The Empirical Implications of Self-Enforceable Insurance Contracts:

Measuring the Size of Sticks and Carrots in Mexican Villages.

Orazio P. Attanasio

UCL, IFS, NBER & BREAD
o.attanasio@ucl.ac.uk

The Walras-Bowley Lecture at the World Congress of the Econometric Society - Shanghai August 2010

www.qeconomics.org

QE
ISSN (e) 1759-7331 (print) 1759-7323

Quantitative Economics

An open-access journal in quantitative economics

Main page | Submit a paper | Become an ES member

Journal of the Econometric Society

Ragnar Frisch, the first president of the Econometric Society envisioned the society as promoting studies that aim at the unification of the theoretical-quantitative and the empirical-quantitative approach to economic problems and that are penetrated by constructive and rigorous thinking.

Quantitative Economics, a new journal sponsored by the Econometric Society, is designed to provide a home for papers that fulfil this vision. As such, it will complement the role currently played by *Econometrica*.

Current Issue: Volume 1, Issue 1 (July 2010)

Table Of Contents

Articles

Analyzing social experiments as implemented: A reexamination of the evidence from the HighScope Perry Preschool Program — PDF
James Heckman, Seong Hyeok Moon, Rodrigo Pinto, Peter Savelyev, Adam Yavitz

Effects of school reform on education and labor market performance: Evidence from Chile's universal voucher system — PDF
David Bravo, Sankar Mukhopadhyay, Petra E Todd

Aggregate labor market outcomes: The roles of choice and chance — PDF
Per Krusell, Toshihiko Mukoyama, Richard Rogerson, Aysegül Sahin

Fragile beliefs and the price of uncertainty — PDF
Lars Peter Hansen, Thomas J Sargent

Memoirs of an indifferent trader: Estimating forecast distributions from prediction markets — PDF
Joyce E Berg, John Geweke, Thomas A Rietz

When consensus choice dominates individualism: Jensen's inequality and collective decisions under uncertainty — PDF
Charles F Manski

ISSN: 1759-7323

Main page
Editorial Standards
Submit a paper
Become an ES member

Risk sharing in developing countries

- Low-income agriculture societies are characterized by large income fluctuations.

Risk sharing in developing countries

- Low-income agriculture societies are characterized by large income fluctuations.
- Consumption fluctuates less than income, but more than under perfect insurance.

Risk sharing in developing countries

- Low-income agriculture societies are characterized by large income fluctuations.
- Consumption fluctuates less than income, but more than under perfect insurance.
- Perfect insurance is strongly rejected.

Risk sharing in developing countries

- Low-income agriculture societies are characterized by large income fluctuations.
- Consumption fluctuates less than income, but more than under perfect insurance.
- Perfect insurance is strongly rejected.
- We therefore need models of partial risk sharing.

Risk sharing in developing countries

- Low-income agriculture societies are characterized by large income fluctuations.
- Consumption fluctuates less than income, but more than under perfect insurance.
- Perfect insurance is strongly rejected.
- We therefore need models of partial risk sharing.
- This is essential for policy analysis.

Risk sharing in developing countries

- The literature has focused on two types of imperfections:
  - Imperfect Information;
  - Imperfect Enforceability of Contracts.

Risk sharing in developing countries

- The literature has focused on two types of imperfections:
  - Imperfect Information;
  - Imperfect Enforceability of Contracts.
- We focus on the second class of models of imperfect insurance:
  - those where first best is not achieved because of imperfect enforceability.

Risk sharing in developing countries

- The literature has focused on two types of imperfections:
  - Imperfect Information;
  - Imperfect Enforceability of Contracts.
- We focus on the second class of models of imperfect insurance:
  - those where first best is not achieved because of imperfect enforceability.
- These models are particularly useful to study consumption smoothing behaviour in village economies.

Why is this framework interesting/useful?

- Assumptions seem 'appropriate' for some village economies:
  - Perfect information;
  - Difficulty to convey information outside the village;
  - Opportunity for risk sharing;
  - Repeated interactions.

Why is this framework interesting/useful?

- Assumptions seem ‘appropriate’ for some village economies:
  - Perfect information;
  - Difficulty to convey information outside the village;
  - Opportunity for risk sharing;
  - Repeated interactions.
- These models can give rise to equilibria that capture some important aspects of risk sharing behaviour:
  - Existing contracts have features of both insurance and debt;
  - Evidence: Townsend 94, Udry 94, Platteau 97.

Why is this framework interesting/useful?

This paper's aims:

- Propose a new test of the empirical relevance of models with imperfect enforceability:
  - Focus on properties of observed intertemporal allocations (as in Townsend 94);

This paper's aims:

- Propose a new test of the empirical relevance of models with imperfect enforceability:
  - Focus on properties of observed intertemporal allocations (as in Townsend 94);
  - Characterize the relationship between the properties of income processes and the amount of risk-sharing across different economies.

This paper's aims:

- Propose a new test of the empirical relevance of models with imperfect enforceability:
  - Focus on properties of observed intertemporal allocations (as in Townsend 94);
  - Characterize the relationship between the properties of income processes and the amount of risk-sharing across different economies.
- Implement the test with a unique data set which includes questions on subjective income expectations:
  - Income processes parameters are estimated using subjective expectations data.

Existing literature: Theory

- Thomas and Worrall (1988),
- Kocherlakota (1996),
- Ligon, Thomas and Worrall (1998, 2002),
- Alvarez and Jerman (2000),
- Attanasio and Rios-Rull (2000, 2004),
- Kehoe and Levine (2001),
- Krueger and Perri (2006,2010),
- Mazzocco (2007),
- Dubois, Jullien and Magnac (2008)

Literature: Empirical evidence

- Rosenzweig and Foster (2001)
- Ligon, Thomas and Worrall (2002)
- Albarran and Attanasio (2002)
- Dubois, Jullien and Magnac (2008)
- Krueger and Perri (2006,2010)
- Laczo (2009)
- Kinnan (2010)

Outline

- A theoretical framework:
  - A very simple model with imperfect enforceability:
    - Characterization of some properties of the equilibrium.
  - A more general model.
    - Defining the ‘distance’ of (observed) equilibrium allocations from full risk sharing.
  - The model’s empirical implications.
- Empirical strategy.
- The data:
  - Mexican PROGRESA data;
  - Validating expectations questions.
- Empirical Specifications and Results.
- Conclusions.

