i(h_t), A_t^i \right] = \lambda^j W_l^j \left[c_t^j(h_t), l_t^j(h_t), A_t^j \right] = \mu_l(h_t) \quad \forall i, j \qquad (7.2.5)$$

where $\mu_c(h_t)$ and $\mu_l(h_t)$ are common Lagrange multipliers on constraints 7.2.2 and 7.2.3, respectively. Note in particular that $\mu_c(h_t)$ is the common marginal utility of aggregate consumption from 7.2.2 and this will play a salient role below. Suppose further that W^i is separable in consumption and leisure, and utility of consumption is exponential.

$$U(c_i) = -\frac{1}{\gamma_i} \exp\left(-\gamma_i \frac{c_i}{a_i} \right) \qquad (7.2.6)$$

and each member k of household j has identical absolute risk aversion γ_i. Then we get the risk sharing rule

$$
\begin{aligned}
\frac{\sum_{k=1}^{N_t^i} c_t^k}{\sum_{k=1}^{N_t^j} A_t^k} = \frac{1}{\sigma}\left(\log\left(\lambda^j\right) - \frac{1}{N}\sum_{i=1}^{N}\log\left(\lambda^i\right)\right) \\
-\frac{1}{\sigma}\left[\frac{\sum_{k=1}^{N_t^i} A_t^k \log\left(A_t^k\right)}{\sum_{k=1}^{N_t^i} A_t^k} - \frac{1}{N}\sum_{i=1}^{N}\frac{\sum_{k=1}^{N_t^i} A_t^k \log\left(A_t^k\right)}{\sum_{k=1}^{N_t^i} A_t^k}\right] \\
+\frac{1}{N}\sum_{i=1}^{N}\frac{\sum_{k=1}^{N_t^i} c_t^k}{\sum_{k=1}^{N_t^i} A_t^k}
\end{aligned}
\qquad (7.2.7)
$$

Evidently, household j per capita adjusted consumption is determined by the log Pareto weight of household j relative to group, its demographics related to the group, and average per capita adjusted consumption of the entire group. The Pareto weight will be the inverse of the marginal utility of wealth in the decentralized problem.

First differences over time of 7.2.7 eliminate the household specific fixed effect. A common time dummy captures the movement of *average* consumption. The inclusion of household income should not be significant. More specifically, a standard econometric specification is

$$
\Delta c_{t,t+1}^j = \beta_{t,t+1}^j D_{t,t+1}^j + \delta\ \Delta\bar{A}_{t,t+1}^j + \eta\ \Delta hs_{t,t+1}^j + \mu\ X_{j96} + \xi\ \Delta Y_{t,t+1}^j + \nu\ \Delta Y_{t,t+1}^j X_{j96} + u_{t,t+1}^j \quad (7.2.8)
$$

The time difference removes the household fixed effect. A term $\Delta hs_{t,t+1}^j$ is added for changing household size to reflect economies of scale in household food consumption, as is standard. The relative demographic change is $\Delta\bar{A}_{t,t+1}^j$. Average consumption change in the group is replaced by a time varying fixed effect, $D_{t,t+1}^j$. The alternative hypothesis is the household-specific income change $\Delta Y_{t,t+1}^j$ will influence household consumption change, $\Delta c_{t,t+1}^j$. By further interacting $\Delta Y_{t,t+1}^j$ with characteristics X_{j96} at some initial date, say, 1996, one can gauge which groups in the population might be especially vulnerable, with uncovered risk. The X_{j96} are put in as further controls. Random variable $u_{t,t+1}^j$ can be interpreted as consumption measurement error.

More generally, the risk sharing and production problem can be embedded in the larger group or in small open economy problems. For simplicity, we suppress labor supply. Then, maximize λ-weighted discounted expected household utilities W_i by choice of not only consumption but also productions q, costly investments I_t, determining capital stock k_{t+1} subject to a budget (resource) constraint for the group, that the sum of consumption plus investment cannot exceed aggregate output less the costs of hiring labor, less the costs of capital adjustment, plus new loans, less the repayment of debt with interest at the outside rate of $r_{t-1}(h_{t-1})$.

$$\max \sum_i \lambda^i \sum_{t=1}^{T} \sum_{h_t} \text{prob}(h_t)\, \beta^t W_i\left[c_{it}(h_t)\right] \tag{7.2.9}$$

subject to the Lagrange multiplier

$$\sum_i c_{it}(h_t) = \bar{c}_t(h_t) \quad \forall h_t \quad \lambda_t(h_t) \tag{7.2.10}$$

and budget constraint

$$\begin{aligned} &\sum_i q^i\left(k_t^i(h_{t-1}), \varepsilon_t\right) - \sum_i C^i(k_t^i(h_{t-1}), \varepsilon_t, I_t^i(h_t)) - (1 + r_{t-1}(h_{t-1}))L_{t-1}(h_{t-1}) + L_t(h_t) \\ &= \bar{c}_t(h_t) + \sum_i I_t^i(h_t) \end{aligned} \tag{7.2.11}$$

and the law of motion for capital

$$k_{t+1}^i = (1-\gamma)\, k_t^i(h_{t-1}) + I_t^i(h_t) \tag{7.2.12}$$

Among the familiar first-order conditions are those for investment

$$\lambda_t(h_t)\left[1 + \frac{\partial C^i\left(k_t^i(h_{t-1}), I_t^i(h_t)\right)}{\partial I_t^i(h_t)}\right] = \tag{7.2.13}$$

$$\sum_{\varepsilon_{t+1}} \lambda_{t+1}(h_t, \varepsilon_{t+1}) \left[\frac{\partial q^i\left(a_{it+1}(h_{t+1}), k_{t+1}^i(h_t)\varepsilon_t\right)}{\partial k_{t+1}^i} + \frac{\partial C^i\left(k_{t+1}^i(h_t), I_{t+1}(h_{t+1}, \varepsilon_{t+1})\right)}{\partial k_{t+1}^i(h_t)}\right]$$

so that the marginal cost of investment at current marginal utility "prices" equals the future net marginal revenue product. The $\lambda_t(h_t)$ here plays the same role as the $\mu_t(h_t)$ earlier, though the aggregate budget constraint is a bit more complicated.

