LECTURE 6:

Insurance: from Village Insurance to Financial Access and Targeting to Risk Instruments

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Risk and Insurance in Village India

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Econometrica, 1994

Motivation

- Large part of the population in developing economies live in high-risk environments
- However, there are numerous mechnisms for how risk can be shared
  - diversification of activities
  - financial transactions
  - gifts and transfers within the family/network
  - ...
- How well do households do using any of these mechanisms?
- Main insight: By focusing directly on the implications of optimal rish-sharing we do not have to explicitly specify these mechanisms
- In particular: Arrow-Debreu style complete markets not necessary!

Optimal risk sharing

- Main implication: Individual consumption should not depend on individual income, once aggregate consumption is controlled for
- Hence: Allocations are *as if* all output were pooled together and then optimally distributed
- Intuition: If one agent absorbs his idiosyncratic risk, other agents are locally risk-neutral with respect to this shock and hence should offer insurance to the former

Where to test risk-sharing? The environment

- Risk-sharing is a property of a *group of individuals.* This could be
  - family
  - village
  - syndicates (banks, kinships...)
- Hence: researcher has to decide which group to consider. In this paper: risk-sharing within villages
- People have to face *idiosyncratic risk* - otherwise there is nothing to insue against and we cannot test anything

Characteristics of village economies

- Risk is important property of the environment, because agriculture is predominant income source
- Individuals face idiosyncratic risk as they specialize in different crops
  - in fact: this itself is already indicative that there are other risk-sharing mechanisms and diversification is not needed!
- From a theoretical point of view, villages seem promising to sustain risk-sharing agreements as
  - Village members face repeated interactions
  - Villages have own contract enforcement mechanisms
  - Informational asymmetries are presumably limited

Risk and diversification possibilities in agriculture

- Yields are risky. In Aurepalle the coefficients of variations range from 0.5 (sorghum) to 1.01 (castor).
- Diversification across crops is possible as cross-crop correlation ranges from 0.09 to 0.81.
- Soil is also not uniform, so that the CV for castor ranges from 0.7 to 1.01 depending on the type of soil.
- Again: diversification across soil is possible as the correlation is only 0.37.
- But: households do not hold the "market portfolio" of soil-crop combinations

The income process: Idiosyncratic risk exists

TABLE I

COMPOSITION OF INCOME, BY SOURCE AND LANDHOLDINGS[a]

Village	Income Source	None	Small	Landholdings Medium	Large	All
Aurepalle	Crop	0.0225	0.2623	0.3967	0.5645	0.4476
	Labor	0.6527	0.3363	0.1623	0.0429	0.1538
	Trade & Handicrafts	0.2799	0.2919	0.3033	0.1242	0.1957
	Animal Husbandry	0.0449	0.1095	0.1373	0.2685	0.2029
Shirapur	Crop	0.4364	0.3735	0.5293	0.5617	0.4992
	Labor	0.4897	0.3825	0.3305	0.2268	0.3209
	Trade & Handicrafts	0.0002	0.0142	0.0000	0.0372	0.0189
	Animal Husbandry	0.0736	0.2298	0.1404	0.1743	0.1610
Kanzara	Crop	0.0529	0.2603	0.5002	0.6429	0.5109
	Labor	0.8506	0.5962	0.3513	0.1424	0.3056
	Trade & Handicrafts	0.0664	0.1144	0.0248	0.0034	0.0307
	Animal Husbandry	0.0301	0.0290	0.1237	0.2113	0.1528

[a] Figures reported are proportions of income from a given source, given village and landholdings.

The income process: Idiosyncratic risk matters

TABLE II

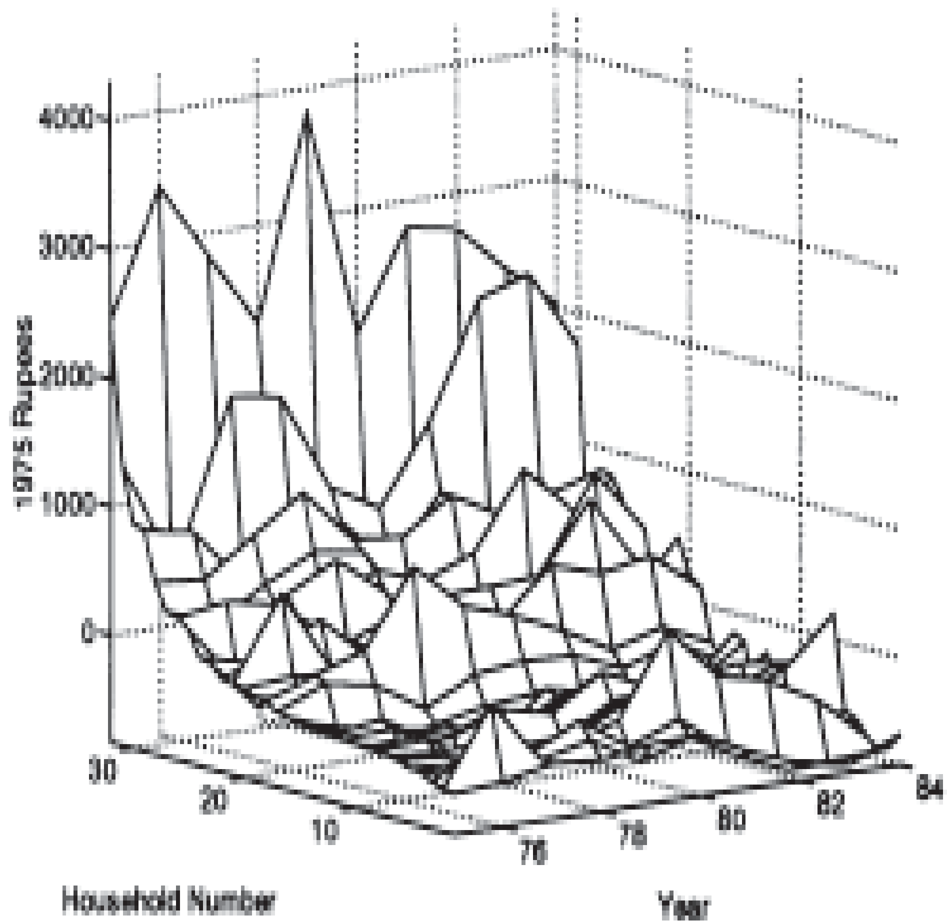
COEFFICIENTS OF VARIATION AND CORRELATION OVER INCOME SOURCES[a]

Village	Profits from Crop Prod.	Livestock Income	Earned Wages	Trade & Handicraft
Aurepalle	0.4227 (0.1101)	−0.0188 [−0.50, 0.50]	0.5800 [0.05, 0.85]	0.6297 [0.05, 0.85]
		0.2136 (0.0499)	0.3607 [−0.25, 0.75]	0.4586 [−0.20, 0.75]
			0.4554 (0.1211)	0.8194 [0.45, 0.95]
				0.4292 (0.1123)
Shirapur	0.2442 (0.0578)	0.5817 [0.05, 0.85]	0.6386 [0.05, 0.85]	0.7913 [0.45, 0.95]
		0.1938 (0.0449)	0.2535 [−0.30, 0.70]	0.6738 [0.05, 0.85]
			1.3068 (0.6140)	0.7352 [0.35, 0.90]
				0.3235 (0.0795)
Kanzara	0.4048 (0.1043)	0.8721 [−0.55, 0.95]	0.8067 [0.45, 0.95]	0.9345 [0.85, 1.00]
		0.3830 (0.0974)	0.7436 [0.35, 0.90]	0.8586 [0.55, 0.95]
			0.5330 (0.1493)	0.8240 [0.45, 0.95]
				0.2973 (0.0721)

Dynamics of the income process

Basic picture: Inequality and uncorrelated shocks.

