# Insurance II: Mutual Insurance in the Village Economy

## 14.740x: Foundations of Development Policy

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# Dealing with risk

We saw in the last lectures that risk averse households would like to smooth fluctuations of their income over time. They cannot achieve much consumption smoothing if they can only save, not borrow.
For example, there are times when assets run out and consumption can drop dramatically. Can they achieve consumption smoothing through mutual insurance?

# Insurance: theoretical principles
## Basic set up

Start with a simple example: Atif and Bibir are two farmers. Next period, each of their incomes can be either low (Rp 1000), with probability 0.5, or high (Rp 2000), with probability 0.5. These probabilities are independent. To simplify, assume that they do not have access to savings or credit.
Each of them maximizes their expected utility next period: $E[u(y)]$. We make the usual assumption that $u(.)$ is concave (farmers are risk averse).

# Sharing risk

Start with a situation where they are isolated: what is their expected utility?

$$E[u(y)] =$$

Consider bringing them together: they agree to share their total income, each taking half at all events. What are the possible events now, with their associated probabilities? What is their expected utility now?
Are they better or worse off? To see this, note that the expected utility can be rewritten:

$$0.5E[u(y)] + 0.5u(E(y)]$$

How does it compare with $E[u(y)]$?
Is $E[u(y)]$ is smaller or larger than $u(E[(y))$? (This is known as Jensen's inequality).

# Some properties of optimal insurance

1. Think about extending this scheme to all subsequent periods. In each period, they will share income in that way. Does it improve their welfare over staying alone?
2. If they could freely borrow and save, would this scheme be necessary?
3. Is current payment from Atif to Bibir related to past payments?
   How does that compare to credit?
   This is the fundamental difference between credit and pure insurance: insurance payments and proceeds are not linked to past payments, while credit payments are.

# More properties

1. Assume that their income is entirely determined by the weather, and that Atif and Bibir face the same weather. So the incomes of Atif and Bibir are perfectly correlated.
   - What are the possible events now?
   - Can Atif and Bibir smooth consumption by mutual insurance? Why?

   *Aggregate* shocks, which affect the members of the network identically, cannot be insured against by insurance within the network

# Strength in numbers

Assume that there are more than 2 members in the network, all with independent and identically distributed income streams, following the same process as Atif and Bibir. There are $N$ members. The average income in the network each period is:

$$\frac{1}{N}\sum_{i=1}^{N} y_i$$

By the *Law of large numbers*, as $N$ goes to infinity, this goes to:
So if all the members put their incomes together, what is the post-insurance income of each network member in any given period?
What is their utility?
Therefore, *with a big enough network*, and if the income of the network members are *not correlated*, they should achieve perfect income smoothing.

# Informal insurance and income fluctuations?

The preceding discussion suggests that we should write individual income as the sum of three components:

$$Y_{hj}^t = A^t + \epsilon_{hj}^t + \theta_j^t$$

Where $t$ is the time, $h$ is the household, and $j$ is the village.
$A^t$ is the average income in the period ( Rp 1,500 in our previous example),
- $\epsilon_{hj}^t$ is a shock which affects only household $h$ in period $t$ (for example, a disease specific to his crop).$\epsilon_{hj}^t$ has mean 0, and the average of $\epsilon_{hj}^t$ over the villagers in any given period will therefore be equal to 0 (law of large number).
- $\theta_j^t$ is the aggregate shock that affects the whole village, for example, the weather. $\theta_j^t$ also has mean 0, but at any point in time it is either positive or negative for the village as a whole. It is only the average over time that sums to 0.

# Empirical questions

Consider a scheme where farmers put their income together. What is the post-insurance income of each farmer?

$$C_{hj}^{t} =$$

This suggests that two elements are going to be important in knowing whether informal insurance can smooth away income fluctuations:

1. How correlated are households' incomes in the same village? If they are very correlated, then there is not much scope for insurance.
2. Do households actually pool their income together? If they do, then we should see consumption levels being much more correlated than income levels.

# How correlated are village incomes?

**Evidence from the ICRISAT villages in India**

The ICRISAT study villages are 3 villages in South India. In each village, 40 households were studied and included in the survey for 10 years.

We have reason to think that the household incomes will not be very correlated:

-Households have plots in different parts of the village, which absorb rain differently.

-Household are engaged in different activities, and grow different crops, which may be affected differently by the weather.

Each year, there is data available on consumption and income for each household. We can therefore look directly at whether incomes in the village seem to move together or not.

# Evidence on correlation

Consider the series:

$$Y_{hj}^t - \overline{Y_j^t} =$$

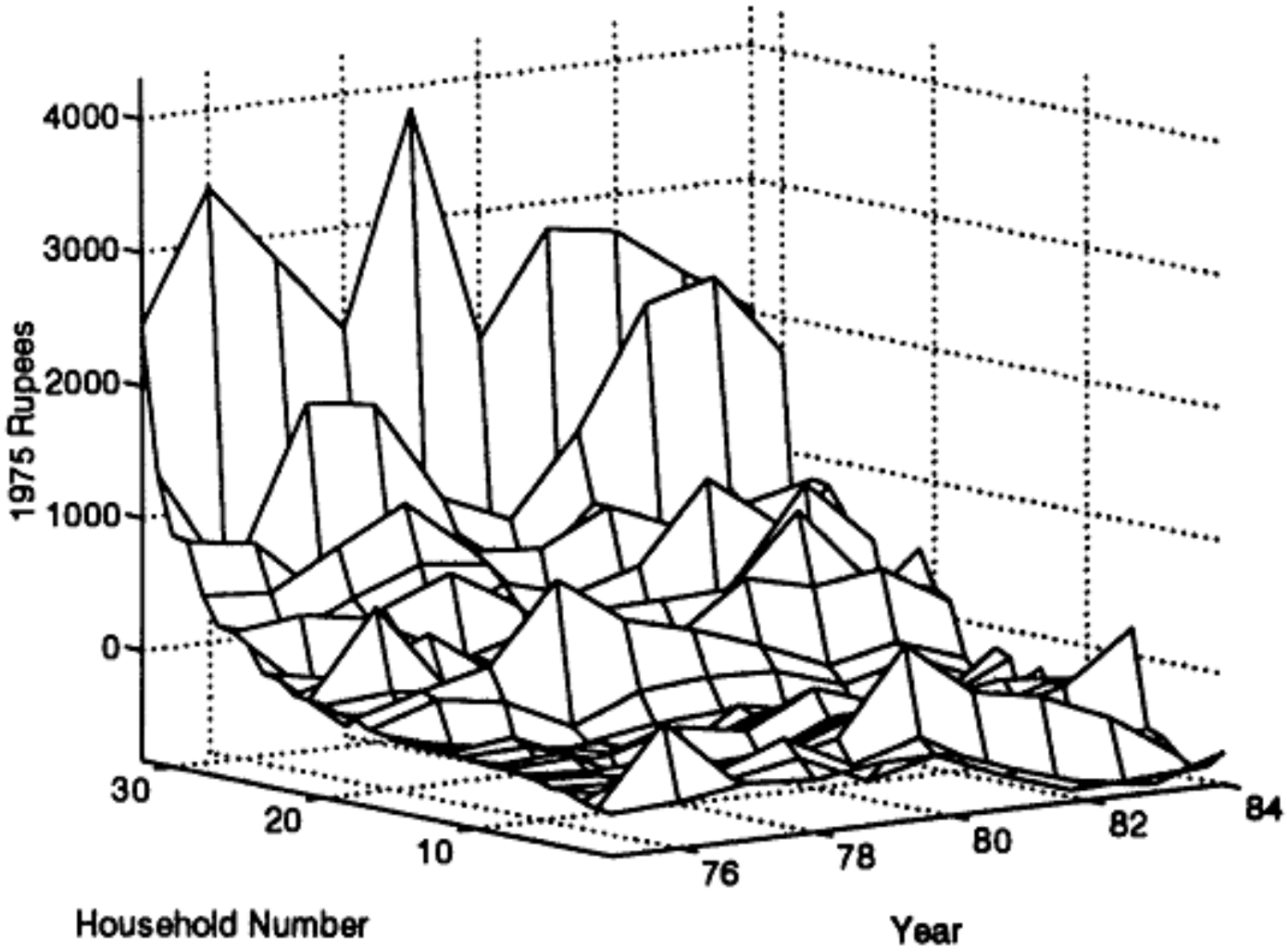
where $\overline{Y_j^t}$ is the average income in the sample. [NB: we would like to observe the average income in the *village*, but we have only sample households. We are hoping that the two will be the same, using again the law of large numbers.]

For each household, we can plot this series over time (for $t = 1, 2, ..4$).

- What do we expect to see if the villagers' incomes are perfectly correlated within the village?
- What do we expect to see if they are independent?
- What do we expect to see if they are very correlated?
- What to we expect to see if they are not very correlated?