Indeed, to decentralize, let $P_{ct}(h_t)$ denote the price of an Arrow-Debreu security giving a unit payoff under history $h_t = (\varepsilon_1, \ldots, \varepsilon_t)$. Then the household i would maximize discounted expected utility at date 0, by choice of state contingent consumption and leisure, as well as the individual level variables mentioned earlier at the aggregate level (investments, hires, subsidized loans, etc.). In sum,

$$\max \sum_{t=1}^{T} \sum_{h_t} \text{prob}\left(h_t\right) \beta^t W_i \left[c_{it}\left(h_t\right) \right] \qquad (7.2.14)$$

subject to *one* single date $t = 0$ budget constraint,

$$\begin{aligned} &\sum_t \sum_{h_t} P_{ct}\left(h_t\right) c_{it}\left(h_t\right) + \sum_t \sum_{h_t} P_{ct}\left(h_t\right) I_t^i\left(h_t\right) \\ &= \sum_t \sum_{h_t} \begin{bmatrix} P_{ct}\left(h_t\right) q^i\left(c_{it}\left(h_t\right), k_t^i\left(h_{t-1}\right)\varepsilon_t\right) - C\left(k_t^i\left(h_{t-1}\right), I_t^i\left(h_t\right)\varepsilon_t\right) \\ -\left(1 + r_{t-1}(h_{t-1}) L_{t-1}^i\left(h_{t-1}\right)\right) + L_t^i\left(h_t\right) \end{bmatrix} \end{aligned} \qquad (7.2.15)$$

Among other things, we get a familiar first order degree condition for investment,

$$P_{ct}\left(h_t\right)\left[1 + \frac{\partial C^i\left(k_t^i\left(h_{t-1}\right), I_t^i\left(h_t\right)\varepsilon_t\right)}{\partial I_t^i\left(h_t\right)}\right] = \sum_{\varepsilon_{t+1}} P_{ct}\left(h_t, \varepsilon_{t+1}\right)\left[\frac{\partial q^i\left(a_{it+1}\left(h_{t+1}\right), k_{t+1}^i\left(h_{t+1}\right)\varepsilon_{t+1}\right)}{\partial k_{t+1}^i\left(h_t\right)}\right] \qquad (7.2.16)$$

which is quite similar to 7.2.13, the marginal cost of investment and the future revenue product. Logically, “firms” face no risk in this perfect market, as all output which is contingent on future shocks is sold forward in advance, in the contingent claims market at known prices. This is virtually identical to the Euler equation in a risk-neutral firm, where the probabilities of that problem are incorporated into the prices here.

The standard result of that financial literature with quadratic equations, as seen in Gilchrist and Himmelberg or Samphantharak after linearizing the approximations is

$$\frac{I_t^i}{k_t^i} = \alpha_0 + f_i + \alpha_1 Q_t^{FIN} + \alpha_2 Q_t^{FIN} + \alpha_3 Q_{it}^{MPK} + \varepsilon_{it} \qquad (7.2.17)$$

where $Q_{it}^{F_{in}}$ is the set of financial characteristics of firm i, $Q_{it}^{F_{in}}$ is the set of financial characteristics that determine *group* borrowing rates and other group constraints in the outside market. Q_i^{MPK} is the firm i, the specific productivity term capturing future profitability, that is, Tobin’s q as it is referred to in the literature. Again the inclusion in 7.2.17 of firm i cash flow characteristics should not be significant. A time dummy might pick up group specific aggregate system effects.

More specifically, again, under various approximations, and retaining a parallel with 7.2.8 there is an investment equation,

$$\frac{I_t^i}{k_t^i} = \beta_{t,t+1}^j D_{t,t+1}^j + \delta\ \Delta\bar{A}_{t,t+1}^j + \eta\ \Delta hs_{t,t+1}^j + \mu\ X_{j96} + \xi\ \Delta Y_{t,t+1}^j + \nu\ \Delta Y_{t,t+1}^j X_{j96} + u_{t,t+1}^j \qquad (7.2.18)$$

such that household/firm investment per unit capital be determined by time specific fixed effects and not by household specific cash flow or income change. The cash flow change variable can be interacted with

X_{j96} characteristics. As noted, the version of this in the finance literature tests for whether investment is sensitive to cash flow, over and above the correlation of cash flow with future productivity.

Change in Consumption onto Change in Income (Levels). Incremental Effect.