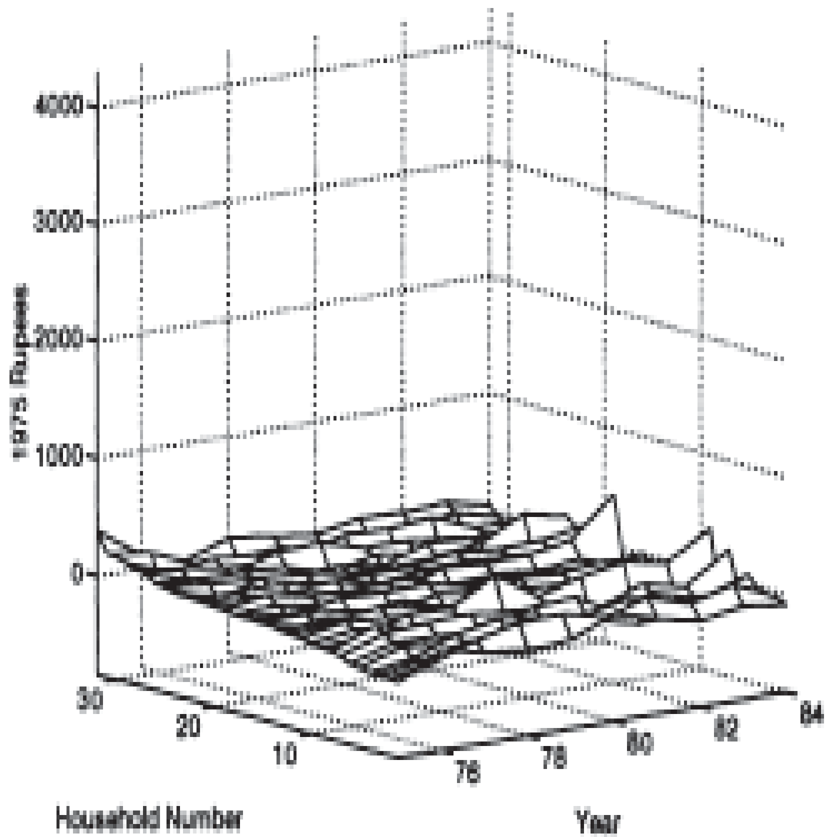
Recall: Households are of very different size.



(a) Comovement of household incomes (deviation from village average) Aurepalle.

Dynamics of individual consumption

Basic picture: consumption profiles much smoother than income process



(a) Comovement of household consumptions (grain only) (deviation from village average) Aurepalle.

Testing risk-sharing formally: Theory

- Let $c_t^k(h_t)$ be consumption of individual k after history $h_t = (\varepsilon_1, \varepsilon_2, ..., \varepsilon_t)$
- Optimal allocation of consumption across individuals maximizes

$$\sum_{i=1}^{M} \lambda_k \left(\sum_{t=1}^{T} \beta^t \sum_{h_t} P(h_t) W^k \left[c_t^k(h_t), A_t^k \right] \right)$$

subject to the aggregate endowment of the village

$$\sum_{k=1}^{M} c_t^k(h_t) \leq \overline{c_t}(h_t) \quad \text{for all } h_t$$

- Here: A_t^k is age-sex index, which might affect marginal utility of consumption
- Note: could allow for leisure-labor tradeoff (and this is done in the paper)
- Note also: choice variable are *state-contingent* consumption allocations

Consumption allocations: Individuals

- Solving this problem for state h_t yields the FOC

$$\lambda_k W_k' \left(c_t^k (h_t), A_t^k \right) = \frac{\mu(h_t)}{\beta^t P(h_t)} \equiv \tilde{\mu}(h_t)$$

  which says: λ-weighted marginal utilities are equalized across individuals
- Suppose: $W(c, A) = -\sigma^{-1} exp\left(-\sigma \frac{c}{A}\right) = -\sigma^{-1} exp(-\sigma \tilde{c})$. Then:

$$\tilde{c}_t^k (h_t) = \frac{1}{\sigma} ln(\lambda_k) - \frac{1}{\sigma} ln\left(A_t^k\right) - \frac{1}{\sigma} ln(\tilde{\mu}(h_t))$$

  - Depends on h_t only via *common* multiplier μ, i.e. full insurance of idiosyncratic shocks
  - risk aversion σ governs sensitivity wrt to shocks in μ
  - λ_k and A_t^k affect level and trend of individual consumption

Consumption allocations: Households

- Problem: Data has *household* consumption

$$
\begin{aligned}
\frac{\sum_{k=1}^{N^j} c_t^k}{\sum_{k=1}^{N^j} A_t^k} = {} & \frac{1}{\sigma_j}\left[\log\left(\lambda^j\right) - \frac{\sum_{i=1}^{N} \frac{1}{\sigma_i}\log\left(\lambda^i\right)}{\sum_{i=1}^{N} \frac{1}{\sigma_i}}\right] \\
& - \frac{1}{\sigma_j}\left[\frac{\sum_{k=1}^{N^j} A_t^k \log\left(A_t^k\right)}{\sum_{k=1}^{N^j} A_t^k}\right. \\
& \left. - \left(\sum_{i=1}^{N} \frac{1}{\sigma_i} \frac{\sum_{k=1}^{N^i} A_t^k \log\left(A_t^k\right)}{\sum_{k=1}^{N^i} A_t^k}\right) \Big/ \sum_{i=1}^{N} \frac{1}{\sigma_i}\right] \\
& + \frac{1/\sigma_j}{\sum_{i=1}^{N} 1/\sigma_i}\left[\sum_{i=1}^{N}\left(\frac{\sum_{k=1}^{N^i} c_t^k}{\sum_{k=1}^{N^i} A_t^k}\right)\right].
\end{aligned}
$$

- Determinants of consumption: (1) pareto weights (wealth), (2) HH composition, (3) Agg consumption, (4) Relative risk aversion

Empirical Application

- Theory implies that

$$c_t^{*j} = \alpha^j + \beta^j \overline{c}_t + \delta^j \overline{A}_t^j + \zeta^j X_t^j + u_t^j$$

  where c_t^{*j} is "age-weighted" family consumption, $\overline{c}_t$ is aggregate consumption and X_t^j are additional variables

- According to the theory:
  - $\beta^j = 1$ if identical risk aversion
  - $\delta^j = -1/\sigma$
  - $\zeta^j = 0$

- Test for those implications using
  - Family-specific time series regressions
  - Panel where all families are pooled

- Note: $\frac{1}{N} \sum_j \beta^j = 1$ if only $\overline{c}_t$ included. Hence: mostly the dispersion of β^j is interesting

Exclusion for idiosyncratic income: Time Series

For how many individuals can you reject $\zeta = 0$ or $\zeta = 1$?

TABLE V

a. TABULATION OF NUMBER OF REJECTIONS OF TWO SETS OF NULL HYPOTHESES (ALL CONSUMPTION)[a]

			H_0: $\zeta = 0$			H_0: $\zeta = 1$		
	Population	Variable	$\zeta < 0$	$\zeta = 0$	$\zeta > 0$	$\zeta < 1$	$\zeta = 1$	$\zeta > 1$
1	Aurepalle	All Income	4	32	8	37	7	0
2		Crop Income	3	40	1	26	18	0
3		Labor Income	3	37	4	17	27	0
4		Profit from Trade and Handicrafts	3	37	4	15	27	2
5		Profit from Animal Husbandry	3	37	4	13	30	1
7		#Household Members	9	35	0			
8		#Adults	5	30	0			
9		#Children	2	31	2			

Exclusion for idiosyncratic income: Panel

TABLE VIII

a. Panel Estimates with All Consumption*

	Village:	Aurepalle			Shirapur			Kanzara		
	Variable	(A) Std. ζ_w	(B) First Diff ζ_Δ	(C) 2 IV G − H ζ	(D) Std. ζ_w	(E) First Diff ζ_Δ	(F) 2 IV G − H ζ	(G) Std. ζ_w	(H) First Diff ζ_Δ	(I) 2 IV G − H ζ
1	All Income	0.0772*	0.0469		0.1169*	0.0592*		−0.0073	0.1233*	0.2177
		(0.0221)	(0.0236)	[0.768]	(0.0277)	[0.0236]	[1.290]	(0.0219)	(0.0227)	[−3.177]
2	Crop Profit	−0.0150	−0.0380		0.0825*	0.0352		0.0513*	0.0677*	−0.2545
		(0.0312)	(0.0299)	[0.380]	(0.0373)	[0.0301]	[0.609]	(0.0286)	(0.0308)	[−2.355]
3	Labor Income	0.0401	0.2597*		0.1127*	0.1925*		0.0198	0.1003*	
		(0.0647)	(0.0830)	[−1.543]	(0.0740)	[0.0655]	[−0.271]	(0.0406)	(0.0422)	[−1.058]
4	Profit from Trade and Handicrafts	0.2363*	0.1495*		0.0291	−0.1091		0.1347	0.4057*	
		(0.0352)	(0.0389)	[1.197]	(0.0671)	[0.0757]	[0.742]	(0.0895)	(0.0863)	[−1.312]
5	Profit from Animal Husbandry	0.0485	−0.0276		0.5014*	0.1994*	1.4678	0.0672	0.2252*	
		(0.0676)	(0.0689)	[−0.116]	(0.0789)	[0.0693]	[2.193]	(0.0606)	(0.0715)	[−1.387]
6	Full Income	−0.0123*	0.0016		NA	NA	NA	−0.0081	0.0058	
		(0.0027)	(0.0058)	[−1.412]				(0.0044)	(0.0043)	[−0.012]
7	Wage	−10.269	−7.1232		−41.201*	−47.7768		−116.31*	−11.7713	−297.696
		(8.4114)	(10.2640)	[0.004]	(15.4649)	[31.3120]	[−0.467]	(14.057)	(16.8668)	[−4.161]