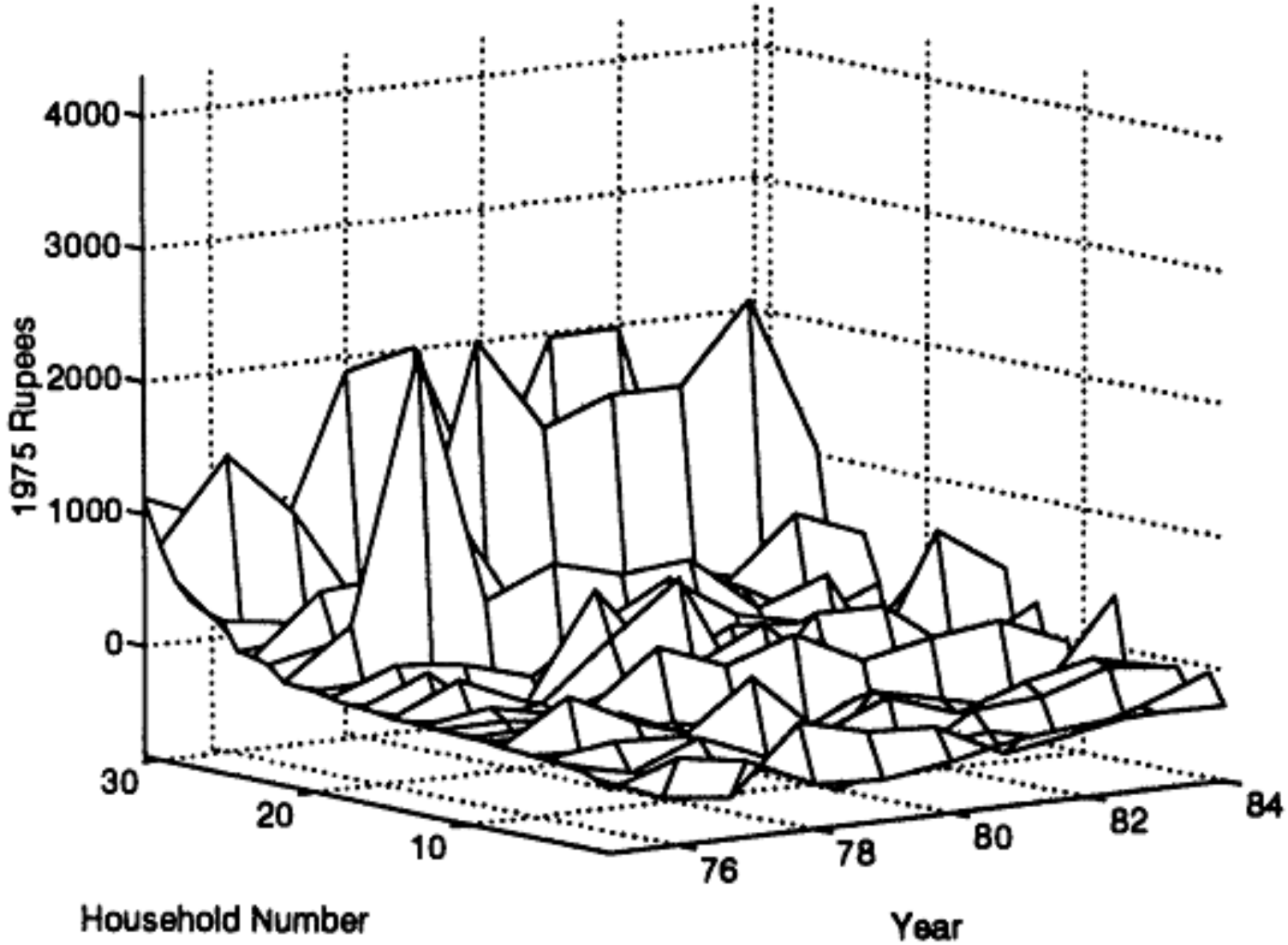
Look at the pictures in the handout: is it evidence for or against correlation of income?