	Overall	Central	Northeast	Central Crisis	Recovery	Northeast Crisis	Recovery
Overall	0.057*** (0.000)	0.109*** (.000)	0.004 (.832)	0.112*** (.000)	0.082*** (.001)	0.013 (.675)	0.003 (.919)
Age	0.047*** (.001)	0.019 (.257)	0.291*** (.000)	0.019 (.499)	0.012 (.620)	0.254*** (.000)	0.391*** (.000)
Female	0.014 (.849)	-0.065 (.468)	0.315** (.031)	-0.193 (.178)	0.091 (.437)	0.227 (.252)	0.815*** (.001)
Educ	-0.009 (.206)	-0.001 (.894)	-0.070*** (.000)	0.007 (.663)	0.011 (.452)	-0.046*** (.017)	-0.121*** (.000)
Wealth	-1.3e-12*** (.000)	-7.8e-07*** (.013)	-6.3e-06*** (.000)	-1.1e-06** (.021)	-7.3e-07 (.135)	-5.4e-06*** (.000)	-8.8e-06*** (.000)

Notes: The table reports the coefficient of income change interacted with household characteristics in Equation (4) of the original text. Line 1, Overall, reports the coefficients from OLS regression and lines 2-5 report the coefficient from Median regressions with age, female, education and wealth run jointly. Tambon-specific fixed effects are included in the regression equations. *** indicates 1% significant level, ** 5%, and * 10%. P-values in parenthesis.

[Table 7.2.1 Consumption Smoothing and Target Groups. Source: Alem and Townsend (2005)]

	Overall	Central	Northeast	Central Crisis	Recovery	Northeast Crisis	Recovery
Overall	2.28*** (0.000)	0.068*** (0.000)	2.84*** (0.000)	0.103*** (0.000)	0.068*** (0.000)	0.044 (0.193)	2.84*** (0.000)
Age	-0.980*** (0.000)	-0.083*** (0.000)	-0.624*** (0.000)	-0.080*** (0.000)	-0.091*** (0.000)	-0.049** (0.040)	-0.649*** (0.000)
Female	-1.80*** (0.000)	0.048 (0.201)	-1.96*** (0.000)	-0.185*** (0.000)	0.183*** (0.005)	-0.856*** (0.000)	-2.23*** (0.000)
Educ	0.229*** (0.000)	-0.042*** (0.000)	-0.265*** (0.000)	-0.008 (0.619)	-0.052*** (0.000)	0.050*** (0.006)	-0.350*** (0.000)
Wealth	-5.7e-05*** (0.000)	-4.1e-06*** (0.000)	-2.1e-05*** (0.000)	-3.5e-06*** (0.001)	-2.1e-06 (0.043)	-1.1e-05*** (0.000)	-1.5e-05** (0.044)

Notes: The table reports the coefficient of income change interacted with household characteristics in Equation (5) of the original text. Line 1, Overall, reports the coefficients from OLS regression and lines 2-5 report the coefficient from Median regressions with age, female, education and wealth run jointly.

Tambon-specific fixed effects are included in the regression equations. *** indicates 1% significant level, ** 5%, and * 10%. P-values in parenthesis. The shaded row highlights that the poor are vulnerable.

[Table 7.2.2 Investment Sensitivity. Source: Alem and Townsend (2005)]

CONSUMPTION	Overall	Central	NE	Central Crisis	Recovery	Northeast Crisis	Recovery
By income source							
Agriculture	0.597***	0.059	0.857***	-0.007	0.157	0.768***	0.069
Fish farmers	0.264**	0.310**	0.172	0.368	0.186	-0.874	-0.242
Wage	1.12***	1.29***	0.343	1.71***	0.425	0.103	0.808
Business	-0.317***	-0.245**	-0.242***	-0.186	-0.238*	-0.530***	-0.022
INVESTMENT							
By income source							
Agriculture	-2.64***	0.201***	-2.49***	0.475***	0.181***	1.13***	-2.47***
Fish farmers	-1.64*	0.791*	1.93	-2.21*	0.920*	10.0	-2.98
Wage	6.90***	0.203**	7.03***	0.504***	0.221*	0.475	7.03***
Business	-0.059	0.302***	2.31***	0.016	0.666***	-0.092	2.70***

Notes: The table reports the coefficient of income change variable by source in Equations (4) and (5) of the original text. Tambon-specific fixed effects are included in the regression equations. *** indicates 1% significant level, ** 5%, and * 10%. P-values in parenthesis. The table highlights that businesses are better covered, either by networks or formal finance.

[Table 7.2.3. Source: Alem and Townsend (2005)]

Townsend Thai panel data indicate, as in Table 7.2.1, that households in the Central region's consumption was vulnerable to idiosyncratic fluctuations, especially during the crisis 1997-1999, and households in the Northeast seem to smooth risk better, on average. But households in the Northeast were vulnerable in investment, especially in the recovery period, between 1999-2001. See table 7.2.2. There are few consistent patterns for supposedly vulnerable groups such as the elderly, female-headed households, and those with low education. There is, however, a very consistent pattern in wealth – the poor households, those with few assets, are more vulnerable. (Related high wealth household can pass tests for permanent income hypothesis but the poor do not). Financial markets seem far from perfect for this low wealth group. Stratifications by primary occupation, and by income source, indicate that wage earners and those in agriculture in the Northeast are vulnerable to shocks. Surprisingly business owners do seem to manage to smooth consumption, but investment is sensitive to cash flow. A conjecture: a rise in income may lead to a more than proportionate increase in investment as consumption leads to a drop in financial investment activities. This seems not to happen for the other occupation groups.