Interpreting optimal risk sharing: λ and wealth

- Theory implies that

$$\tilde{c}_t^k(h_t) = \frac{1}{\sigma} ln(\lambda_k) - \frac{1}{\sigma} ln \quad A_t^k \quad - \frac{1}{\sigma} ln(\tilde{\mu}(h_t))$$

- Empirical implementation

$$c_t^{*k} = \alpha^k + \beta^k \overline{c}_t + \delta^k \overline{A}_t^k + \zeta^k X_t^k + u_t^k$$

- Hence: the fixed effect α^k is related to the pareto weight λ^k
- *If* risk-sharing were generated through Arrow-Debreu-style market, α^k should be explained by individuals' period 0 wealth
- Reason: with complete markets, there is *one* budget constraint
- Interesing to see if estimated intercept α^k varies with measures of wealth
  - land holdings
  - inheritances
  - value of owned bullocks

Wealth and Pareto weights

RELATIONSHIP BETWEEN INTERCEPTS AND WEALTH (ALL CONSUMPTION)[a]

Variable	Aurepalle Coefficient	Aurepalle R^2 Pr > F	Shirapur Coefficient	Shirapur R^2 Pr > F	Kanzara Coefficient	Kanzara R^2 Pr > F
Area of Operated Landholdings	75.3901*	0.3654	46.8825	0.1119	72.6061*	0.3964
	(17.5627)	0.0002	(23.7264)	0.0571	(16.0915)	0.0001
Value of Owned Bulls	0.7888*	0.5485	0.1829	0.0140	0.4786*	0.3817
	(0.1265)	0.0001	(0.2755)	0.5116	(0.1094)	0.0001
Value of Inheritance	0.0279*	0.5164	0.0001	0.0000	0.0091	0.0478
	(0.0048)	0.0001	(0.0102)	0.9926	(0.0073)	0.2214
Number of Siblings	7.8893	0.0206	1.0890	0.0003	15.0894	0.0634
	(9.6170)	0.6730	(10.5034)	0.9181	(10.4125)	0.1573
Number of Married Sons	−29.8590	0.0468	−47.0702	0.0712	−28.0986	0.0069
	(23.8171)	0.2190	(30.5264)	0.1332	(60.3379)	0.6447
Number of Migrants	27.3845	0.0066	−23.6448	0.0624	−11.3360	0.0225
	(59.2378)	0.6470	(16.4622)	0.1609	(13.4121)	0.4045
Total Wealth	0.0092*	0.4826	0.0113*	0.2346	0.0111*	0.3390
	(0.0017)	0.0001	(0.0037)	0.0043	(0.0028)	0.0004
Age of Head of Household	−4.6972	0.0543	13.6948	0.0415	26.3948	0.0719
	(12.3202)	0.4206	(14.5099)	0.5296	(17.3928)	0.3264
Age of Head squared	0.0223		−0.1484		−0.2845	
	(0.1080)		(0.1454)		(0.1914)	

Summary and lessons

- Village households adapt well to the risk they are facing
- Apparently there are important risk-sharing mechanisms, which make diversification on the employment level unneccessary. Note that this is an important efficiency gain if we think that specialization is important for productivity
- While wealth is correlated with the pareto weights, the results are inconsistent with existence of Arrow-Debreu markets
  - Explanatory power of inheritance is limited
  - Explanatory power of assets that are accumulated over time is high
  - This pattern is more consistent with models of private information about individual productivity

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Alem and Townsend (2012) "An Evaluation of Financial Institutions: Impact on Consumption and Investment Using Panel Data and the Theory of Risk-Bearing"

This paper shows how to rate outside financial institutions using instruments for financial access, such as distance to provider's branch. Those with financial access are compared to those without, to see if risk sharing is improved. The treatment group is the set of customers of the financial intuitions, directly measured through actual use in the data.

We derive both consumption and investment equations from a common core theory with both risk and productive activities. The empirical specification follows closely from this theory. We link financial institution assessment to the actual impact on clients, rather than ratios and non-performing loans.

Policy question: the effectiveness of financial institutions - Alem and Townsend (2012)

Results:

- A government development bank (BAAC) is particularly helpful in smoothing consumption and investment, in no small part through credit, consistent with its own operating system, which embeds an implicit insurance operation. The complete market hypothesis is rejected. The results appear to be driven by low wealth households.
- Commercial banks are smoothing investment, largely through formal savings accounts.
- Other institutions seem ineffective by these metrics.

Policy question: the effectiveness of financial institutions - Alem and Townsend (2012)

Model: a modified version of the final choice model of Greenwood and Jovanovic (1990).

Financial institutions:

- **Costs:** Costly to establish or to learn to use. Household i has to pay a once-and-for-all lump-sum cost Z_i to become a member of a financial institution, incurred at the time of joining.
- **Benefits:** Provide households access to better information and as-if-complete markets.

Policy question: the effectiveness of financial institutions - Alem and Townsend (2012)

Preferences: autoregressive preference shock $\xi_{i,t+1} = \rho\xi_{it} + \nu_{it}$, where ν_{it} is i.i.d. over individuals and time. Potential endogeneity problem if $\rho > 0$.

Technology: $q_{it} = f_i(k_{it}, \theta_t + \varepsilon_{it})$, where $\theta_t + \varepsilon_{it}$ is a composite technology shock. For wage earning households, k_{it} is simply a constant, not business capital.

Investment: $g_i(I_{it}, k_{it}, \omega_{it})$ is the cost of adjustment function where I_{it} is investment of household i at t and ω_{it} is an i.i.d. household-specific shock to the cost of capital stock adjustment.

Policy question: the effectiveness of financial institutions - Alem and Townsend (2012)

At $t = 0$, financial participation decision is made. At that point, household i occupation, all initial preference shocks ξ_{i0}, technology shocks $\theta_0 + \varepsilon_{i0}$,adjustment cost shocks ω_{i0} and initial asset conditions k_{i0} are predetermined. Initially, the household can only see the sum, $\theta_0 + \varepsilon_{i0}$.

Value functions:

Participant in the financial system:

$$V_i(k_{i0} - Z_i, \xi_{i0}, \theta_0 + \varepsilon_{i0}, \omega_{i0})$$

Autarky:

$$W_i(k_{i0}, \xi_{i0}, \theta_0 + \varepsilon_{i0}, \omega_{i0})$$

Policy question: the effectiveness of financial institutions - Alem and Townsend (2012)

Policy Functions for the Different Financial Regimes

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

Policy question: the effectiveness of financial institutions - Alem and Townsend (2012)

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

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

Cost Z_i does not affect potential levels of consumption or investment other than in the initial date before our sample periods, but cost Z_i does affect the initial choice of financial participation. In this sense, Z_i in the theory is a valid instrument for the participation decision.

Policy question: the effectiveness of financial institutions - Alem and Townsend (2012)

Instruments for Z_i: alternative measures of the cost of financial participation based on geographical variation

- History of institution use
- Time to district center
- GIS: use the responses from nearby CDD villages in 1996 to create a weighted membership variable for each of the villages of the Townsend Thai survey.
  - The averaging is removing some measurement error.
  - Can impute values to villages that otherwise are missing headmen responses.
  - There may be supply-side variation.