Models of imperfectly enforceable contracts.

- We will be considering models where contracts cannot be enforced perfectly.

Models of imperfectly enforceable contracts.

- We will be considering models where contracts cannot be enforced perfectly.
- Individuals will only enter contracts that are self-enforceable.

Models of imperfectly enforceable contracts.

- We will be considering models where contracts cannot be enforced perfectly.
- Individuals will only enter contracts that are self-enforceable.
- The equilibrium concept used is the one proposed by Abreu Pearce and Stacchetti (Ecta, 1990):
  - Contracts enforced by the threat to revert to Autarky, which is the worst subgame perfect equilibrium.

Models of imperfectly enforceable contracts.

- We will be considering models where contracts cannot be enforced perfectly.
- Individuals will only enter contracts that are self-enforceable.
- The equilibrium concept used is the one proposed by Abreu Pearce and Stacchetti (Ecta, 1990):
  - Contracts enforced by the threat to revert to Autarky, which is the worst subgame perfect equilibrium.
- If you deviate, you are excluded from future risk sharing and confined to Autarky.

Models of imperfectly enforceable contracts.

- We will be considering models where contracts cannot be enforced perfectly.
- Individuals will only enter contracts that are self-enforceable.
- The equilibrium concept used is the one proposed by Abreu Pearce and Stacchetti (Ecta, 1990):
  - Contracts enforced by the threat to revert to Autarky, which is the worst subgame perfect equilibrium.
- If you deviate, you are excluded from future risk sharing and confined to Autarky.
- The value of Autarky is crucial to determine how much risk sharing happens in equillibrium.

An extension of Kehoe and Levine (2001).

- Two infinitely lived agents, A and B.
- Endowments, e_t^A and e_t^B: one consumer receives $1+\xi_t$, while the other receives $1-\xi_t$.
- Random variable ξ_t can take two values:

$$\xi_t = \begin{cases} 0 & \text{with prob } 1-p_1, \\ y>0 & \text{with prob } \quad p_1. \end{cases}$$

An extension of Kehoe and Levine (2001).

- The variability of the random variable ξ_t depends on y and on p_1.

An extension of Kehoe and Levine (2001).

- The variability of the random variable ξ_t depends on y and on p_1.
- A second random variable ζ_t determines who receives the positive and negative shock.
- The 'lucky' consumer's identity will change with probability $1 - p_2$.

An extension of Kehoe and Levine (2001).

- The variability of the random variable ξ_t depends on y and on p_1.
- A second random variable ζ_t determines who receives the positive and negative shock.
- The 'lucky' consumer's identity will change with probability $1 - p_2$.
- The parameter p_2 determines the persistence of the income process.

An extension of Kehoe and Levine (2001).

- In addition to the endowment, there is 1 unit of capital that generates returns 2r in each period.
- The capital is owned in shares θ_t^A and θ_t^B: $\theta_t^A + \theta_t^B = 1$.
- Total resources therefore will be constant and equal to $\omega = 2(1 + r)$.

The optimization problem.

State $s_t = \{\xi_t, \zeta_t\}$;

History $s^t = \{s_0, s_1, s_2, ..., s_t\}$, with probability $\pi(s^t)$;

Denote the consumption of agent j at time t as c_t^j, $j =, A, B$.

$m(s^t)$ is the Arrow-Debreu price of one unit of consumption at time t given history s^t.

The optimization problem.

State $s_t = \{\xi_t, \zeta_t\}$;

History $s^t = \{s_0, s_1, s_2, ..., s_t\}$, with probability $\pi(s^t)$;

Denote the consumption of agent j at time t as c_t^j, $j =, A, B$.

$m(s^t)$ is the Arrow-Debreu price of one unit of consumption at time t given history s^t.

$$\max(1-\beta)\sum_{t=1}^{\infty}\sum_{s^t \in S^t}\beta^t \pi(s^t) u(c^i(s^t)),$$

subject to....

The optimization problem.

a resource constraint:

$$\sum_{t=1}^{\infty} \sum_{s^t \in S^t} m(s^t) c^j(s^t) \leq \sum_{t=1}^{\infty} \sum_{s^t \in S^t} m(s^t)(e^j(s_t) + \theta_0^j r), \quad j = A, B.$$

The optimization problem.

a resource constraint:

$$\sum_{t=1}^{\infty}\sum_{s^t\in S^t} m(s^t)c^j(s^t) \leq \sum_{t=1}^{\infty}\sum_{s^t\in S^t} m(s^t)(e^j(s_t)+\theta_0^j r), \quad j=A,B.$$

and a participation constraint:

$$(1-\beta)\sum_{\tau>t}^{\infty}\sum_{s^\tau\in S^\tau}\beta^{\tau-t}\pi(s^\tau)/\pi(s^t)u(c^j(s^\tau)) \geq$$
$$(1-\beta)\sum_{\tau>t}^{\infty}\sum_{s^\tau\in S^\tau}\beta^{\tau-t}\pi(s^\tau)/\pi(s^t)u(e^j(s_t)),.$$

Results

- **Proposition 1**
  - A symmetric Steady State Equilibrium exists and is unique.

Results

- **Proposition 1**
  - A symmetric Steady State Equilibrium exists and is unique.
- **Proposition 2**
  - Risk sharing decreases with persistence p_2 (the probability that the identity of the ‘lucky’ consumer does not change).

Results

- **Proposition 1**
  - A symmetric Steady State Equilibrium exists and is unique.
- **Proposition 2**
  - Risk sharing decreases with persistence p_2 (the probability that the identity of the 'lucky' consumer does not change).
- **Proposition 3**
  - Risk sharing increases with the variance of the endowment process as measured by p_1.