Liquidity/ Investment-Cash Flow Sensitivity

	All	1st Quartile	4th Quartile
Simple regression			
Beta	0.039***	0.09***	.008**
t-stat	5.19	9.79	1.79
Number of observations	1,476	284	406
Controlled for industry fixed effects (captured profitability)			
Beta	0.039***	0.078***	0.007
t-stat	5.02	7.45	1.63
Number of observations	1,476	284	406

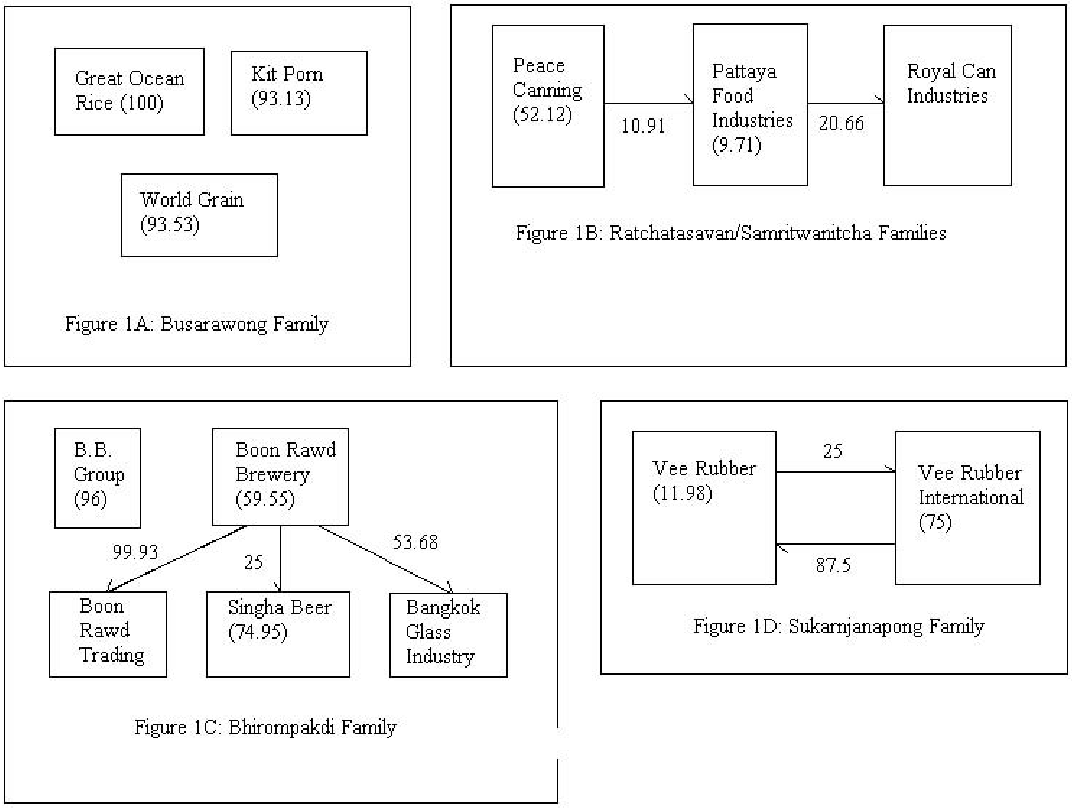
Regression: Investment= alpha +beta*Cash flow +epsilon
Investment= Change in fixed assets/ Beginning fixed assets
Cash flow= (Net profit + Depreciation)/ Beginning fixed assets
***, **, * indicate significance levels of 1%, 5%, and 10% respectively

Controlling for capital structure (debt to asset ratios), size (total assets), and ownership (Thai vs. foreign) do not change the results. These control variables are not statistically significant.

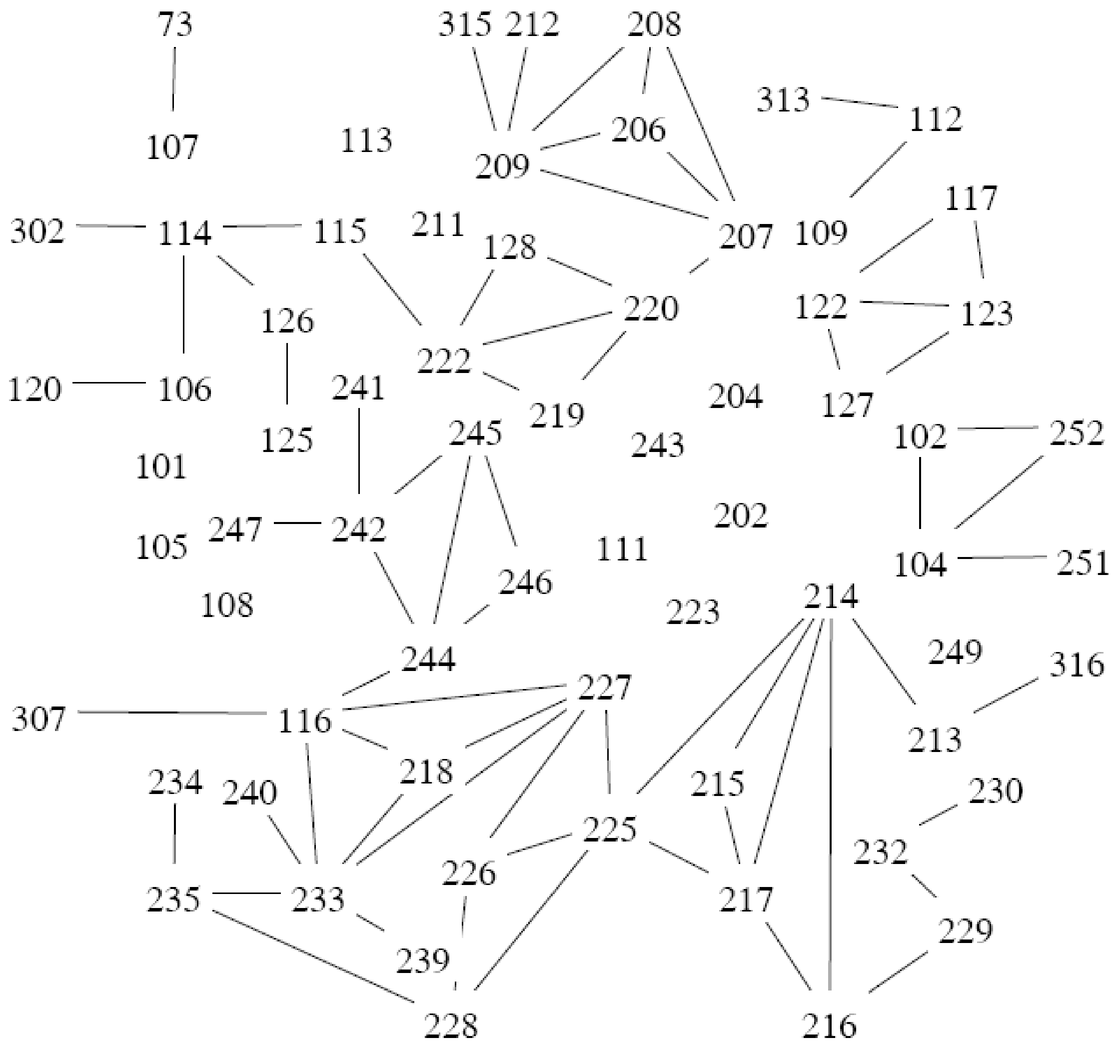
[Table 7.2.4. Investment Cash-Flow Sensitivity. Source: Samphantharak and Townsend (2006)]