Policy question: the effectiveness of financial institutions - Alem and Townsend (2012)

Shocks in the data:

- **Aggregate:** The data start in May 1997, just prior to the onset of the July 1997 financial crisis, and continue through 2001, that is, through the recovery.
- **Idiosyncratic:** The data from households and small businesses specialized in different mixes of occupations and subject to different shocks.

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Policy question: the role of neglected informal finance

The relationship between kinship networks and financial access, and the *channels* through which their effects occur are not well understood in the literature.

Kinnan and Townsend (2012) show that within a village, households connected to each other through chains of financial transactions (gifts, loans) or related by family ties, can mean the effective treatment groups, those indirectly as well as directly connected to a financial service provider, is larger. Ignoring the effect of being indirectly connected to financial networks and institutions, and using households not directly connected as a comparison group, may yield biased estimates of the effect of financial access, due to the spillover of indirect access through other households. This also means that those not connected in any way are actually even more vulnerable than had been surmised, and might be targeted. **Andgelucci, de Giogi, Rangel, and Rasul (2009)** find similar effects in Mexico.

Kinnan and Townsend (2012) “Kinship and Financial Networks, Formal Financial Access and Risk Reduction”

Analyze the role of indirect access (through another household) to financial institutions in facilitating access to credit.

Strikingly, the results show that an indirect connection is as effective in consumption smoothing as a direct connection, suggesting that borrowing and lending among households acts to distribute capital from formal financial institutions.

For investment smoothing, presence of kin is very effective while bank connections do not play a significant role.

Policy question: the role of neglected informal finance - Kinnan and Townsend (2012)

Prevalence of transfers with other households in the village:

- Out of 531 households in 16 villages, 411 borrow or receive gifts at least once over 84 months.
- Conditional on participation, the average household borrows/receives from 3.2 other households (minimum 1, maximum 17).
- Intra-village borrowing transactions tend to be large, but relatively infrequent:
    - The average amount borrowed per transaction is 12,200 baht, which is equal to 60% of average monthly household expenditure.
    - The average household borrows from other villagers 4.75 times over 84 months.

Policy question: the role of neglected informal finance - Kinnan and Townsend (2012)

Consumption-smoothing specification:

$$\Delta c_{i\nu t} = \alpha_1 \Delta y_{i\nu t} + \alpha_2 \Delta y_{i\nu t} \times d_{i,B} + \alpha_3 \Delta y_{i\nu t} \times r_{i,B} +$$

$$+ \alpha_4 \Delta y_{i\nu t} \times k_i + \alpha_5 \Delta y_{i\nu t} \times \bar{\omega}_i + \delta_{B,t} + \varepsilon_{it}$$

$c_{i\nu t}$ and $y_{i\nu t}$ are, respectively the per capita consumption and income of household i in village v in month t.

$d_{i,B}$ and $r_{i,B}$ indicate, respectively, direct and any connection to the financial system.

k_i is an indicator for presence of kin in the village.

$\bar{\omega}_i$ is household i's average net worth over the sample period and $\delta_{B,t}$ is a common time effect for all households connected to the financial system.

Policy question: the role of neglected informal finance - Kinnan and Townsend (2012)

Investment-smoothing specification:

$$\left(\frac{I}{A}\right)_{i\nu t} = \alpha_1 \left(\frac{y}{A}\right)_{i\nu t} + \alpha_2 \left(\frac{y}{A}\right)_{i\nu t} \times r_{i,B} + \alpha_3 \left(\frac{y}{A}\right)_{i\nu t} \times k_i +$$

$$+\alpha_4 \left(\frac{y}{A}\right)_{i\nu t} \times \bar{\omega}_i + \beta_1 r_{i,B} + \beta_2 k_{i,B} + \beta_3 \bar{\omega}_i + \delta_\nu + \delta_{B,t} + \varepsilon_{it}$$

A is total household assets.

δ_ν is village fixed effects, included to capture common characteristics such as suitability of the area for different occupations (rainfall, proximity to large towns, etc.).

$\delta_{B,t}$ is a common time effect for all households connected to the financial system.

Policy question: the role of neglected informal finance - Kinnan and Townsend (2012)

Results: consumption smoothing

	Coef.	Sign. level	Net effect	p-value
Unconditional	0.078	1%		
No any bank access	0.1645	1%		
Direct bank connection	-0.1658	1%	-0.013	0.696
Indirect bank connection	-0.1643	1%	0.0002	0.958
Presence of kin	0.0102	1%		

Policy question: the role of neglected informal finance - Kinnan and Townsend (2012)

Results: investment smoothing

	No controls	All house-holds	Above-median investment size	Below median investment size
Income	0.1078*	0.6526***	0.6370***	0.0077
	[0.0649]	[0.1950]	[0.2102]	[0.3359]
IncomeX...				
Any link		-0.1268	-0.0821	0.2931
to bank		[0.1288]	[0.1292]	[0.3983]
Kin in		-0.4136***	-0.5056***	0.4543
village		[0.1549]	[0.1599]	[0.3256]
Net worth		-0.1087	-.0405**	-0.3710
(mill. baht)		[0.0762]	[0.0205]	[0.2357]
N	6055	5794	2319	3463

Note: Heteroskedasticity-robust standard errors in brackets.

Significance: ***=1 percent level; **=5 percent; *=1 percent.

Policy question: the role of neglected informal finance - Kinnan and Townsend (2012)

Different types of networks (kin versus financial) matter for different types of insurance: the relatively small deviations of realized income from desired contemporaneous consumption, versus the potentially large difference between the scale of an investment opportunity and the amount of cash on hand to finance it.

- Financing needs of small magnitudes can be most effectively met with borrowing that can be implicitly or explicitly collateralized with tangible assets or threatened loss of participation in the financial network.
- Kinship networks are important in financing investment for transactions too large to be collateralized with tangible assets, so that extended or nonpecuniary punishments by kin are important in assuring lenders that their loans will be repaid.

Policy question: the role of neglected informal finance

Angelucci, de Giorgi, Rangel, and Rasul (2009) "Village Economies and the Structure of Extended Family Networks"
Apply the Hispanic naming convention to the household census data for 504 poor rural villages from the evaluation of Progresa, a social assistance program in rural Mexico, to construct within-village extended family networks.

Results: Family networks are larger (both in the number of members and as a share of the village population) and out-migration is lower the poorer and the less unequal the village of residence. The results are consistent with the extended family being a source of informal insurance to its members.

Policy question: the role of neglected informal finance - Angelucci, de Giorgi, Rangel, and Rasul (2009)

The relationship between the structure of extended family networks and the characteristics of the local village economy:

- The need for resource-sharing is greater in poorer or more marginal villages, because the costs of forming links outside the village are higher.
- The establishment of resource sharing family networks may help to smooth consumption and increase investment, hence endogenously improving the wealth in the village economy. If this effect dominates overall, we expect to observe larger and denser family networks in less marginal villages.

Policy question: the role of neglected informal finance - Angelucci, de Giorgi, Rangel, and Rasul (2009)

Empirical specification: measures of economic environment in the village as explanatory variables and measures of network structures as dependent variables

- Village-level OLS with the number of family networks in the village as dependent variable
- Household-level SURE with indicators for eight different types of kinship links within village (head-sibling, head-offspring, etc.) as dependent variables.
- Village-level probit with probability of having at least one migrant out of the village from a given network as dependent variable.

Policy question: the role of neglected informal finance - Angelucci, de Giorgi, Rangel, and Rasul (2009)

Two key variables measuring economic environment in each village:

- An index of the development or marginality of the village designed by the Mexican federal government.
- An index of household's permanent income, from which we construct the Gini coefficient for each village. This coefficient proxies the extent of within-village inequality in the distribution of income, assets, and land.

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Chiappori, Samphantharak, Schulhofer-Wohl and Townsend (2012) "Heterogeneity and Risk Sharing in Village Economies"

Policy question: can well-intended interventions that provide missing insurance have the opposite of their intended effect, i.e. welfare losses for at least some households.

Heterogeneity in risk preferences is documented in this paper. Intuitively, can use variation in village level risk and response of household-specific consumption to that risk to back our coefficients of risk aversion. Then an outside intervention could actually cause a welfare loss for the most risk tolerant household who had been providing insurance.

Full insurance cannot be rejected. As the risk sharing, as-if-complete-markets theory might predict, estimated risk preferences are unrelated to wealth or other characteristics.