Observations

- Propositions 1 and 2 are straightforward extensions of Kehoe and Levine (2002) and Krueger and Perri (2006, 2010).

Observations

- Propositions 1 and 2 are straightforward extensions of Kehoe and Levine (2002) and Krueger and Perri (2006, 2010).
- Proposition 3 is derived under the assumption that the variance is increased by shifting probability mass, but keeping the support constant.

Observations

- Propositions 1 and 2 are straightforward extensions of Kehoe and Levine (2002) and Krueger and Perri (2006, 2010).
- Proposition 3 is derived under the assumption that the variance is increased by shifting probability mass, but keeping the support constant.
- When one increases the variance by shifting the support (say, increasing y), risk sharing does not necessarily increase. (see Krueger and Perri (2010)).

A more general framework

- We want to extend this simple model in various dimensions:
  - Richer income structures;
  - Many agents.

A more general framework

- We want to extend this simple model in various dimensions:
  - Richer income structures;
  - Many agents.
- A different set of results are useful to characterize the equilibrium's properties :
  - Ligon, Thomas and Worrall (2002) (LTW).

A more general framework

- We want to extend this simple model in various dimensions:
  - Richer income structures;
  - Many agents.
- A different set of results are useful to characterize the equilibrium's properties :
  - Ligon, Thomas and Worrall (2002) (LTW).
- Within this more general framework, we want to construct a measure of the level of risk sharing.

LTW: The basic setup

- Two (to be extended to many) infinitely lived agents.
- Endowments function of aggregate and idiosyncratic shocks: $e_t^j = e^j(\nu_t^j, z_t)$.
- Shocks have discrete support.
- The vector $s_t = \{z_t, \nu_t^A, \nu_t^B\}$ is Markov.
- History to time t: $s^t = \{s_0, s_1, s_2, ..., s_t\}$.

LTW: The basic setup

- Two (to be extended to many) infinitely lived agents.
- Endowments function of aggregate and idiosyncratic shocks: $e_t^j = e^j(\nu_t^j, z_t)$.
- Shocks have discrete support.
- The vector $s_t = \{z_t, \nu_t^A, \nu_t^B\}$ is Markov.
- History to time t: $s^t = \{s_0, s_1, s_2, ..., s_t\}$.
- No storage (to start with) and complete information.

LTW: The setup

- As the two idiosyncratic shocks are uncorrelated there is scope for risk-sharing.

LTW: The setup

- As the two idiosyncratic shocks are uncorrelated there is scope for risk-sharing.
- A contract between the two individuals specifies the net transfer from individual A to individual B as a function of current history:

$$c^A_{t+k}(s^{t+k}) = e^A(s_{t+k}) - \kappa(s^{t+k}), \quad k = 0, 1, 2, ...$$
$$c^B_{t+k}(s^{t+k}) = e^B(s_{t+k}) + \kappa(s^{t+k}), \quad k = 0, 1, 2, ...$$

LTW: The setup

- The value of Autarky is:
$$\underline{U}^j(s^t) = u(e^j(s_t)) + E\left[\sum_{k=1}^{\infty} \beta^k u(e^j(s^{t+k})) \,\middle|\, e^j(s^t)\right] - P(s^t),$$
$j = A, B$; $P(s^t)$ is a penalty imposed upon default from an insurance contract.

LTW: The setup

- The value of Autarky is:
$$\underline{U}^j(s^t) = u(e^j(s_t)) + E\left[\sum_{k=1}^{\infty} \beta^k u(e^j(s^{t+k})) \,\middle|\, e^j(s^t)\right] - P(s^t),$$
$j = A, B$; $P(s^t)$ is a penalty imposed upon default from an insurance contract.
- Utility associated with an insurance contract is:

$$U^j(s^t) = u(c^j(s^t)) + E\left[\sum_{k=1}^{\infty} \beta^k u(c^j(s^{t+j})) \,|\, s^t\right].$$

LTW: The setup

- The value of Autarky is:
$$\underline{U}^j(s^t) = u(e^j(s_t)) + E\left[\sum_{k=1}^{\infty} \beta^k u(e^j(s^{t+k})) \,\middle|\, e^j(s^t)\right] - P(s^t),$$
$j = A, B$; $P(s^t)$ is a penalty imposed upon default from an insurance contract.
- Utility associated with an insurance contract is:
$$U^j(s^t) = u(c^j(s^t)) + E\left[\sum_{k=1}^{\infty} \beta^k u(c^j(s^{t+j})) \,|\, s^t\right].$$
- In the absence of enforceability problems, a first best allocation of resources can be achieved and the two individuals share idiosyncratic risk fully.

LTW: Characterizing the solution

The Pareto frontier is defined by the following problem:

$$U_s^B(U_s^A) = Max_{\kappa_s, \{U_r^A\}_{r=1}^S} \Big\{ u^B(e^B(s_t) + \kappa_s) + \beta \Big[\sum_r^\infty \pi_{sr} U^B(U^A(r)) \Big] \Big\}$$

subject to

the subscript r indexes future states of the world, while s indexes current states of the world.