Likewise in the Ministry of Industry data in Table 7.2.4, normalized investment is sensitive to cash flow, and this is more salient for smaller firms. Controlling for industry fixed effects, the lowest quartile firms are vulnerable and the highest are not.

7.3 Disaggregation and Risk-Sharing Groups



[Figure 7.3.1. Source: Samphantharak (2002)]



[Figure 7.3.1. (top) Family-related firms (part 1) and (bottom) family-related firms (part2). Source: Samphantharak (2002)]

The entire economy may not be the appropriate level of aggregation. The economy under consideration might consist of a collection of family-related firms in an industrial conglomerate, or a family dynasty in a village, if not the entire village itself. Various illustrations of this were given earlier in Chapter 2 (Figure 2.5.1.for networks in villages, and 2.5.3.for industrial groups).

Dependent Variable: Investment/Capital	(1)	(2)
Cash Flow/Capital	0.124***	0.412***
	(0.015)	(0.033)
Group vs. Non-Group Dummy * (Cash Flow/Capital)		-0.350***
		(0.037)
Group vs. Non-Group Dummy	Not Included	Included
Industry Average Q	0.012	0.012*
	(0.078)	(0.007)
Adjusted R^2	0.022	0.115

Remarks: All regressions include firm fixed effects, firm size, and year effects. Standard errors are in parentheses. ***, **, and * indicate that the estimate is significant at 1%, 5%, and 10%, respectively.

Dependent Variable: Investment/Capital	(1)	(2)	(3)	(4)
Cash Flow/Capital	0.176***	0.222***	0.309***	0.341***
	(0.023)	(0.026)	(0.034)	0.038
Group's Number of Firms * (Cash Flow/Capital)	-0.004**	-0.055***	-0.035***	-0.041***
	(0.002)	(0.015)	(0.010)	(0.011)
Group's Number of Industries * (Cash Flow/Capital)		0.003	-0.023	-0.016
		(0.003)	(0.017)	(0.017)
Group's Number of Listed Firms * (Cash Flow/Capital)			0.092***	0.081***
			(0.024)	(0.025)
Group's Number of Within-Group Intermediaries * (Cash Flow/Capital)				-0.047*
				(0.026)
Individual Group-Year Dummies	Included	Included	Included	Included
Industry Average Q	0.024**	0.025**	0.026***	0.025**
	(0.010)	(0.010)	(0.010)	(0.010)
R^2	0.138	0.155	0.171	0.175

Remarks: All regressions include firm fixed effects, firm size, and year effects. Standard errors are in parentheses. ***, **, and * indicate that the estimate is significant at 1%, 5%, and 10%, respectively.

[Table 7.3.2. Regressions of Investment on Cash Flow and Q for Non-Group Firms and Group Firms (Top) Effects of Group Size and Composition on Investment - Cash Flow Sensitivity of Group Firms (Bottom). Source: Samphantharak (2002)]

Samphantharak (2004) shows that the sensitivity to cash flow is much reduced for family related industrial groups, reduced to such an extent that the magnitude of vulnerability is almost zero. Attributes of the group which are especially helpful are number of members, not being listed on the stock exchange, and the existence of a financial intermediary in the group itself. See Table 7.3.2.