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)

Intuition on **measuring heterogeneity in risk preferences**:

From the literature on risk sharing: efficient risk sharing allocates more risk to less risk-averse households, so a household whose consumption strongly co-moves with the aggregate must be relatively less risk averse. Thus, a household's risk aversion is identified up to scale.

Under full insurance, the only reason two households' consumptions can move together is that both of their consumptions are co-moving with aggregate shocks; both must be relatively risk tolerant. Similarly, if two households' consumptions are not strongly correlated, at least one must have consumption that does not move strongly with the aggregate shock; at least one must be very risk averse.

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)

Measuring heterogeneity in risk preferences:
Under the maintained hypothesis of full insurance, the data must satisfy

$$\ln c_{it} = \frac{\ln \alpha_i}{\gamma_i} + \frac{\ln \beta_i}{\gamma_i} t + \frac{\ln \xi_{i,m(t)}}{\gamma_i} + \frac{1}{\gamma_i}(-\ln \lambda_{j(i),t}) + \epsilon_{it}$$

β_i is the household's rate of time preference.
γ_i is household's coefficient of relative risk aversion.
$\xi_{i,m}$ is the household's relative preference for consuming in month $m \in \{\text{Jan, Feb, ..., Dec}\}$.
m_t is the month corresponding to date t.
$j(i)$ is household i's village.
α_i is a non-negative Pareto weight.
$\lambda_{j(i),t}$ is the Lagrange multiplier on village j's aggregate resource constraint at date t.

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)

Measuring heterogeneity in risk preferences:

$$\sum_{i' \neq i} E[\nu_{it}\nu_{i',t}] = \frac{1}{\gamma_i} \sum_{i' \neq i} \frac{1}{\gamma_i}$$

ν_{it} is the log consumption residual from linear projection on a household-specific intercept, time trend, and month dummies.

This gives us N_j moment conditions in N_j unknowns, where N_j is the number of households in village j.

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)

Test of efficient risk sharing:

$$\ln c_{it} = \frac{\ln \alpha_i}{\gamma_i} + \frac{\ln \beta_i}{\gamma_i} t + \frac{\ln \xi_{i,m(t)}}{\gamma_i} + \frac{1}{\gamma_i}(-\ln \lambda_{j(i),t}) + b_j \ln income_{it} + \epsilon_{it}$$

As used in most literature in practice:

$$\ln c_{it} = a_i + d_{j(i),t} + b_j \ln income_{it} + u_{it}$$

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)

Key difference: the latter ignores heterogeneity in both risk and time preferences and absorbs the household-specific trends and seasonality into the aggregate shocks d_{it}.

This may be generate bias against the null of full insurance when risk preferences are heterogeneous, because of the assumption that aggregate shocks affect all households' consumption equally even though, under heterogeneous preferences, aggregate shocks have a larger effect on the consumption of less-risk-averse households.

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)

Measuring the welfare cost of aggregate risk:
The basic idea, following Lucas (1987), is to calculate a household's expected utility from a risky consumption stream and compare it to the amount of certain consumption that would yield the same utility.

For each household, we find the value of k such that the household would be indifferent between living in the real economy with risky aggregate endowment, and living in an economy with a constant aggregate endowment equal to $(1 - k)$ times the expected aggregate endowment of the real economy.

- If $k > 0$, the household is willing to give up a fraction k of its consumption to eliminate aggregate risk.
- If $k < 0$, aggregate risk gives the household a welfare gain equal to a fraction k of consumption.

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)

Measuring the welfare cost of aggregate risk:

Schulhofer-Wohl (2008) shows that the welfare cost depends only on the household's risk aversion γ_i, not on its endowment share or the size of the economy:

$$k(\gamma_i) = 1 - \left(\sum_s \pi_s (p_s^*)^{-(1-\gamma_i)/\gamma_i} \right)^{\gamma_i/(1-\gamma_i)},$$

where $\pi_s p_s^*$ is the equilibrium price of a claim to one unit of consumption in state s.

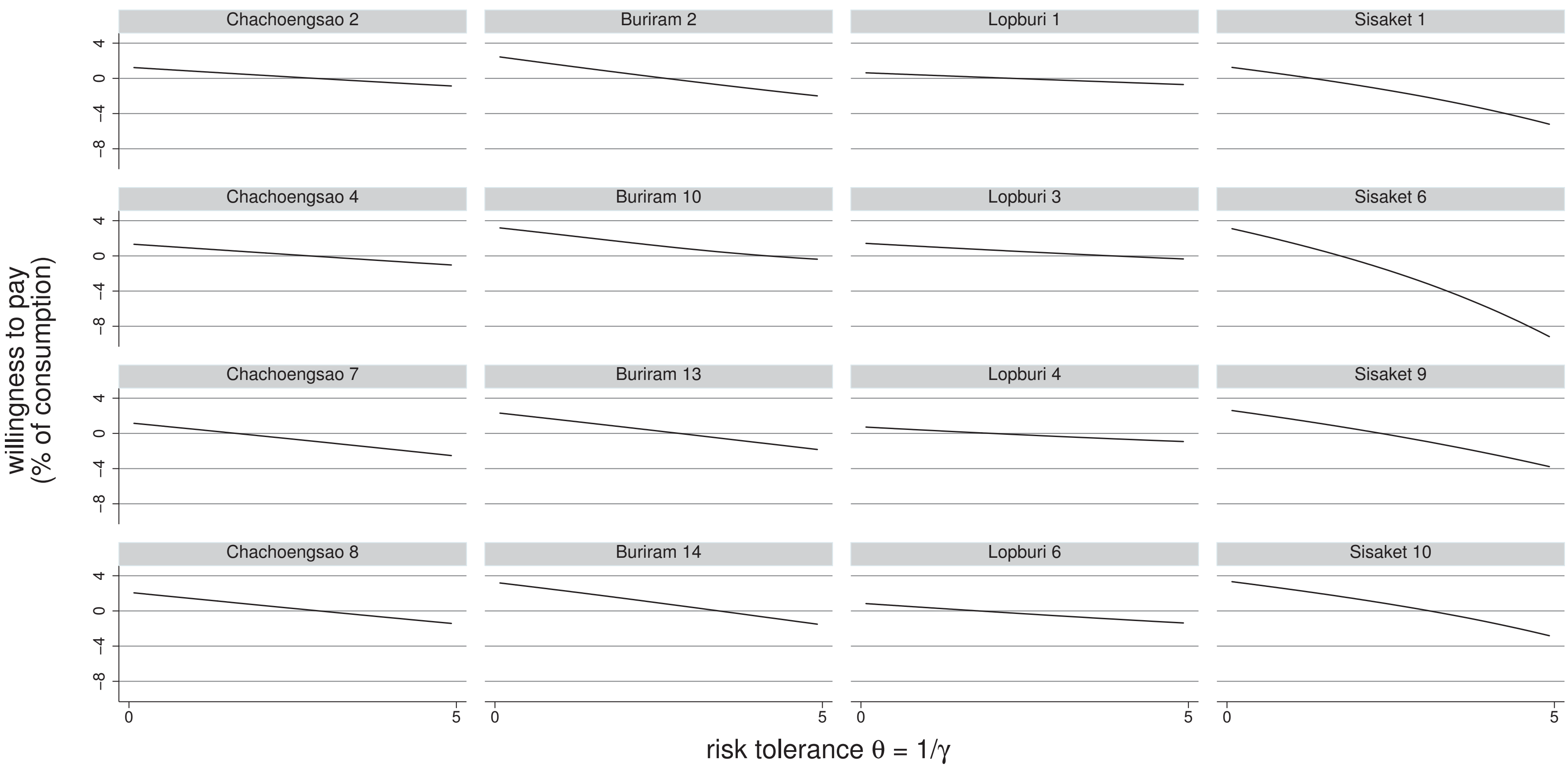
For γ_i sufficiently close to zero, $k(\gamma_i)$ is negative, which means the household has a welfare *gain* from aggregate risk. The gain arises because the household is selling so much insurance to more risk-averse households that the resulting risk premiums more than offset the risk the household faces.

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)

Results:

- Welfare losses for households with the mean risk tolerance of 1 are on the order of 1% of mean consumption, or about 10 times what has been estimated for the United States.
- The estimates also show that allowing heterogeneity matters dramatically for the results: the welfare costs are typically two to three times as large if we assume all households have identical risk preferences.
- In each village, the more risk tolerant a household is, the smaller its welfare cost of aggregate risk.
- Households that are sufficiently close to risk neutral have welfare gains from aggregate risk: their welfare cost is less than zero.