LTW: Characterizing the solution

Constraints

$$\lambda : \quad u^A(e^A(s_t) - \kappa_s) - u(e^A(s_t)) + \beta \left[\sum_r^{\infty} \pi_{sr} U^A(r) \right] \geq U_s^A \quad \forall r;$$

$$\beta \pi_{sr} \phi_r : \quad U_r^A \geq \underline{U}^A, \quad \forall r;$$

$$\beta \pi_{sr} \mu_r : \quad U_r^B(U_r^A) \geq \underline{U}^B, \quad \forall r;$$

$$\psi_1 : \quad e^A(s) - \kappa \geq 0$$

$$\psi_2 : \quad e^B(s) + \kappa \geq 0$$

LTW: Characterizing the solution

First order conditions.

$$\lambda = \frac{u^{B\prime}(e^B(s_t)+\kappa_s)}{u^{A\prime}(e^A(s_t)-\kappa_s)};$$

$$-U_s^{2\prime}(U_s^1) = \lambda;$$

$$U_r^{2\prime}(U_r^1) = \frac{\lambda+\phi_r}{1+\mu_r}.$$

LTW: Characterizing the solution

- The solution is characterized, for each state of the world r, by an interval $[\underline{\lambda}_r, \overline{\lambda}_r]$ and the following rule:

$$\lambda(s^t, r) = \begin{cases} \overline{\lambda}_r & \text{if} \quad \lambda(s^t) > \overline{\lambda}_r \\ \lambda(s^t) & \text{if} \quad \underline{\lambda}_r < \lambda(s^t) < \overline{\lambda}_r \\ \underline{\lambda}_r & \text{if} \quad \lambda(s^t) < \underline{\lambda}_r \end{cases}$$

Extensions: Storage

- The value of autarky will be affected by storage.

Extensions: Storage

- The value of autarky will be affected by storage.
- The resource constraint will also change.

Extensions: Storage

- The value of autarky will be affected by storage.
- The resource constraint will also change.
- However, the main ideas go through.

Extensions: Many consumers

- A similar approach can be used with many consumers:
  - Characterize the Pareto efficient frontier;
  - Derive conditions for relative marginal utilities.

Extensions: Many consumers

- A similar approach can be used with many consumers:
  - Characterize the Pareto efficient frontier;
  - Derive conditions for relative marginal utilities.
- Two groups of consumers:
  - Consumers for whom the participation constraint is not binding;
    - The m.u. of consumption grows at the same rate;
  - Consumers for whom the P.C. is binding;
    - The m.u. of consumption grows more slowly.

How much risk sharing?

Armed with this framework, we can now construct a measure of risk sharing (relative to first best).

How much risk sharing?

Armed with this framework, we can now construct a measure of risk sharing (relative to first best).

- The amount of risk sharing is determined by the size of the intervals $[\underline{\lambda}_r, \overline{\lambda}_r]$ that govern the dynamics of the ratio of marginal utilities λ.
  - More risk sharing is equivalent to wider intervals.

How much risk sharing?

Armed with this framework, we can now construct a measure of risk sharing (relative to first best).

- The amount of risk sharing is determined by the size of the intervals $[\underline{\lambda}_r, \overline{\lambda}_r]$ that govern the dynamics of the ratio of marginal utilities λ.
  - More risk sharing is equivalent to wider intervals.

- When the intervals are large enough so that their intersection is non-empty, first best is achieved.

How much risk sharing?

Armed with this framework, we can now construct a measure of risk sharing (relative to first best).

- The amount of risk sharing is determined by the size of the intervals $[\underline{\lambda}_r, \overline{\lambda}_r]$ that govern the dynamics of the ratio of marginal utilities λ.
  - More risk sharing is equivalent to wider intervals.
- When the intervals are large enough so that their intersection is non-empty, first best is achieved.
- Under first best, the cross sectional distribution of marginal utilities is constant.

How much risk sharing?

Armed with this framework, we can now construct a measure of risk sharing (relative to first best).

- When the participation constraints are binding, the cross-sectional distribution changes.

How much risk sharing?

Armed with this framework, we can now construct a measure of risk sharing (relative to first best).

- When the participation constraints are binding, the cross-sectional distribution changes.
- The smaller the intervals, the larger the changes in the cross sectional distribution of marginal utilities.

How much risk sharing?

Armed with this framework, we can now construct a measure of risk sharing (relative to first best).

- When the participation constraints are binding, the cross-sectional distribution changes.
- The smaller the intervals, the larger the changes in the cross sectional distribution of marginal utilities.
- Our measure of risk sharing is constructed by considering changes in the cross sectional distribution of log-marginal utilities.

Deviations from first best.

- With power utility, we can approximate log marginal utility with log consumption.
- We consider changes in the cross-sectional variance of log consumption.

Deviations from first best.

- With power utility, we can approximate log marginal utility with log consumption.
- We consider changes in the cross-sectional variance of log consumption.
- However we want to normalize it by the variance of income:

Deviations from first best.

- With power utility, we can approximate log marginal utility with log consumption.
- We consider changes in the cross-sectional variance of log consumption.
- However we want to normalize it by the variance of income:

$$\frac{\left|\Delta Var_v(\log(c_t^i))\right|}{Var_v(\log(y_t^i))}.$$

the subscript v indexes 'villages'.

- Note: under first best this quantity is zero.

Properties of our measure of risk sharing.

Recalling the propositions we derived for the simple model we can now state:

Properties of our measure of risk sharing.

Recalling the propositions we derived for the simple model we can now state:

- An increase in the (time series) variance of income increases risk sharing (under certain conditions);

Properties of our measure of risk sharing.

Recalling the propositions we derived for the simple model we can now state:

- An increase in the (time series) variance of income increases risk sharing (under certain conditions);
- An increase in the persistence of idiosyncratic income decreases risk sharing;

Changes in the cross sectional variance of consumption.

- The main idea of the test is to relate the amount of risk sharing, as measured by:

$$\frac{\left|\Delta Var_v(\log(c_t^i))\right|}{Var_v(\log(y_t^i))},$$

to the properties of the stochastic process that generates income.

Changes in the cross sectional variance of consumption.

- The main idea of the test is to relate the amount of risk sharing, as measured by:

$$\frac{\left|\Delta Var_v(\log(c_t^i))\right|}{Var_v(\log(y_t^i))},$$

  to the properties of the stochastic process that generates income.

- We consider many villages and in each of them we measure risk sharing and the income properties.

Changes in the cross sectional variance of consumption

- The test can be framed as a test of perfect insurance.