Chiappori, Schulhofer-Wohl, Samphantharak and Townsend (2006) consider efficient risk sharing and heterogeneous preferences. We start from the usual procedure in literature: Assume $u_i(c) = c^{1-\gamma}/(1-\gamma)$ (identical CRRA preferences). Then, as earlier for efficient allocations:

$$\log c_{it} = \alpha_i + \delta_t \tag{7.3.1}$$

which is the log analogue. α_i is the household fixed effect and δ_t is the common time dummy. But, what if $u_i(c) = c^{1-\gamma_i}/(1-\gamma_i)$, heterogeneity in risk aversion. Then, for efficient allocations:

$$\log c_{it} = \alpha_i + \delta_t / \gamma_i \tag{7.3.2}$$

If we maintain hypothesis of efficiency, we can use a likelihood ratio to test identical preferences 7.3.1 versus heterogeneity as in 7.3.2. Or, we can test for efficiency with heterogeneous preferences by seeing whether income is significant in 7.3.2. We can add heterogeneous rates of time preference as well, so that

$$\log c_{it} = \alpha_i + \rho_i t - \delta_t / \gamma_i \tag{7.3.3}$$

Parameters can be found by minimizing a mean square error criterion. In ongoing work, Chiappori, Schulhofer-Wohl and Samphantarak examine the villages of the Townsend Thai monthly surveys for variation in risk aversion and time preferences, as well as Pareto weights.

	heterogeneous risk aversion?	N	Y	N	Y
	heterogeneous time preference?	N	N	Y	Y
Changwat	Village	p-values			
Chachoengsao	1	0.09	0.01	0.41	0.23
	2	0.04	0.03	0.05	0.03
	3	0.97	0.68	0.69	0.46
	4	0.04	0.13	0.19	0.05
Buriram	1	0.002	0.003	0.04	0.03
	2	0.92	0.65	0.99	0.84
	3	0.05	0.10	0.15	0.26
	4	0.000	0.000	0.001	0.000
Lopburi	1	0.60	0.26	0.28	0.29
	2	0.14	0.12	0.05	0.05
	3	0.10	0.03	0.02	0.03
	4	0.22	0.20	0.24	0.09
Sisaket	1	0.48	0.44	0.47	0.40
	2	0.61	0.57	0.55	0.34
	3	0.003	0.004	0.003	0.002
	4	0.08	0.03	0.10	0.02

[Table 7.3.3. Test of Efficient Risk Sharing Using Income. Source: Chiappori, Schulhofer-Wohl, Samphantharak & Townsend, research note]

		test of H_0: identical risk aversion		
Changwat	Village	χ^2	d.f.	p-value
Chachoengsao	3	111.54	29	1e-11
Buriram	2	124.03	13	3e-20
Lopburi	1	64.28	34	0.00129
	4	69.90	30	0.00005
Sisaket	1	74.63	37	0.00024
	2	110.81	41	2e-8

[Notes: Must maintain the hypothesis of perfect risk-sharing to perform this test, so we test for identical preferences only in villages where we cannot reject perfect risk-sharing. Based on 52 months of data on per capita consumption per household; the test assumes identical time preference.]

[Table 7.3.4. Test of Homogeneous vs. Heterogeneous Risk Aversion. Source: Chiappori, Schulhofer-Wohl, Samphantharak & Townsend, research note]

Approximately half the villages pass tests for full insurance, Table 7.3.3., with heterogeneous preferences within them, Table 7.3.4.

7.4 By Shock: Rain and Rubber Prices

The analyst can also assess vulnerability, and a residual need for insurance, against specific shocks. When provincial GDP is regressed onto rainfall, controlling for year and region effects, the results indicate that mean per capita provincial GDP would increase by 17% if rainfall were one standard deviation above the mean. This regression has an adjusted R^2 of 57%. Using the same rainfall data but with observations on household income from the Thai SES, Paxson (1992) finds roughly the same relationship between rainfall and the income of rice farmers: their income would increase by 13% if rainfall were one standard deviation above the mean from April to June.

Evident from the graph shown in Chapter 3, Figure 3.3.3, and as shown in the table 3.4.9, rubber price shocks are quite persistent, with a half-life of about three and a half years. Real prices have drifted downward on average over the sample period (driven in substantial part by increasing competition from synthetic rubber substitutes.)

Similarly, households are potentially vulnerable to movements in international rubber prices. For areas of potential vulnerability, especially those in the South, see Chapter 3, Figure 3.4.4.

The permanent income standard can be used as a measure of insurance. The difference between the permanent income, perfect credit markets model and the full insurance model is that the household does its smoothing by borrowing and lending against a given interest rate, typically assumed to be less than or equal to the rate implicit in the time discount rate. Depending on the model, idiosyncratic shocks may not be completely smoothed – some portion of a shock may enter into consumption, the rest into saving. For example, if credit is limited, or there is no borrowing at all, then households save at relatively high rates on average. They accumulate buffer stocks in anticipation of future shortfalls. Consumption moves even more with current income when buffer stocks are low.

The difference between the full risk sharing model and the permanent income model becomes more apparent when shocks have a persistent component. A shock to permanent income moves consumption in the full risk sharing model only if the persistent component is common across households. Consider an infinitely-lived household with an exponential utility function maximizing

$$U_t = -\frac{1}{\gamma} E_t \left[\sum_{t-1}^{\infty} \beta^t \exp\left(-\gamma c_{it}\right) \right]$$

and income stream following an $AR(1)$ process: $y_t = \bar{y} + \rho y_{t-1} + \varepsilon_t$ where ε_t is normally distributed $(0, \sigma^2)$. Denote the household's wealth at the time t by W_t, and assume the household can borrow and lend at interest rate $r = \frac{1-\beta}{\beta}$. Under these special conditions, the current-period consumption of the household is given by the simple linear form,

$$c_t = \underbrace{\mu + (1-\beta)W_t}_{\text{permanent income component}} + \underbrace{\frac{1-\beta}{1-\rho\beta}\left[y_t - \mu\right]}_{\text{current income: deviation from long-run average}} - \underbrace{\frac{\beta}{1-\beta} \cdot \frac{1}{2}\sigma^2\gamma}_{\text{precautionary savings component}}$$

where $\mu = \frac{\bar{y}}{1-\rho}$ is the unconditional mean of y_t. The current period saving of the household is given by:

$$s_t = -(1-\beta)W_t + \frac{\beta(1-\rho)}{1-\rho\beta}\left[y_t - \mu\right] + \frac{\beta}{1-\beta}\frac{1}{2}\sigma^2\gamma$$

As $\rho \to 1$ (i.e., as the shock comes close to being permanent), a unit shock to income y_t results in a unit change in c_t, leaving saving unchanged. Conversely, as $\rho \to 0$, only the fraction $1-\beta$ is consumed, and typically this is close to zero.