Policy question: can well-intended interventions result in welfare losses - Chiappori et al. (2012)



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Tazhibayeva and Townsend (2012) "The Impact of Climate Change on Rice Yields: Heterogeneity and Uncertainty"

Basis risk may be larger than we think due to within-village heterogeneous impact of village-level rainfall shocks. Rice farmers choose based on soil, hydrology, water flow, to plant at different times, meaning a common rainfall shocks hits farmers differentially.

We specify a three-stage production function for rice cultivation which incorporates the sequential nature of both production shocks, including weather, and input choices based on sequentially updated information sets of history of realized shocks and observed changes in crop growth. The production function is CES across stages, thus taking into account substantial complementarities between different phases of the biophysical crop growth process, in contrast to the substitute nature of commonly used Cobb-Douglas specification.

Rainfall insurance: why is take up low - Tazhibayeva and Townsend (2012)

Taking advantage of detailed panel data, we are able to distinguish two dimensions of the effect of climate change on rice yields:

- The extent of heterogeneity in yield distributions across households, both in means and in variation, or uncertainty, that is present under a given climate, and how this cross sectional heterogeneity in means and variation is affected by climate change.
- How climate change affects yield uncertainty from the household's perspective.

Rainfall insurance: why is take up low - Tazhibayeva and Townsend (2012)

We consider two alternative climate change scenarios for Southeast Asia, one with mild increases of temperature and rainfall throughout the year and the other with more extreme temperature increases and less rainfall during months of rice cultivation.

We find that from a household's perspective, mean yields decrease with more severe climate change. While this decrease is statistically significant, its magnitude is low. There is no significant change in mean household yields for a milder climate change. Yet at the same time, heterogeneity in mean yields across households, in the cross section, increases for both alternative climate change scenarios. From the perspective of the farmer, uncertainty in the distribution of yields decreases in the more extreme climate.

Rainfall insurance: why is take up low - Tazhibayeva and Townsend (2012)

Set up:

$$f_i(y_{i-1}, x_i, \varepsilon_i) =$$

$$= A_i \left(\theta_i (y_{i-1} \exp(\varepsilon_{i-1}))^{\gamma_i} + (1-\theta_i) \left(B_i \prod_{n=1}^{N_i} x_{in}^{\alpha_{in}} \right)^{\gamma_i} \right)^{1/\gamma_i} \exp(\varepsilon_i)$$

where $i \in \{1, 2, 3\}$ indexes the three production stages, and ε_i are stage-specific production shocks, including weather.

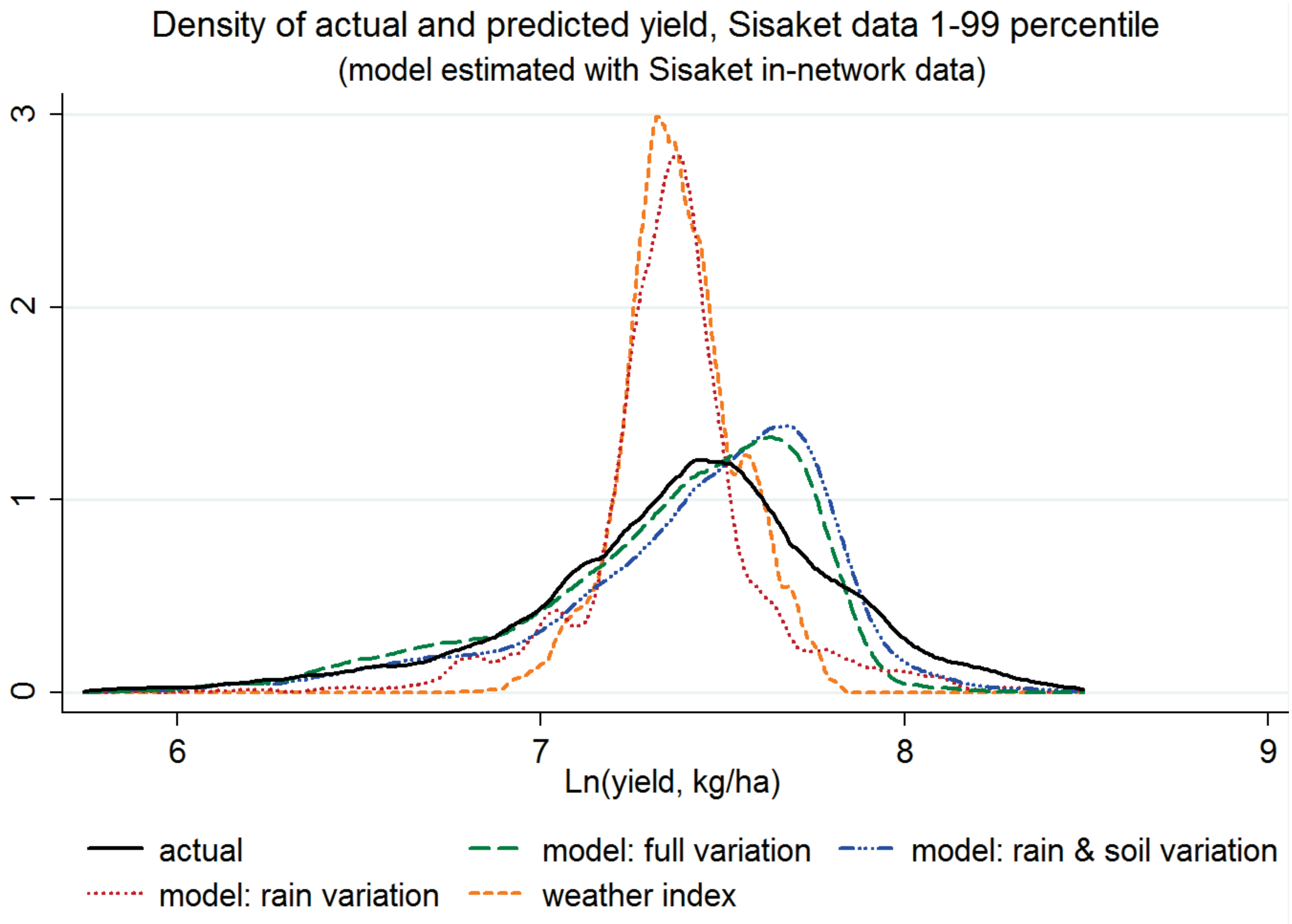
Households are forward looking and make expectations of weather and prices into the future based on current information. The timing of planting is incorporated through its effect on the timing of stages and therefore on the weather realization for a given plot. While weather is mostly uniform within a village, or even across nearby villages, its impact is heterogeneous as farmers plant at different time.

Rainfall insurance: why is take up low - Tazhibayeva and Townsend (2012)

CES:
Lack of flexibility in adjusting timing of inputs use once production has started. Thus input choices are driven more by the demands of the current state of the crop, prior to realization of all weather shocks, and less by expectations of future weather shocks.

Cobb-Douglas:
Substantial flexibility in timing of inputs application even after planting has started. Consequently, input choices are driven by expectations of future weather shocks and current weather realizations, with current and future inputs being substituted for one another depending on the relative effect of current versus expected impact of weather realizations. That is, the important factor in farmer's decisions is farmer's weather expectations once planting has started. As a result, Cobb-Douglas specification does not capture heterogeneity in planting time.

Rainfall insurance: why is take up low - Tazhibayeva and Townsend (2012)



Courtesy of Kamilya Tazhibayeva and Robert M. Townsend. Used with permission.

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Kapphan (2012) "Weather Risk Management in Light of Climate Change Using Financial Derivatives"

The main objective of this paper is to propose a method for structuring index-based weather insurance such that it yields optimal hedging effectiveness for the insured without imposing functional form assumptions on the relationship between crop yields and weather, using a fully non-parametric approach. In addition, to account for transaction costs, a weather contract is derived that maximizes an insurer's profits such that the insured still considers the loaded contract as a viable purchase (for a given level of risk aversion).

Appropriate design of rainfall instruments - Kapphan (2012)

Rather than restricting attention to piecewise linear contracts in the first place, I determine the classical parameters of a derivative contract (trigger and limit) from the optimization problem and in addition derive the local slope of the pay-off function (tick size) at each realization of the underlying index.