Changes in the cross sectional variance of consumption

- The test can be framed as a test of perfect insurance.
- Under first best:

$$U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v}))\lambda^{i,v}\beta^i = \mu(s^{t_v})$$

Changes in the cross sectional variance of consumption

- The test can be framed as a test of perfect insurance.
- Under first best:

$$U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v}))\lambda^{i,v}\beta^i = \mu(s^{t_v})$$

- Taking logs:

$$\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v}))) = \log(\mu(s^{t_v})) - \log(\lambda^{i,v}\beta^{i,v})$$

Changes in the cross sectional variance of consumption

$$\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v}))) = \log(\mu(s^{t_v})) - \log(\lambda^{i,v}\beta^{i,v})$$

- Computing the cross sectional variance of both sides:

$$Var_v[\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v})))] = Var_v[\log(\lambda^{i,v}\beta^{i,v}] \equiv d_v$$

Changes in the cross sectional variance of consumption

$$\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v}))) = \log(\mu(s^{t_v})) - \log(\lambda^{i,v}\beta^{i,v})$$

- Computing the cross sectional variance of both sides:

$$Var_v[\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v})))] = Var_v[\log(\lambda^{i,v}\beta^{i,v}] \equiv d_v$$

- Taking first differences:

$$\Delta Var_v[\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v})))] = 0$$

Changes in the cross sectional variance of consumption

$$\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v}))) = \log(\mu(s^{t_v})) - \log(\lambda^{i,v}\beta^{i,v})$$

- Computing the cross sectional variance of both sides:

$$Var_v[\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v})))] = Var_v[\log(\lambda^{i,v}\beta^{i,v}] \equiv d_v$$

- Taking first differences:

$$\Delta Var_v[\log(U_c(c_t^{i,v}(s^{t_v}), z_t^{i,v}(s^{t_v})))] = 0$$

- Normalizing by the income variance and expressing it as a function of moments of the income process:

$$\frac{|\Delta Var_v(\log(c_t^{i,v}))|}{Var_v(\log(y_t^{i,v}))} = f(var(\log(y_t^{i,v})), \rho^{y^{i,v}})$$

Village data from Mexico

- Data come from 506 villages in rural Mexico
  - Collected to evaluate the PROGRESA program;

Village data from Mexico

- Data come from 506 villages in rural Mexico
  - Collected to evaluate the PROGRESA program;
- We use 7 waves of a panel:
  - 1998 march, october;
  - 1999 march, november;
  - 2000 april, november;
  - 2003 october.

Village data from Mexico

- Data come from 506 villages in rural Mexico
  - Collected to evaluate the PROGRESA program;
- We use 7 waves of a panel:
  - 1998 march, october;
  - 1999 march, november;
  - 2000 april, november;
  - 2003 october.
- Census in each village.
- Start with about 25,000 households.
- Complete information on consumption, income etc.

Village data from Mexico

- Consumption includes in-kind consumption.
  - Detailed information on many items, especially food.
  - Food accounts for about 70% of budget.

Village data from Mexico

- Consumption includes in-kind consumption.
  - Detailed information on many items, especially food.
  - Food accounts for about 70% of budget.
  - Different items recalled over different horizon.
- Information on household income derived from labour supply and transfer information.

Village data from Mexico

- Consumption includes in-kind consumption.
  - Detailed information on many items, especially food.
  - Food accounts for about 70% of budget.
  - Different items recalled over different horizon.
- Information on household income derived from labour supply and transfer information.
- **The data contain questions on income expectations and uncertainty.**

The Income Expectations questions

- Respondents are asked questions about their perceptions of the distribution of future income.

The Income Expectations questions

- Respondents are asked questions about their perceptions of the distribution of future income.
- These questions should, in theory, allow us to derive three points of the cdf and, with some assumptions, all moments of the distribution.

The Income Expectations questions

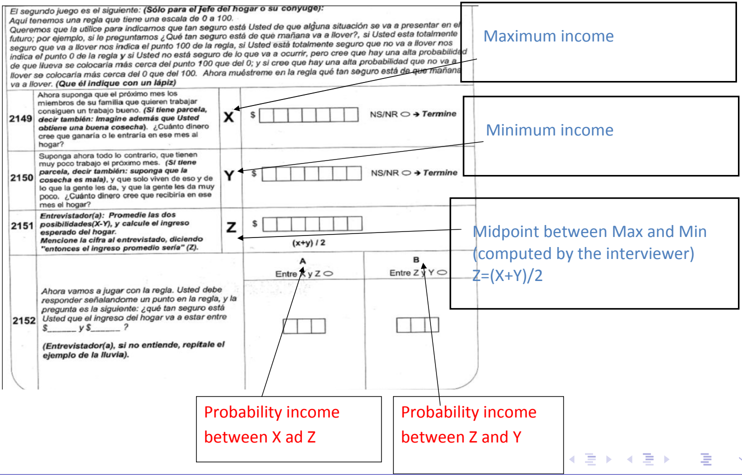
- Respondents are asked questions about their perceptions of the distribution of future income.
- These questions should, in theory, allow us to derive three points of the cdf and, with some assumptions, all moments of the distribution.
- This type of approach has been promoted by Manski.
- We have used similar questions in a variety of contexts.

Income expectations questions

El segundo juego es el siguiente: ***(Sólo para el jefe del hogar o su conyuge):***
Aquí tenemos una regla que tiene una escala de 0 a 100.
Queremos que la utilice para indicarnos que tan seguro está Usted de que alguna situación se va a presentar en el futuro; por ejemplo, si le preguntamos ¿Qué tan seguro está de que mañana va a llover?, si Usted esta totalmente seguro que va a llover nos indica el punto 100 de la regla, si Usted está totalmente seguro que no va a llover nos indica el punto 0 de la regla ***y*** *si Usted no está seguro de lo que va a ocurrir, pero cree que hay una alta probabilidad de que llueva se colocaría más cerca del punto 100 que del 0; y si cree que hay una alta probabilidad que no va a llover se colocaría más cerca del 0 que del 100. Ahora muéstreme en la regla qué tan seguro está de que mañana va a llover.* ***(Que él indique con un lápiz)***