If rainfall shocks are entirely transitory, as they seem to be in the data, then the income process is autoregressive with parameter ρ close to zero. The coefficient on income in the consumption equation should be of the order of magnitude of the size of the interest rate $\frac{r}{1-r}$, and the coefficient on savings should be $\beta = \frac{1}{1+r}$, close to one, as if all transitory income were saved. Thus income and saving should respond equally to exogenous shocks.

If rubber price shocks are persistent, as they seem to be in the data, then ρ is far from zero, and consumption should move with income, in the order of magnitude $\frac{1-\beta}{1-\rho\beta}$.

Response of Savings to Transitory Income

	Income		Save1		Save2		Save3	
Variable	Estimate	t	Estimate	t	Estimate	t	Estimate	t
Intercept	2,455.6	(16.30)	767.30	(2.88)	1,062.0	(4.03)	358.38	(1.06)
Year = 1981	301.68	(6.39)	44.774	(0.54)	37.450	(0.45)	121.57	(1.15)
Year= 1986	-402.26	(4.85)	-616.08	(4.20)	-725.18	(5.00)	-229.02	(1.23)
Rainfall variables:								
$(R_1 - R_1)$	1.9093	(2.52)	3.238	(2.42)	2.9861	(2.26)	2.6737	(1.58)
$(R_2 - R_1)^2$	-0.0450	(3.99)	-0.0654	(3.28)	-0.0493	(2.50)	-0.0388	(1.54)
$(R_2 - R_2)$	1.2502	(5.55)	1.2077	(3.03)	1.2888	(3.27)	1.2698	(2.52)
$(R_2 - R_2)^2$	0.2282	(1.00)	-0.7973	(1.98)	-0.6963	(1.75)	0.6231	(1.23)
$(R_3 - R_3)$	0.2282	(1.00)	-0.7973	(1.98)	-0.6963	(1.75)	0.6231	(1.23)
$(R_3 - R_3)^2$	0.0004	(0.62)	0.0008	(0.63)	0.0009	(0.72)	0.0011	(0.66)
$(R_4 - R_4)$	1.6097	(2.57)	0.5466	(0.49)	0.6314	(0.58)	2.7626	(1.97)
$(R_4 - R_4)^2$	-0.0095	(2.85)	-0.0090	(1.53)	-0.0087	(1.50)	-0.0170	(2.29)
Sex/age/education variables:								

Number of people aged 0-5	37.693	(1.73)	-43.168	(1.12)	-56.465	(1.48)	26.942	(0.55)
Number of males aged 6- 11	59.730	(2.29)	13.313	(0.29)	37.334	(0.82)	20.976	(0.36)
Number of females aged 6- 11	79.547	(3.16)	9.2344	(0.21)	20.577	(0.47)	-74.5333	(1.32)
Number of males aged 12- 17	220.57	(8.11)	-32.445	(0.68)	38.508	(0.81)	32.678	(0.54)
Number of females aged 12-17	192.98	(7.80)	-19.965	(0.41)	40.598	(0.85)	60.605	(1.00)
Number of males aged 18-64:								
Primary school or less	349.38	(13.14)	41.919	(0.89)	95.070	(2.04)	30.400	(0.51)
Secondary school	765.72	(8.20)	-131.55	(0.80)	76.724	(0.47)	-318.86	(1.53)
Postsecondary school	1042.9	(7.69)	23.487	(0.10)	302.51	(1.27)	-185.55	(0.60)
Number of females aged 18-64:								
Primary school or less	62.306	(1.62)	31.259	(0.46)	43.890	(0.65)	292.07	(3.39)
Secondary school	345.63	(2.59)	-257.59	(1.09)	-43.456	(0.19)	210.00	(0.70)
Postsecondary school	676.93	(3.32)	186.11	(0.52)	277.2	(0.78)	-429.96	(0.94)
Number of males aged 65 or more	135.52	(1.99)	-5.1721	(0.04)	-32.04	(0.27)	-48.097	(0.32)
Number of females aged 65 or more	159.68	(2.60)	-91.856	(0.85)	-53.10	(0.50)	27.394	(0.20)
Landownership dummies (omitted category is owns 40 rai or more):								
Renter	-1,338.8	(18.93)	-742.32	(5.93)	-938.24	(7.58)	-297.15	(1.88)
Owns less than 2 rai	-1,699.6	(5.46)	-281.72	(0.51)	-588.17	(1.08)	-24.900	(0.04)
Owns 2-4 rai	-1,769.4	(16.32)	-707.31	(3.69)	-924.65	(4.87)	-479.16	(1.98)
Owns 5-9 rai	-1,583.2	(20.97)	-641.01	(4.80)	-850.34	(6.44)	-440.61	(2.61)
Owns 10-19 rai	-1,368.3	(21.11)	-695.45	(6.07)	-841.95	(7.42)	-382.71	(2.64)
Owns 20-39 rai	-1,008.3	15.99	-559.39	(5.01)	-685.25	(6.21)	-367.25	(2.60)
R^2	0.34		0.03		0.04		0.02	
F tests:[a]								