Simulated weather and crop yield data is used, which represents a maize-growing region in Switzerland, and is derived from a process-based crop simulation model in combination with a weather generator.

In the Over-the-Counter (OTC) weather derivative market, generic weather derivatives are offered that possess a linear payoff structure in contrast to the non-linear contracts considered here. I find that hedging weather risk with linear contracts decreases the insured's hedging benefits, as well as the insurer's profits, by about 20 to 24

Appropriate design of rainfall instruments - Kapphan (2012)

With climate change putting an end to stationarity of weather and yield time series, a fundamental assumption underlying risk management is undermined.

Adjusted insurance contracts are simulated that account for the changing distribution of weather and yields due to climate change. For the underlying location, crop and climate scenario, I find that the benefits of hedging weather with adjusted contracts almost triple for the insured (relative to contracts based on today's climatic conditions), and insurers' expected profits increase by about 240% when offering adjusted contracts.

Appropriate design of rainfall instruments - Kapphan (2012)

Farmers face a stochastic yield $y \in Y \equiv [\underline{y}, \overline{y}]$.
The distribution of output, $F(y|z)$, depends on the weather variable z with cdf $G(z)$.

The farmers' **expected utility maximizing contract** $p^*(z)$ solves

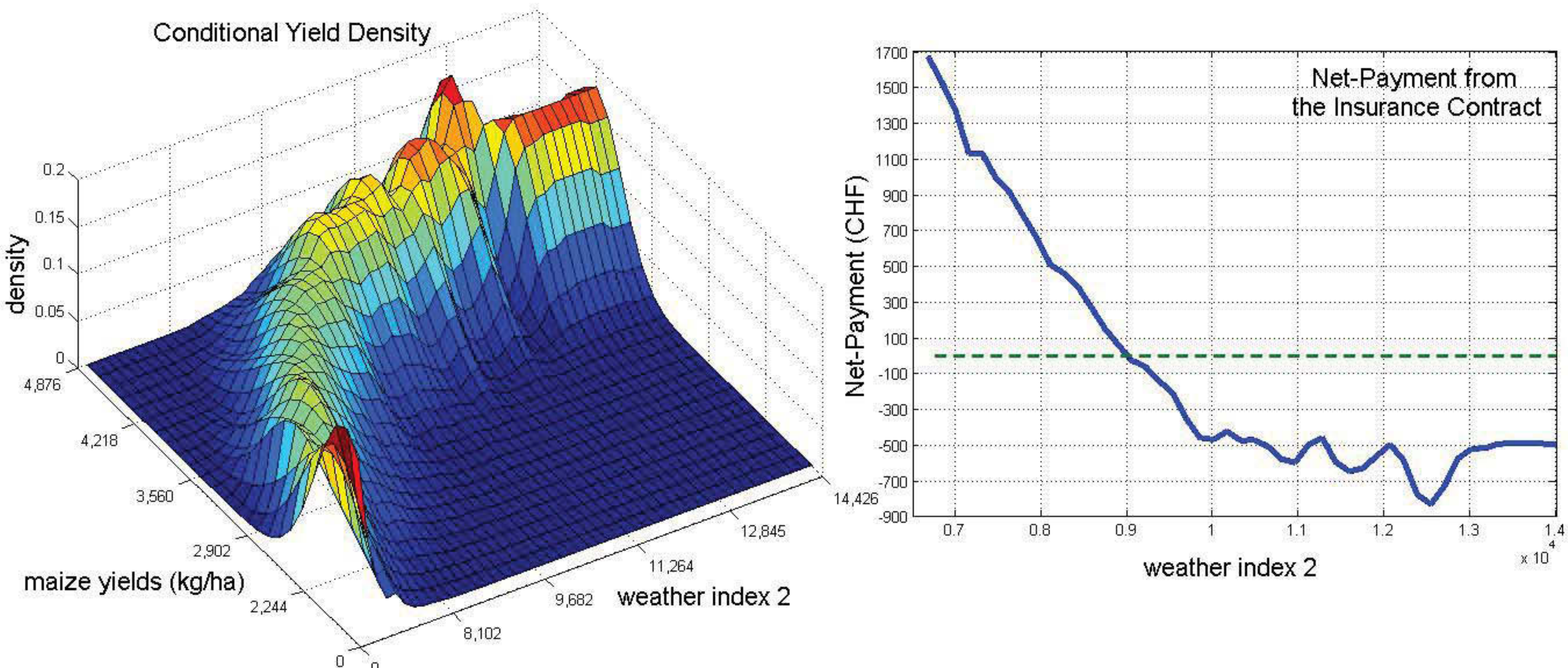
$$\max_{p(z)} \int_Z \int_Y u(y + p(z)) dF(y|z) dG(z)$$

subject to the constraint that the insurer does not make losses with the weather insurance contract $p(z)$ in expectation:

$$\int_Z p(z) dG(z) \leq 0$$

.

Appropriate design of rainfall instruments - Kapphan (2012)



Courtesy of Ines Kapphan. Used with permission.

Figure 2.3: Conditional yield density and insurance contract for Index 2

Appropriate design of rainfall instruments - Kapphan (2012)

Examining the relationship between pay-offs and the frequency of payments, I find that the optimal insurance contract offers high levels of protection for catastrophic weather events that occur with very low probabilities. At the same time, the optimal insurance contract offers moderate payments for small deviations from average weather conditions.

For all contracts considered, I find that the insured breaks-even, i.e. receives an indemnification that compensates for the premium, in 48% of the cases.

Estimating degree of co-movement in consumption

Suri (2011) deals with the reflection problem, estimating the **degree of co-movement in consumption**. She does this by contrasting within-village insurance (from idiosyncratic shocks) with across-village insurance (from aggregate village shocks). She shows that village income shocks are not covariate.

But is it necessarily the case in other countries that insurance is actually worse across villages or regions? **Paweenawat and Townsend (2011)** and **Hong (2013)** reject that even in point estimates. Remittances seem to play a huge smoothing role.

Suri (2011) "Estimating the Extent of Local Risk Sharing Between Households"

The test proposed in this paper measures the extent of local risk sharing, i.e. how far from Pareto optimality households are.

Since the village is presumed to be the relevant risk sharing group, the between village response to shocks estimates the behavioral response if there was no risk sharing within the villages. It therefore serves as an important benchmark or 'norm' for what the counterfactual of no risk sharing at the village level would look like.

The estimator is adapted from an estimator derived in the peer effects literature for an experimental setting (see Boozer and Cacciola (2001)).

Suri (2011) "Estimating the Extent of Local Risk Sharing Between Households"

Assuming homogeneous risk aversion:

$$C_{ij} = \beta \bar{C}_j + \delta S_{ij} + \phi A_{ij} + \gamma Z_j + \epsilon_{ij}$$

C_{ij} is the consumption for household i in village j.

$\bar{C}_j$ is the average consumption for village j.

S_{ij} is income shock of household i in village j.

A_{ij} are household level demographics.

Z_j are any village level covariates.

Suri (2011) "Estimating the Extent of Local Risk Sharing Between Households"

Within-village:

$$C_{ij} - \bar{C}_j = (S_{ij} - \bar{S}_j)\delta^W + (A_{ij} - \bar{A}_j)\phi^W + \epsilon_{ij} - \bar{\epsilon}_j$$

Between-village:

$$\bar{C}_j = \bar{S}_j\delta^B + \bar{A}_j\phi^B + Z_j\gamma^B + \bar{\epsilon}_j$$

Contrast estimator:

$$\hat{\beta} = 1 - \frac{\hat{\delta}^W}{\hat{\delta}^B}$$

Perfect risk sharing test: joint test of $\beta = 1$ and $\delta^W = 0$, which requires $\delta^W = 0$ and $\delta^B \neq 0$. As δ^B goes towards zero, the test approaches zero power.

Suri (2011) “Estimating the Extent of Local Risk Sharing Between Households”

The panel version of the estimator would basically use the first differences in consumption instead of the levels of consumption.

With heterogeneity in the rates of risk aversion (and hence in the regression coefficients), as long as the shocks to income are uncorrelated with the risk aversion, the contrast estimator estimates the average beta in the sample.

Boozer and Cacciola (2001) show that this is equivalent to a particular IV estimator, with specification not in terms of average village consumption but in terms of the leave-out mean village consumption (mean of the village excluding the specific household), which is then instrumented with the leave-out mean village shock while controlling (in both stages of the IV regression) for the individual shock.