2149	Ahora suponga que el próximo mes los miembros de su familia que quieren trabajar consiguen un trabajo bueno. ***(Si tiene parcela, decir también: Imagine además que Usted obtiene una buena cosecha).*** ¿Cuánto dinero cree que ganaría o le entraría en ese mes al hogar?	**X**	$ ☐☐☐☐☐☐☐	NS/NR ⬭ → ***Termine***
2150	Suponga ahora todo lo contrario, que tienen muy poco trabajo el próximo mes. ***(Si tiene parcela, decir también: suponga que la cosecha es mala),*** y que solo viven de eso y de lo que la gente les da, y que la gente les da muy poco. ¿Cuánto dinero cree que recibiría en ese mes el hogar?	**Y**	$ ☐☐☐☐☐☐☐	NS/NR ⬭ → ***Termine***
2151	***Entrevistador(a): Promedie las dos posibilidades(X-Y), y calcule el ingreso esperado del hogar. Mencione la cifra al entrevistado, diciendo "entonces el ingreso promedio sería" (Z).***	**Z**	$ ☐☐☐☐☐☐☐ **(x+y) / 2**	
2152	*Ahora vamos a jugar con la regla. Usted debe responder señalandome un punto en la regla, y la pregunta es la siguiente: ¿qué tan seguro está Usted que el ingreso del hogar va a estar entre $______ y $______ ?* ***(Entrevistador(a), si no entiende, repítale el ejemplo de la lluvia).***		**A** Entre X y Z ⬭ ☐☐☐	**B** Entre Z y Y ⬭ ☐☐☐

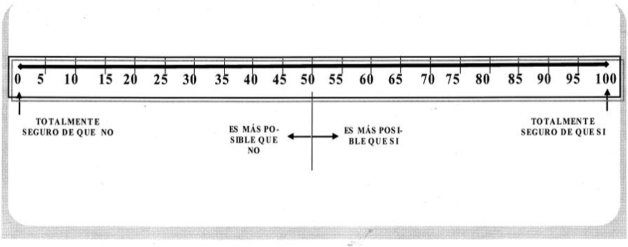
Income expectations questions



El segundo juego es el siguiente: ***(Sólo para el jefe del hogar o su conyuge):***
Aquí tenemos una regla que tiene una escala de 0 a 100.
Queremos que la utilice para indicarnos que tan seguro está Usted de que alguna situación se va a presentar en el futuro; por ejemplo, si le preguntamos ¿Qué tan seguro está de que mañana va a llover?, si Usted esta totalmente seguro que va a llover nos indica el punto 100 de la regla, si Usted está totalmente seguro que no va a llover nos indica el punto 0 de la regla y si Usted no está seguro de lo que va a ocurrir, pero cree que hay una alta probabilidad de que llueva se colocaria más cerca del punto 100 que del 0; y si cree que hay una alta probabilidad que no va a llover se colocaria más cerca del 0 que del 100. Ahora muéstreme en la regla qué tan seguro está de que mañana va a llover. ***(Que él indique con un lápiz)***

2149	Ahora suponga que el próximo mes los miembros de su familia que quieren trabajar consiguen un trabajo bueno. ***(Si tiene parcela, decir también: Imagine además que Usted obtiene una buena cosecha).*** ¿Cuánto dinero cree que ganaría o le entraría en ese mes al hogar?	X	$	NS/NR ○ → ***Termine***
2150	Suponga ahora todo lo contrario, que tienen muy poco trabajo el próximo mes. ***(Si tiene parcela, decir también: suponga que la cosecha es mala)***, y que solo viven de eso y de lo que la gente les da, y que la gente les da muy poco. ¿Cuánto dinero cree que recibiría en ese mes el hogar?	Y	$	NS/NR ○ → ***Termine***
2151	***Entrevistador(a): Promedie las dos posibilidades(X-Y), y calcule el ingreso esperado del hogar. Mencione la cifra al entrevistado, diciendo "entonces el ingreso promedio sería" (Z).***	Z	$ **(x+y) / 2**	
2152	*Ahora vamos a jugar con la regla. Usted debe responder señalandome un punto en la regla, y la pregunta es la siguiente: ¿qué tan seguro está Usted que el ingreso del hogar va a estar entre $______ y $______ ?* ***(Entrevistador(a), si no entiende, repítale el ejemplo de la lluvia).***		**A** Entre X y Z ○	**B** Entre Z y Y ○

The Ruler


0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
TOTALMENTE SEGURO DE QUE NO
ES MÁS PO-SIBLE QUE NO
ES MÁS POSI-BLE QUE SI
TOTALMENTE SEGURO DE QUE SI

Using the expectations questions

- Given the min and max expected income and the probability questions we make a functional form assumption:

Using the expectations questions

- Given the min and max expected income and the probability questions we make a functional form assumption:
  - We assume a triangular distribution (approximation to a Beta).

Using the expectations questions

- Given the min and max expected income and the probability questions we make a functional form assumption:
  - We assume a triangular distribution (approximation to a Beta).
- We can then estimate all moments of the distribution.

The expectations data in the Mexican survey.

- The max and min expected income were asked of all households in the 2003 survey.

The expectations data in the Mexican survey.

- The max and min expected income were asked of all households in the 2003 survey.
- Piloting of the probability questions showed some problems with the administration of these questions.
- The probability questions were only asked for a few households for villages:
  - The households interviewed by the supervisor.

The expectations data in the Mexican survey.

- The max and min expected income were asked of all households in the 2003 survey.
- Piloting of the probability questions showed some problems with the administration of these questions.
- The probability questions were only asked for a few households for villages:
  - The households interviewed by the supervisor.
- As probabilities are not observed for all households, we use village level probabilities for the missing ones.
  - We also experimented with alternative imputation schemes.