Test 1	0.0001	0.0008	0.0016	0.0090
Test 2		0.4044	0.6180	0.9049
Test 3		0.0001	0.0001	0.1432

Notes: The numbers in parentheses are *t* statistics. The table shows ordinary least-squares estimates of income and savings equations. The number of observations is 4,855. In addition to the variables listed, the regression included dummy variables for 20 regions over two years. Definitions of variables: SAVE1 is income minus expenditure on all goods; SAVE2 is income minus expenditure on nondurable goods; SAVE3 is the change in assets.
[a]Table entries for F tests are P values. Test 1: rainfall variables jointly are insignificant. Test 2: effect of rain on income equals effect of rain on savings. Test 3: landownership variables are jointly insignificant.

[Table 7.4.1. Response of Savings to Transitory Income. Source: Paxson (1992)]

Paxson cannot reject in cross sectional SES data that various (imperfect) measures of saving move one to one with rainfall related income. See Table 7.4.1. A guess from the thesis work of Paulson (2001) is that remittances are helping to smooth shocks, especially in the Northeast.

Basic Results

(A) Least Squares			
Dependent Variable	Household Income	Household Saving	Household Consumption
rubber_prop	-938.642	-371.956	-566.686
	(465.414)**	(440.771)	(265.694)**
rubber_prop*time	73.314	16.958	56.356
	(52.758)	(50.310)	(31.439)*
rubber_prop*rubber_price	521.445	37.741	483.703
	(131.282)***	(149.130)	(124.259)***
Number of observations	44009	44009	44009
R^2	0.15	0.04	0.18
(B) Median regression			
Dependent Variable	Household Income	Household Saving	Household Consumption
rubber_prop	-139.344	-254.458	-219.973
	(163.798)	(112.071)**	(128.721)*
rubber_prop*time	28.714	40.280	4.586
	(19.532)	(13.361)***	(15.353)
rubber_prop*rubber_price	243.363	15.499	231.589
	(62.091)***	(42.473)	(48.823)***
Number of observations	44009	44009	44009

Notes: Estimation by least square (first part of table) and median regression (second part of table). Robust standard errors. Regression also includes a constant and: (i) 8 dummies for the sex and education level of household head (ii) controls for number of children in 5 different sex-age categories (iii) dummies for Changwat (province) location of household (iv) dummies for the year-quarter the household was surveyed (v) 8 dummies for the socio-economic class of the household head (vi) 13 dummies for the type of enterprise the household head was primarily occupied with.
*, **, ***– significant at 10%, 5%, and 1% respectively

[Table 7.4.2. Source: Vickery (2004)]

But virtually identical tests in Townsend and Vickery (2004) find that consumption moves with rubber-price-related income more than would be predicted by the permanent income model. Specifically, as earlier, let the income of household i be expressed as

$$y_{it} = \alpha_0 + X_{it}\alpha_1 + \alpha_2 E_{it} R_t + \varepsilon_{it} \qquad (7.4.1)$$

where R_t is the rubber price at t and E_{it} is a measure of the intensity of rubber farming in the village of household i at date t. The X_{it} are controls. The consumption specification is

$$c_{it} = \delta_0 + X_{it}\delta_1 + \delta_2 E_{it} R_t + u_{it}\,. \qquad (7.4.2)$$

Turning to column 1, of Table 7.4.2, α_2, the coefficient on $E_{it}R_t$ as a determinant of household income has the expected positive sign: when rubber prices are high (low), households in villages with a high proportion of rubber tappers (‘rubber villages’ for short) experience an increase (decrease) in income relative to other households. A one standard deviation fall in rubber prices reduces income in rubber villages by 521 baht; this corresponds to 7.7 per cent of average household income. This estimate is statistically significant at the 1 per cent level (*z*-stat = 3.9). Rubber villages have a somewhat (938 baht) lower income on average compared to non-rubber villages.

Columns 2 and 3 presents estimates of the effect of rubber price shocks on household savings and consumption respectively - only one of these is independently estimated; since we define consumption identically as $c_{it} = y_{it} - s_{it}$ any one of columns 1, 2 or 3 is a linear combination of the other two. The results suggest that little of the rubber-price-induced change in income is absorbed by borrowing and saving. The point estimate of $\alpha_2 - \delta_2$ from Column 2 (i.e. the coefficient on $E_{it}R_t$) implies that a one standard deviation fall in rubber prices reduces saving for households in rubber villages by only 38 baht relative to non-rubber households (6 per cent of the estimated change in income, and in fact not statistically distinguishable from zero). The remainder (483 baht) is reflected in a change in consumption.

That is, our point estimate of the marginal propensity to consume out of rubber-price-induced changes in income is 0.94.

A simple permanent income model can account for part of the divergence of the results from the previous literature, simply because rubber price shocks are quite persistent, and thus have large effects on permanent income. As a rough guide, we take Cashin, Liang and McDermott's (1999) estimate of an autocorrelation parameter of 0.82, assume an interest rate of .10, and apply these to the CARA-normal permanent income model. This yields a marginal propensity to consume of $\frac{1-\beta}{1-\rho\beta}=0.38$. But our estimated marginal propensity to consume of 0.94 is economically and statistically higher than this number.

Related, savings, credit, and remittances change little with rubber price movements, especially in the South. Thus parts of the Thai economy seem to suffer from incomplete insurance.