# Household Income (Aurepalle)



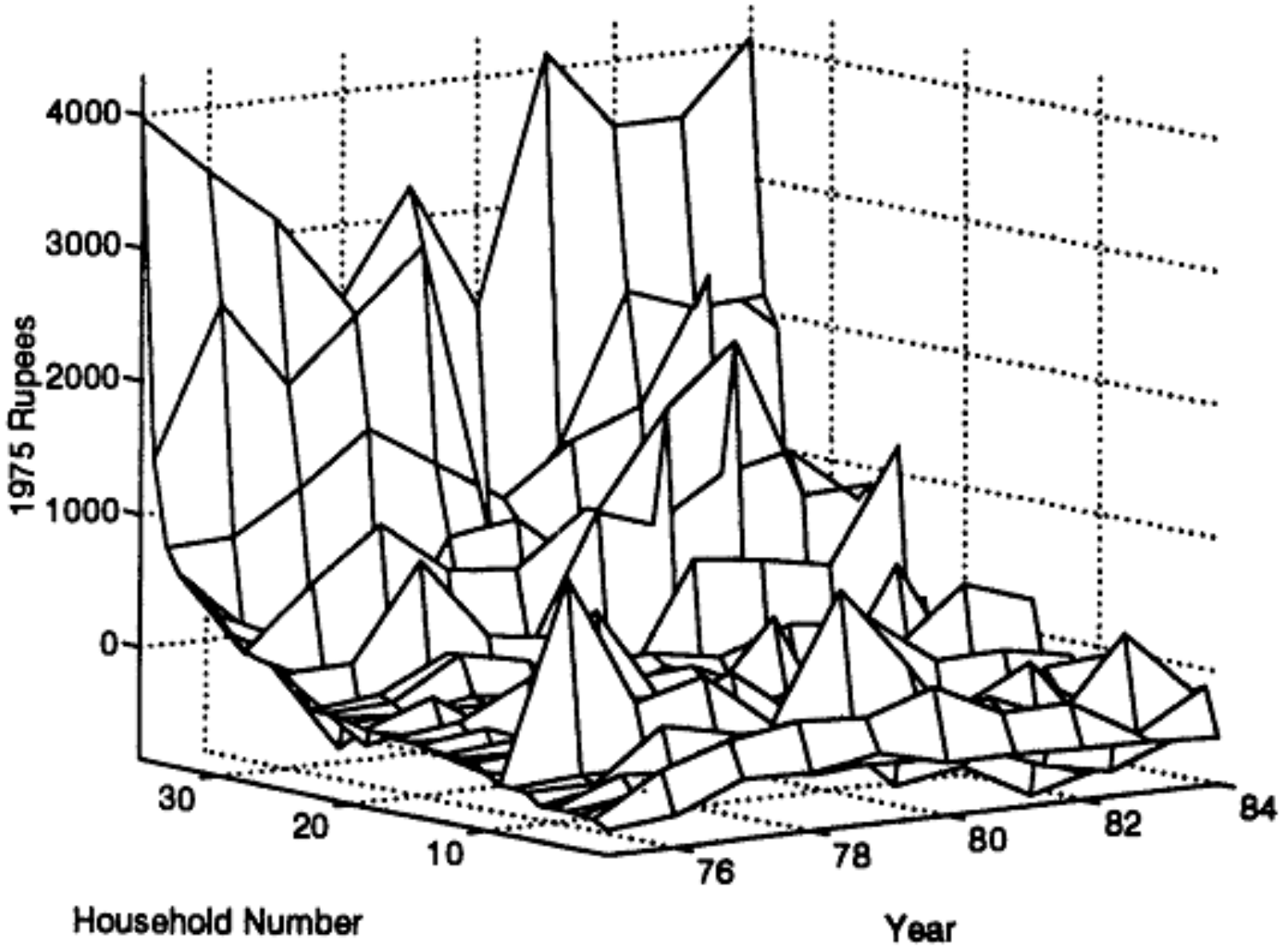

Source: Townsend (1994) "Risk and Insurance in Village India"

# Household Income (Shirapur)




Source: Townsend (1994) "Risk and Insurance in Village India"

# Household Income (Kanzara)




Source: Townsend (1994) "Risk and Insurance in Village India"

# Consumption smoothing within villages

**Evidence from the ICRISAT villages**

The question is now whether individual consumption (our measure of post-insurance income) moves together with average consumption in the village:

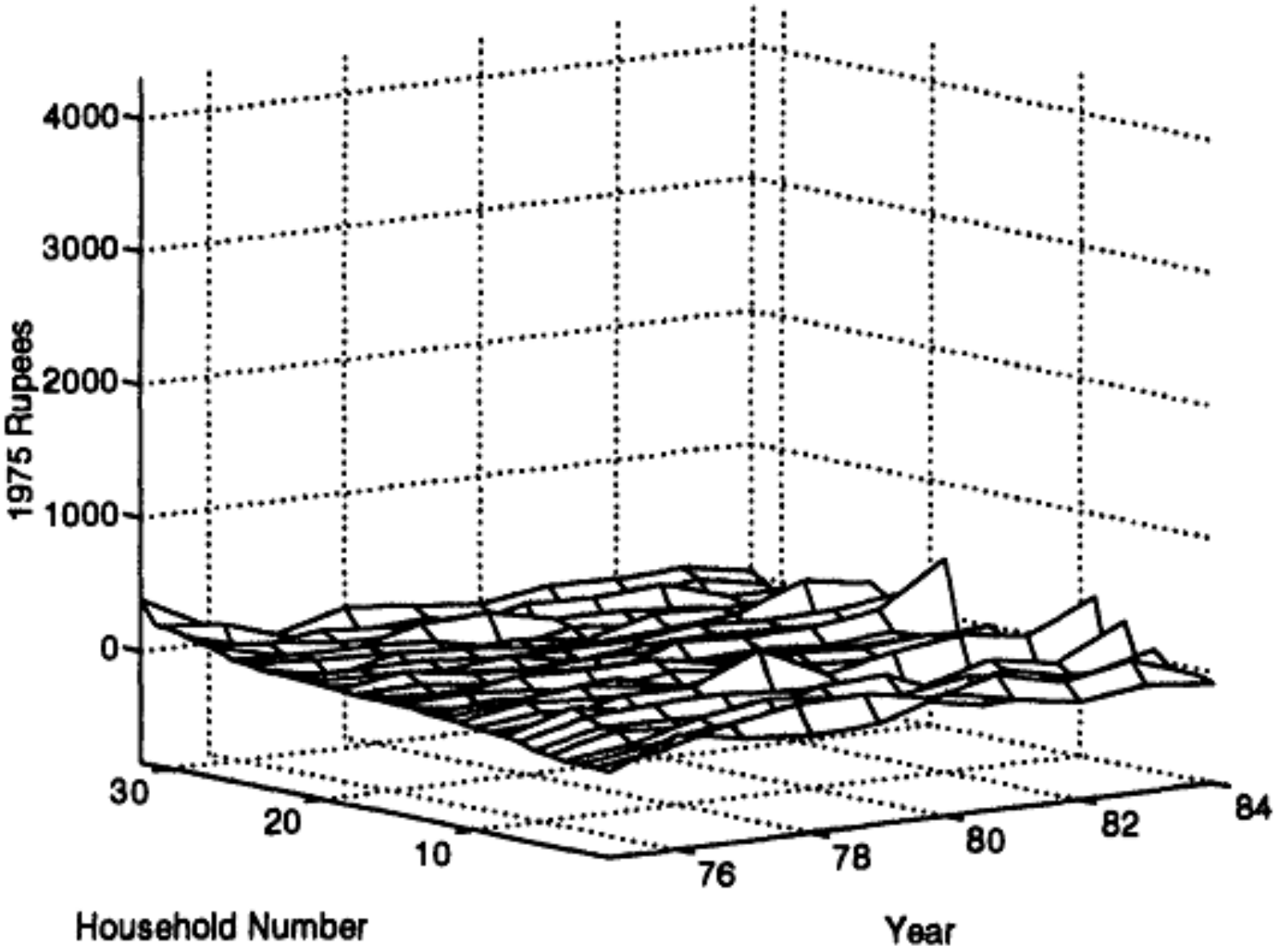
What would the following series be with perfect insurance?

$$C_{hj}^t - \overline{C_j^t} =$$

If we plot this series for each household over time, like we did for consumption, what do we expect to see if there is perfect insurance? If insurance is not perfect?