Descriptive statistics on subjective income expectations

Descriptive statistics of the moments of the individual distributions

Pct	E[y]	Median[y]	St.dev[y]	Coef.of Var.[y]
1	96	99	5.1	0.018
5	188	188	24.8	0.059
10	283	285	37.4	0.082
25	597	595	78.8	0.121
Median	1139	1142	167.8	0.162
75	2111	2119	357.1	0.224
90	3511	3497	669.7	0.278
95	4583	4576	964.7	0.312
99	6944	6863	1599.7	0.378
Mean	**1592**	**1588**	**283.1**	**0.172**
IQ diff.	1514	1524	278.3	0.103
SD	1452	1444	331.0	0.078

Triangular distribution

Validating the expectations questions

- The questions on expectations are relatively new and novel in a development context.
- Substantial piloting of the questions was necessary to arrive at a formulation respondents were comfortable with.
- We have tried these questions in several different contexts:
  - Urban Colombia (see Attanasio, Meghir and Vera , 2005),
  - Rural Colombia (Attanasio and DiMaro, 2006),
  - Rural Mexico (the data being used here),
  - Urban Mexico (high school students assessing the return to education),
  - Rural India (income expectations and returns to investment).

The expectations data in the Mexican survey.

- The questions are validated in Attanasio and di Maro (2006).
- Some of the results from that paper:
  - The Min and Max covary in a sensible way with observables (education, ethniticity);

The expectations data in the Mexican survey.

- The questions are validated in Attanasio and di Maro (2006).
- Some of the results from that paper:
  - The Min and Max covary in a sensible way with observables (education, ethniticity);
  - The range covaries significantly (and with the correct sign) with the standard deviation of past income;

The expectations data in the Mexican survey.

- The questions are validated in Attanasio and di Maro (2006).
- Some of the results from that paper:
  - The Min and Max covary in a sensible way with observables (education, ethniticity);
  - The range covaries significantly (and with the correct sign) with the standard deviation of past income;
  - There is not a large amount of bunching in the probabilities;

The expectations data in the Mexican survey.

- The questions are validated in Attanasio and di Maro (2006).
- Some of the results from that paper:
  - The Min and Max covary in a sensible way with observables (education, ethnicity);
  - The range covaries significantly (and with the correct sign) with the standard deviation of past income;
  - There is not a large amount of bunching in the probabilities;
  - The sum of probabilities averages to 0.9782 and is not significantly different from 1.

The expectations data in the Mexican survey.

- The questions are validated in Attanasio and di Maro (2006).
- Some of the results from that paper:
  - The Min and Max covary in a sensible way with observables (education, ethniticity);
  - The range covaries significantly (and with the correct sign) with the standard deviation of past income;
  - There is not a large amount of bunching in the probabilities;
  - The sum of probabilities averages to 0.9782 and is not significantly different from 1.
  - We normalize probabilities so that they sum up to 100.

'External' validation: Variance

- We can relate measures of variability obtained from the subjective expectations (coeff. of variation, st.dev. of logs, etc.) to analogous measures computed on actual data:
  - Retrospective questions on income in 2003;
  - Actual variation over the period 1998-2003.
- There is a significant and positive association between these measures.

'External' validation: Persistence

- We can also use the expectations questions to estimate income persistence (in each village).

'External' validation: Persistence

- We can also use the expectations questions to estimate income persistence (in each village).
- Expected future income can be regressed on current income:

$$E[log(y_{t+1}^{i,v})] = \alpha + \rho^v log(y_t^{i,v}) + u_{t+1}^{i,v}.$$

'External' validation: Persistence

- We can also use the expectations questions to estimate income persistence (in each village).
- Expected future income can be regressed on current income:

$$E[log(y_{t+1}^{i,v})] = \alpha + \rho^v log(y_t^{i,v}) + u_{t+1}^{i,v}.$$

- An alternative measure can be obtained estimating village by village a VAR model for income.
  - The relationship between the two measures is positive and mildly significant.

Village level variability and persistence

- We need estimates of the variability and persistence of individual income at the village level.

Village level variability and persistence

- We need estimates of the variability and persistence of individual income at the village level.
- For variability, we compute the average of individual variances in each village.

Village level variability and persistence

- We need estimates of the variability and persistence of individual income at the village level.
- For variability, we compute the average of individual variances in each village.
- For persistence, we use the ρ^{v} 's estimated from village level regressions of future expected income on current income.

What is a village?

- We would like ‘villages’ to be isolated from each other.

What is a village?

- We would like ‘villages’ to be isolated from each other.
- We consider two levels of aggregation:
  - Locality (average 500 households), small and isolated.
  - Municipality: larger entities (like counties).
    - (Not all localities in a municipality are included.)

What is a village?

- We would like 'villages' to be isolated from each other.
- We consider two levels of aggregation:
  - Locality (average 500 households), small and isolated.
  - Municipality: larger entities (like counties).
    - (Not all localities in a municipality are included.)
- Locality might be better in terms of information flows and homogeneity.
- Municipality allow us more precision in the estimation of village level variables.

Approximation to marginal utility

- The theory is informative about the cross sectional distribution of (log) marginal utilities.

Approximation to marginal utility

- The theory is informative about the cross sectional distribution of (log) marginal utilities.
- We approximate it by the log of consumption per adult equivalent.

Approximation to marginal utility

- The theory is informative about the cross sectional distribution of (log) marginal utilities.
- We approximate it by the log of consumption per adult equivalent.
- We use different ad.eq. schemes
  - Number of people
  - OECD scales
  - Based on caloric needs (Mexican tables)
  - Based on protein needs (Mexican tables)
- For consumption we use both total consumption and food.

Functional forms

- The theory is nearly silent about the specific functional form one should use.

Functional forms

- The theory is nearly silent about the specific functional form one should use.
- Except that for some variables, we know that the relationship is not linear:
  - If the variance is small enough autarky is the only equilibrium, and if it is big enough first best is sustainable.
  - If income is persistent enough, autarky is the only equilibrium.

Functional forms

- The theory is nearly silent about the specific functional form one should use.
- Except that for some variables, we know that the relationship is not linear:
  - If the variance is small enough autarky is the only equilibrium, and if it is big enough first best is sustainable.
  - If income is persistent enough, autarky is the only equilibrium.
- We therefore explore several functional forms and allow the relationship to be non-linear.