Suri (2011) "Estimating the Extent of Local Risk Sharing Between Households"

An estimated $\hat{\beta}$ coefficient different from one could imply any or all of the following:

1. The relevant risk sharing group is not the village but some other group, like ethnicity, caste, gender or a combination of these.
2. The relevant risk sharing group is the village, but individuals in the risk sharing groups are not fully insuring each other.
3. Individuals are in fact not smoothing consumption over space, but instead they are insuring with their future selves.

Suri (2011) "Estimating the Extent of Local Risk Sharing Between Households"

Kenya results:

- Use per capita specifications of maize consumption and crop consumption.
- Cannot reject $\beta = 1$ (reject weakly at 10% significance level for log specification).
- For level crop consumption, $\hat{\delta}^B$ is not different from zero. In all other cases, both $\hat{\delta}^W$ and $\hat{\delta}^B$ are significant, and $\hat{\beta}$ ranges from 0.4 to 0.7.
- Results are similar with and without accounting for household FE.
- For **village specification**:
  - Cannot reject perfect risk sharing.
  - Cannot reject small amounts of risk sharing.
  - Reject no risk sharing.

Suri (2011) "Estimating the Extent of Local Risk Sharing Between Households"

Cote d'Ivoire results:

- Use per capita specifications of food consumption and total consumption.
- Reject $\beta = 1$ for level specifications without household FE.
- Cannot reject $\beta = 1$ for log specifications without household FE or for any specification with household FE (FD).
- For log total consumption, $\hat{\delta}^B$ is not different from zero (both with and without household FE). In all other cases, both $\hat{\delta}^W$ and $\hat{\delta}^B$ are significant, and $\hat{\beta}$ ranges from 0.5 to 0.8.
- For log food specification with household FE, $\hat{\delta}^W$ is not different from zero.

Suri (2011) "Estimating the Extent of Local Risk Sharing Between Households"

Relevant policy questions:

At what level of geographic aggregation does local risk sharing break down?

What level of regional aggregation should government policy be targeted to?

How widespread do income shocks in an economy have to be to warrant a role for government policy?

Conflicting evidence on consumption smoothing from Thailand

Paweenawat and Townsend (2011) "Village Economic Accounts: Real and Financial Intertwined"

Using the household panel data from Townsend Thai data, we create the economic and balance of payments accounts for a set of villages in rural and semi-urban areas of Thailand. We then study these village economies as small open countries, as in international economics, exploring in particular the relationship between the real (production and trade) and financial (credit and financial flows) variables. We examine inter-village risk-sharing and the Feldstein-Horioka puzzle.

Paweenawat and Townsend (2011) “Village Economic Accounts: Real and Financial Intertwined”

We use the contrast estimator specification developed in Suri (2011) to estimate the risk-sharing coefficient. Our results suggest that within-village consumption-against-income risk-sharing is better that across-village and, while there is smoothing in both, the mechanisms are different. In both cases, the estimate of risk-sharing coefficient is significantly different from perfect risk-sharing.

We do find complementary evidence using a mean squared metric, differences in consumption financing mechanisms within versus across villages. Within village, there is greater use of gifts but in a typical village’s relationship with the rest of the economy, there is greater use of cash and formal borrowing.

Consumption Risk-Sharing

- Full risk-sharing model suggests that $C_{i,t} = \alpha_i + \bar{C}_{v,t}$ and we can estimate:

$$C_{i,t} = \alpha_i + \beta \bar{C}_{v,t} + \delta Y_{i,t} + \varepsilon_{i,t}$$

where $C_{i,t}$ and $Y_{i,t}$ are the consumption and income of household i in village v in time t, $\bar{C}_{v,t}$ is the average consumption of households in village v in time t.

- Deaton(1990) shows that the OLS estimation of β will be biased toward 1.
- Following Suri (2011), we use the contrast estimator to overcome this problem:

$$\bar{C}_{v,t} = \alpha^B + \delta^B \bar{Y}_{v,t} + \hat{\varepsilon}_{v,t}$$

$$\left(C_{i,t} - \bar{C}_{v,t}\right) = (\alpha_i - \bar{\alpha}_v) + \delta^W (Y_{i,t} - \bar{Y}_{v,t}) + \varepsilon_{i,t} - \hat{\varepsilon}_{v,t}$$

- First equation is between regression and second is within regression
- We can estimate β as:

$$\hat{\beta} = 1 - \frac{\hat{\delta}^W}{\hat{\delta}^B}$$

- We can do this analysis at household level as well as at village level or provincial level.

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Low take up of formal insurance (identifying implicit obstacles) - evidence from actual interventions

- Karlan, Osei, Osei-Akoto, Udry (2012) "Agricultural Decisions after Relaxing Credit and Risk Constraints"
- Cole, Gine, Tobacman, Topalova, Townsend, and Vickery, (2013) "Barriers to Household Risk Management: Evidence from India"
- Mobarak and Rosenzweig (2012) "Selling Formal Insurance to the Informally Insured"
- Gine and Yang (2009) "Insurance, credit, and technology adoption: Field experimental evidence from Malawi"

Karlan, Osei, Osei-Akoto, Udry (2012) "Agricultural Decisions after Relaxing Credit and Risk Constraints"

We experimentally manipulate the financial environment in which farmers in northern Ghana make investment decisions. We do so by providing farmers with cash grants, grants or access to purchase rainfall index insurance or both. The experiments are motivated by a simple model which starts with perfect capital and perfect insurance markets, and then shuts down each. To test the model predictions, we turn to a three-year multi-stage randomized trial.

Low take up of formal insurance - Karlan, Osei, Osei-Akoto, Udry (2012)

Main results:

- Demand for index insurance is strong, and insurance leads to significantly larger agricultural investment and riskier production choices in agriculture: when provided with insurance against the primary catastrophic risk they face, farmers are able to find resources to increase expenditure on their farms.
- Demand for insurance in subsequent years is strongly increasing in a farmer's own receipt of insurance payouts, and with the receipt of payouts by others in the farmer's social network.
- Both investment patterns and the demand for index insurance are consistent with the presence of important basis risk associated with the index insurance, and with imperfect trust that promised payouts will be delivered.

Low take up of formal insurance - Karlan, Osei, Osei-Akoto, Udry (2012)

Environment:

- Agriculture in northern Ghana is almost exclusively rainfed. Thus weather risk is significant and index insurance on rainfall has promise.
- If risk is discouraging investment, and marginal return on investments are high, the returns to removing risk could be high.
- We have strong evidence that rainfall shocks translate directly to consumption fluctuations (Kazianga and Udry, 2006). Thus mitigating the risks from rainfall should lead to not just higher yields but also smoother consumption.

Low take up of formal insurance - Karlan, Osei, Osei-Akoto, Udry (2012)

2-period model:

$$u(c) + \beta \sum_{s \in S} \pi_s u(c_s)$$

Model assumptions: The household is a member of an informal risk sharing group which permits the efficient ex-post pooling of all risk. This informal risk sharing operates such that every household consumes the expected value of its second period consumption in any realized second period state. We assume that the risk pooling group is sufficiently diverse that there is no aggregate risk. This extreme assumption serves to focus on the implications of binding credit constraints in the absence of any risk-based motivation for moving resources across periods.

Low take up of formal insurance - Karlan, Osei, Osei-Akoto, Udry (2012)

Model predictions:

With **binding credit constraints (either with or without complete insurance markets)**, investment rises with a capital grant and falls when insurance is provided:

- The capital grant reduces the shadow price of the binding borrowing constraint, raising the relative value of consumption in the future and therefore inducing higher investment in agricultural inputs.
- In contrast, the promise of future resources through insurance, even in the bad state, increases that shadow price and lowers the relative value of consumption in the future. Hence investment in agricultural inputs falls with promised contingent payments.

Low take up of formal insurance - Karlan, Osei, Osei-Akoto, Udry (2012)

Model predictions:

When **credit constraints are not binding but insurance is imperfect**, investment rises with the provision of insurance or a capital grant:

- The cash grant increases cash on hand, saving in the safe asset and thus consumption in either state of the second period, implying more investment in the risky asset. Index insurance directly increases consumption in the low state of period 2, implying greater investment in the risky asset.

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