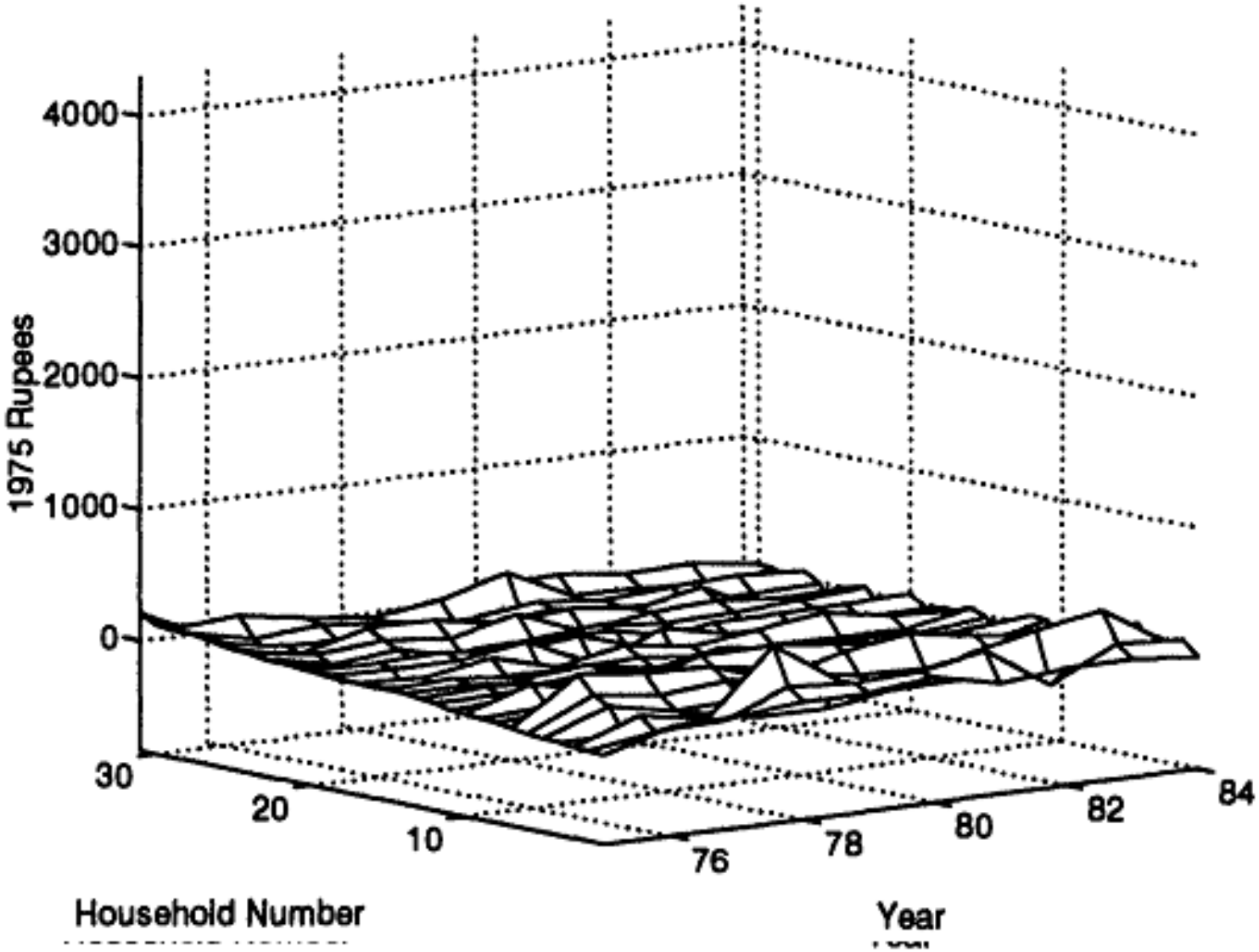
The results: series are much less bumpy: there is a fair amount of insurance (perhaps not complete).