Regression Results: $\frac{|\Delta Var_v(\log(c_t^i))|}{Var_v(\log(y_t^i))} = f(st.dev.((y_t^i)), \rho^y)$

Locality level regression		
	Food	**Total Consumption**
Income Standard Deviation	-0.9320	-0.9720
	(0.2490)	(0.2879)
Income Persistence	0.0053	0.0033
	(0.0018)	(0.0016)
Dummy Persistence<0	0.0156	0.0068
	(0.0115)	(0.0145)
N. obs	1259	1259

Adult equivalence scheme based on caloric needs .
Standard errors clustered at the village level in parentheses. 506 clusters. Year dummies included but not reported

- An increase in the (time series) variance of income increases risk sharing.
- An increase in the (time series) persistence of income decreases risk sharing.

Regression Results: $\frac{|\Delta Var_v(\log(c_t^i))|}{Var_v(\log(y_t^i))} = f(coeff.var.((y_t^i)), \rho^y)$

Locality level regression		
	Food	**Total Consumption**
Income coefficient of variation	-0.2163	-0.3081
	(0.1623)	(0.1632)
Income Persistence	0.0026	0.0046
	(0.0012)	(0.0010)
Dummy Persistence<0	0.0124	0.0160
	(0.0112)	(0.0098)
N.obs	1241	1248

Adult equivalence scheme based on caloric needs .
Standard errors clustered at the village level in parentheses. 506 clusters.
1% trimming. Year dummies included but not reported

- An increase in the (time series) variance of income increases risk sharing
- An increase in the (time series) persistence of income decreases risk sharing

Regression Results: $\frac{\left|\Delta Var_v(\log(c_t^i))\right|}{Var_v(\log(y_t^i))} = f(st.dev.(y_t^i), \rho^y)$

Municipality level regression		
	Food	**Total Consumption**
Income Standard Deviation	-0.8180	-0.8100
	(0.3246)	(0.2862)
Income Persistence	-0.0352	-0.0019
	(0.0782)	(0.0493)
Dummy Persistence<0	0.0423	0.0474
	(0.0445)	(0.0145)
N.obs	460	460

Adult equivalence scheme based on caloric needs .
Standard errors clustered at the village level in parentheses. 191 clusters. Year dummies included but not reported

- An increase in the (time series) variance of income increases risk sharing.

Regression Results: $\frac{\left|\Delta Var_v(\log(c_t^i))\right|}{Var_v(\log(y_t^i))} = f(coeff.var.(y_t^i), \rho^y)$

Municipality level regression		
	Food	**Total Consumption**
Income coefficient of variation	-0.0748	-0.0322
	(0.2525)	(0.2702)
Income Persistence	-0.0434	-0.0021
	(0.0792)	(0.0437)
Dummy Persistence<0	0.0195	0.0262
	(0.0270)	(0.0272)
N.obs	452	452

Adult equivalence scheme based on caloric needs .
Standard errors clustered at the village level in parentheses. 191 clusters.
1% trimming. Year dummies included but not reported

An Alternative Method

- As an alternative to using the subjective expectations data one can use time series variation to estimate the stochastic properties of income

An Alternative Method

- As an alternative to using the subjective expectations data one can use time series variation to estimate the stochastic properties of income
- Estimate time series model in each village using 6 waves panel

An Alternative Method

- As an alternative to using the subjective expectations data one can use time series variation to estimate the stochastic properties of income
- Estimate time series model in each village using 6 waves panel
- We use an Arellano-Bond GMM estimator to estimate an autoregressive model of income in each village.
- We obtain estimates of persistence and variability of income for each village that we use in the exercise instead of the measures derived from subjective expectations.

Regression Results: $\frac{|\Delta Var_v(\log(c_t^i))|}{Var_v(\log(y_t^i))} = f(var(\log(y_t^i)), \rho^y)$

Locality level regression
(Arellano Bond estimates of persistence and variability from actual historical data)

	Food	Total Consumption
Income Standard Deviation	-0.0957	-0.0945
	(0.0413)	(0.0350)
Income Persistence	0.0571	0.0525
	(0.0333)	(0.0264)
Dummy Persistence<0	-0.0029	-0.0053
	(0.0119)	(0.0101)
N.obs	1258	1258

Adult equivalence scheme based on caloric needs .
Standard errors clustered at the village level in parentheses. 505 clusters. Year dummies included but not reported.

- An increase in the (time series) variance of income increases risk sharing.
- An increase in the (time series) persistence of income decreases risk sharing.

Regression Results: $\frac{|\Delta Var_v(\log(c_t^i))|}{Var_v(\log(y_t^i))} = f(var(\log(y_t^i)), \rho^y)$

Municipality level regression (Arellano Bond estimates of persistence and variability from actual historical data)		
	Food	**Total Consumption**
Income Standard Deviation	-0.0193	-0.0329
	(0.0421)	(0.0330)
Income Persistence	-0.1138	-0.0989
	(0.0334)	(0.0400)
Dummy Persistence<0	-0.0294	-0.0412
	(0.0156)	(0.0157)
N.obs	460	460

Adult equivalence scheme based on caloric needs .
Standard errors clustered at the village level in parentheses. 191 clusters. Year dummies included but not reported.

Conclusions

- A test of the empirical implications of models with imperfect enforceability

Conclusions

- A test of the empirical implications of models with imperfect enforceability
- We relate the amount of risk sharing to properties of the income distribution.

Conclusions

- A test of the empirical implications of models with imperfect enforceability
- We relate the amount of risk sharing to properties of the income distribution.
- These are estimated using questions on subjective income expectations.

Conclusions

- A test of the empirical implications of models with imperfect enforceability
- We relate the amount of risk sharing to properties of the income distribution.
- These are estimated using questions on subjective income expectations.
- The implications of the model seem to be consistent with the data:
  - High persistence implies less risk sharing;
  - High variability implies more risk sharing.