# Household Consumption (Aurepalle)



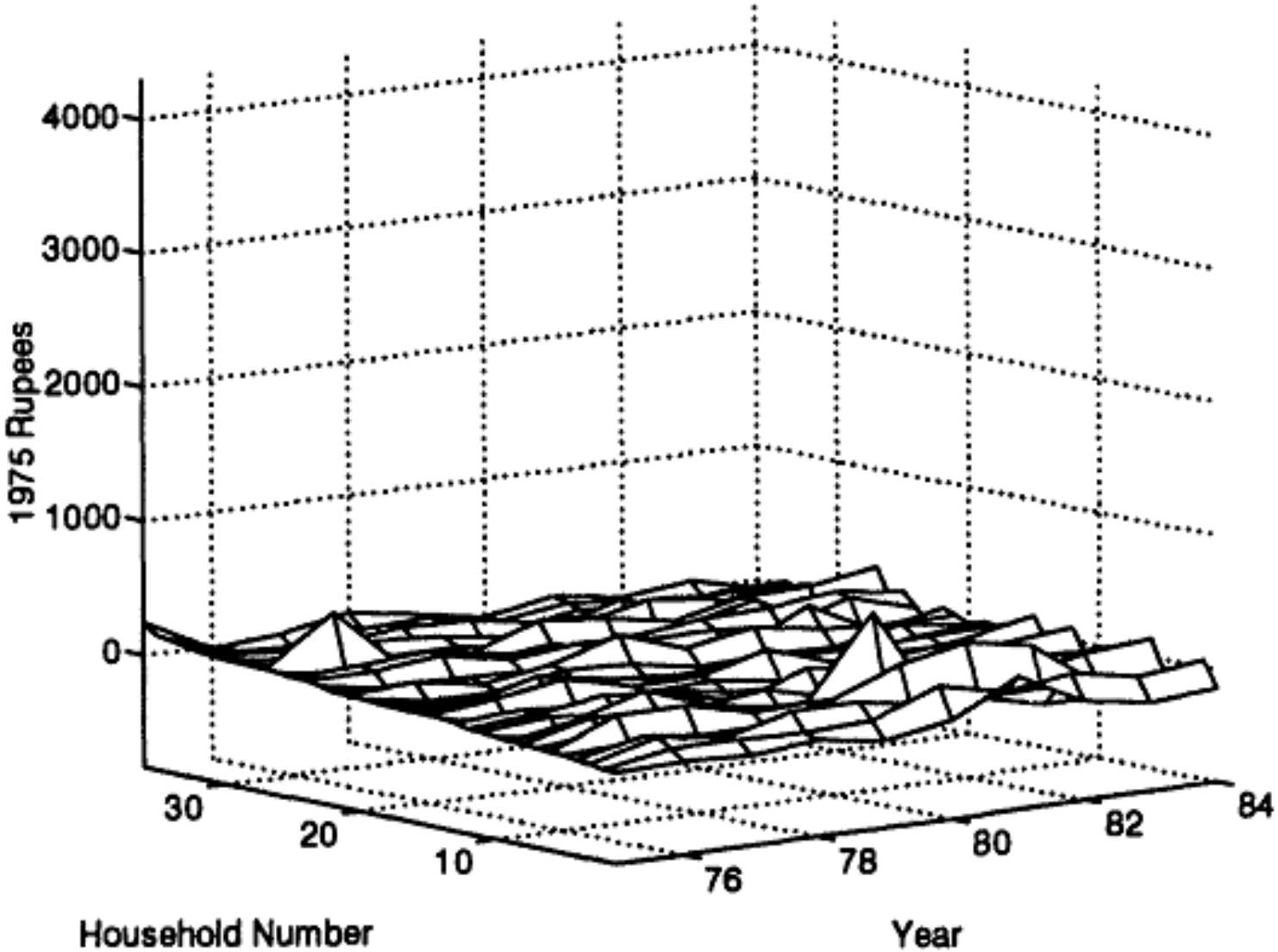

Source: Townsend (1994) "Risk and Insurance in Village India"

# Household Consumption (Shirapur)




Source: Townsend (1994) "Risk and Insurance in Village India"

# Household Consumption (Kanzara)




Source: Townsend (1994) "Risk and Insurance in Village India"

# Evidence from Cote d'Ivoire

Perfect insurance implies that variations in consumption should not depend on individual income, only on village income.
Consider running the regression:

$$C_{hj}^2 - C_{hj}^1 = \alpha + \beta(\overline{y_j^2} - \overline{y_j^1}) + \gamma(y_{hj}^2 - y_{hj}^1) + \upsilon_{hj}^t$$

In the presence of perfect insurance, what do you expect to find for $\gamma$?
Do we have a strong prediction for the coefficient of $\beta$?
Result: see the tables.
Are the results suggestive of perfect insurance? Of partial insurance?

# Income and Consumption Changes

**Table 6.4. Income and consumption changes, 1985–86 and 1986–87**
(thousands of CFAs, household averages)

| | *1985–86* | | | | *1986–87* | | | |
|---|---|---|---|---|---|---|---|---|
| *Income* | $\Delta y$ | $F$ | $df_1$ | $df_2$ | $\Delta y$ | $F$ | $df_1$ | $df_2$ |
| West Forest | –308 | 2.04 | 10 | 139 | –74 | 1.93 | 4 | 72 |
| East Forest | 160 | 1.28 | 11 | 169 | –64 | 2.05 | 10 | 154 |
| Savannah | 159 | 1.52 | 7 | 115 | –26 | 1.17 | 9 | 144 |
| All rural | 5 | 2.30 | 30 | 423 | –51 | 1.65 | 25 | 370 |
| *Consumption* | $\Delta c$ | $F$ | $df_1$ | $df_2$ | $\Delta c$ | $F$ | $df_1$ | $df_2$ |
| West Forest | –285 | 4.10 | 10 | 139 | –133 | 4.04 | 4 | 72 |
| East Forest | 37 | 4.15 | 11 | 169 | –99 | 2.16 | 10 | 154 |
| Savannah | 157 | 1.35 | 7 | 115 | –111 | 0.70 | 9 | 114 |
| All rural | –37 | 4.62 | 30 | 423 | –110 | 2.14 | 25 | 370 |

*Source*: Author's calculations using CILSS data.

Source: Deaton (1997) "The Analysis of Household Surveys"

# Effect of Income on Consumption

**Table 6.5. OLS and IV estimates of the effects of income on consumption**

| | *West Forest* | | *East Forest* | | *Savannah* | | *All rural* | |
|---|---|---|---|---|---|---|---|---|
| | | | *OLS 1985–86* | | | | | |
| No dummies | 0.290 | (6.2) | 0.153 | (3.2) | 0.368 | (5.8) | 0.259 | (8.8) |
| Village dummies | 0.265 | (5.7) | 0.155 | (3.5) | 0.373 | (5.7) | 0.223 | (7.7) |
| Own income | 0.265 | (5.3) | 0.155 | (3.2) | 0.373 | (5.6) | 0.223 | (7.1) |
| Village income | 0.199 | (1.4) | –0.031 | (0.2) | –0.050 | (0.2) | 0.252 | (3.0) |
| | | | *IVE 1985–86* | | | | | |
| No dummies | 0.192 | (3.9) | –0.003 | (0.1) | 0.271 | (4.0) | 0.126 | (4.0) |
| Village dummies | 0.171 | (3.5) | 0.029 | (0.6) | 0.270 | (3.8) | 0.107 | (3.4) |
| Own income | 0.171 | (3.2) | 0.029 | (0.5) | 0.270 | (3.7) | 0.107 | (3.1) |
| Village income | 0.161 | (1.1) | –0.417 | (2.0) | 0.020 | (0.1) | 0.144 | (1.6) |
| | | | *OLS 1986–87* | | | | | |
| No dummies | 0.458 | (8.8) | 0.162 | (5.3) | 0.168 | (4.0) | 0.239 | (10.4) |
| Village dummies | 0.424 | (8.1) | 0.173 | (5.6) | 0.164 | (3.8) | 0.235 | (10.1) |
| Own income | 0.424 | (7.9) | 0.173 | (5.3) | 0.164 | (3.8) | 0.235 | (9.7) |
| Village income | 0.350 | (2.0) | –0.094 | (1.0) | 0.061 | (0.4) | 0.039 | (0.5) |
| | | | *IVE 1986–87* | | | | | |
| No dummies | 0.418 | (7.8) | 0.090 | (2.8) | 0.088 | (2.0) | 0.177 | (7.4) |
| Village dummies | 0.388 | (7.3) | 0.105 | (3.2) | 0.087 | (1.9) | 0.177 | (7.3) |
| Own income | 0.388 | (7.1) | 0.105 | (3.1) | 0.087 | (1.9) | 0.177 | (7.0) |
| Village income | 0.353 | (2.0) | –0.127 | (1.3) | 0.015 | (0.1) | –0.002 | (0.0) |

*Note*: Absolute values of *t*-values are shown in brackets The first row of each panel shows the coefficient on income change of a regression of consumption changes on income changes. The second row reports the same result when village dummies are included in the regression. The third and fourth rows show the estimates from a regression of consumption changes on individual household and village average changes in income. The IV regressions use the change in the value of cash income, individual and village average, as instruments for total income including imputations; the *t*-values on these instruments in the first-stage regressions are large, typically larger than 30. Because village dummies "sweep out" the village means, the coefficients—but not the standard errors—are identical in the second and third rows in each panel.

Source: Deaton (1997) "The Analysis of Household Surveys"

# Limits to insurance

There is scope for insurance in the village economy, since incomes of villages do not co-move very strongly. There is evidence of some consumption smoothing, but only partial. What are the limits to insurance?
Limits to insurance:
-adverse selection: you may not like someone new to join an insurance network.
-moral hazard : will people slack if they know they will be covered in case of bad outcomes?
-difficulty to observe real output.
-imperfect enforcement: people who have had a good shock may refuse to contribute to the pot: members will trade off the short-term gain from defaulting today against the long-term loss of being isolated from then on (if the defaulters are excluded from the network).

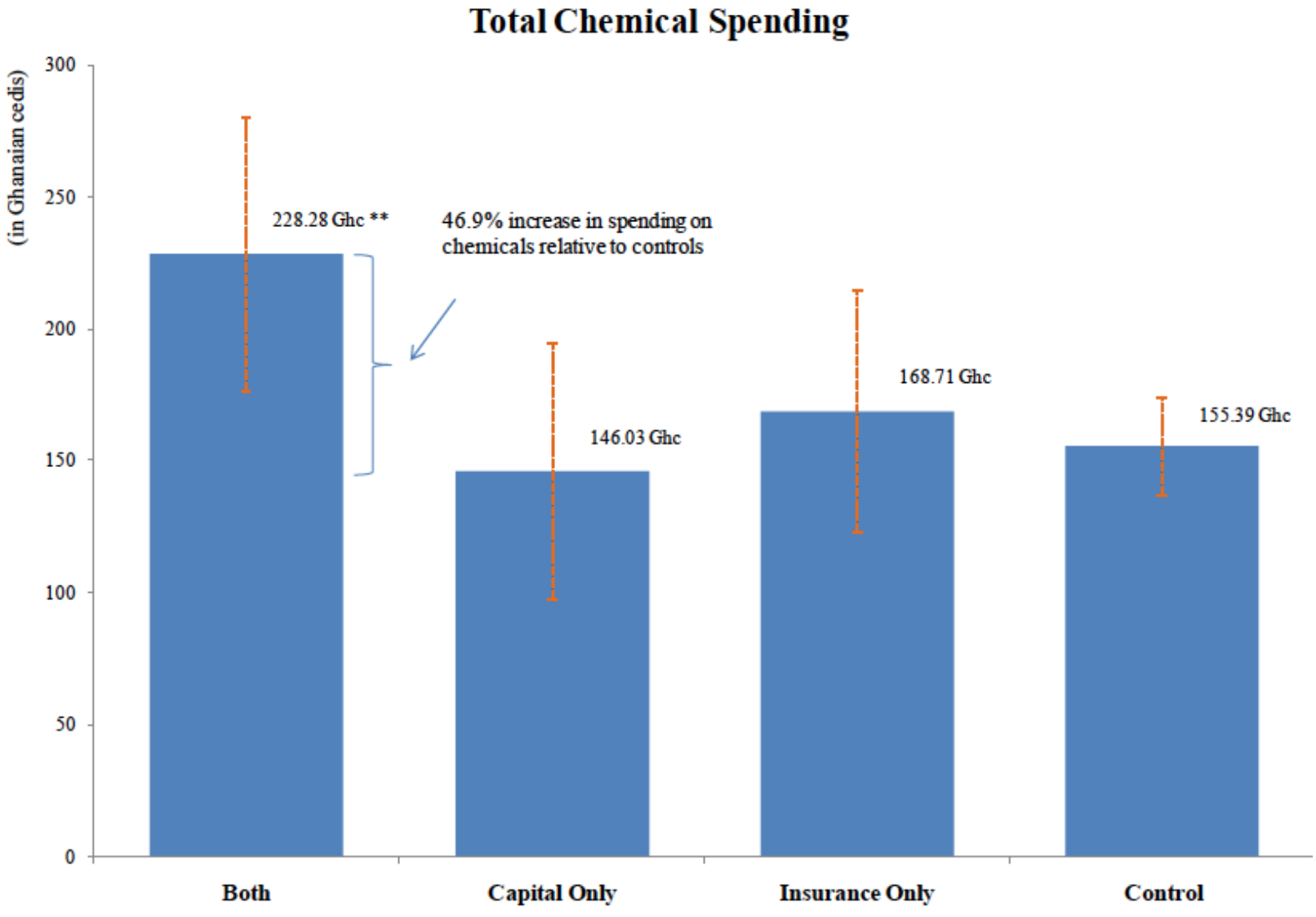
## Which means

All of these will lead to limited insurance: you will need to maintain a difference between the income in the high state and the income in the low state to :
-force people to work (moral hazard, imperfect observability of the output)
-maintain people's happiness that they are in the system (imperfect enforcement).
People may make the payment partly dependent on history (a mix between credit and insurance): Udry, Nigeria: state contingent loans (repayment depend not only on history, but also the current situation of the borrower and the lender).

# Market insurance: insuring what is exogenous

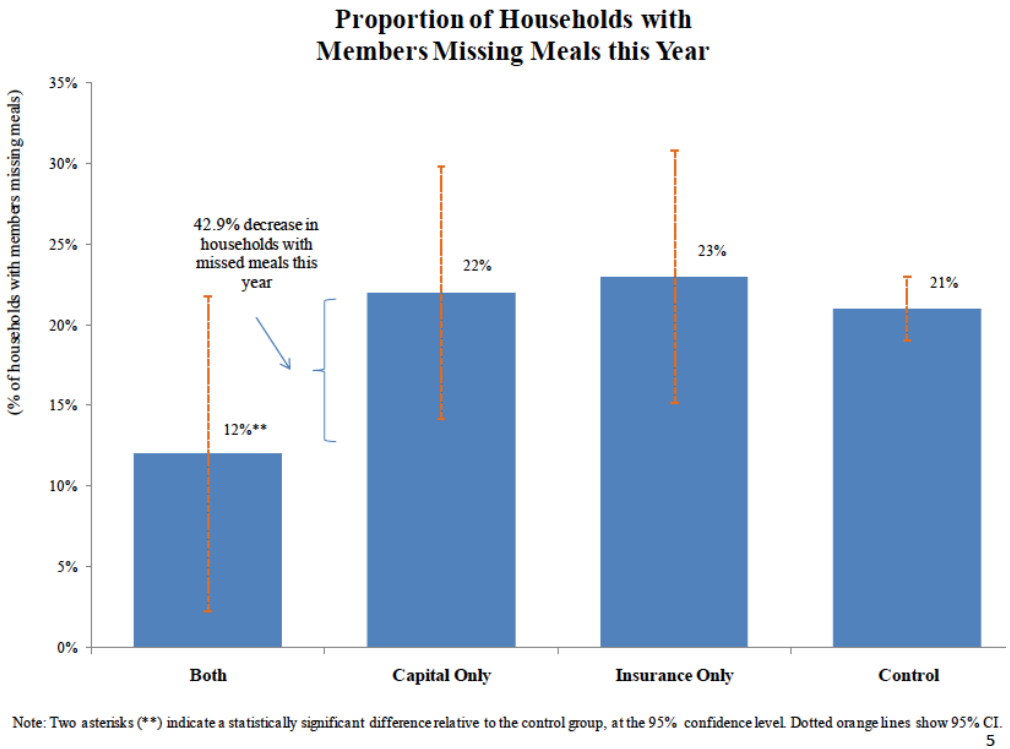
Weather Index insurance
Accident insurance
Life insurance
Karlan-Udry experiment in Ghana on "selling" insurance and credit
Interested whether it affects risk-taking and consumption smoothing

# Effect of insurance on fertilizer use




Note: Two asterisks (**) indicate a statistically significant difference relative to the control group, at the 95% confidence level. Orange bars show 95% CI.

# Effect on consumption smoothing




Note: Two asterisks (**) indicate a statistically significant difference relative to the control group, at the 95% confidence level. Dotted orange lines show 95% CI.

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# No one wants insurance(why?)