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Interpreting Experiments through Structural Models

(Lecture 1)

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Lecture 1: Interpreting Experiments through Structural Models (2/25)

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Overview

- RCT and structural models in tandem
- How do we choose what ingredients to put into the model?
- How do we validate a model using measured impacts of policy?
- Doing counterfactual policy evaluation in the estimated model

Heterogeneous Impacts and the Role of Structural Models

- Kaboski and Townsend (2011) stress the importance of heterogeneous impacts across agents, even those who may be observably equivalent but vary on unobservables such as permanent income. They distinguish households on the margin of making an indivisible investment, for whom consumption actually drops, versus those who are credit-constrained hand to mouth, for whom consumption increases 1-1, and those not constrained and not investing but able to spend out of what had been a buffer stock of savings (no longer needed in the future with credit available). In the counterfactual policy requiring borrowers to invest, the distribution of treatment effects and welfare benefits were shifted from those who desired small loans for consumption to those who desired larger loans and loans to invest.

Evaluation of a large scale microfinance experiment: reduced-form and structural analysis

Kaboski and Townsend (2011 and 2012)

Robert M. Townsend

MIT

KT (2012) - Description of the Program

- Big program: 1.5% of GDP in 2001
  - affected 77,000 villages
- Valid quasi-experiment, since likely exogenous:
  - Surpise program: Parliament dissolved in November 2000, new government elected in January 2001
  - Variation: each village" received 1 million fund, regardless of village size

KT (2012) - Description of the Program (cont.)

- Set up quasi-formal micro-lending village fund
- Rules to ensure equal access
- Typical loan: 20,000 baht ($500), one year loan limits, 2 guarantors, 7 percent nominal interest rate
- Investment or consumption loans (explicitly)

KT (2012) - Data and Outcomes

- Panel survey data from the Townsend Thai dataset.
- Five years (1997-2001) of pre-experiment data, six years (2002-2007) of post-program data.
- Supplement the data with information gathered in informal interviews conducted in the field.
- Four outcome classes:
  - short-term credit, borrowing from other formal sources (i.e., the BAAC and commercial banks); reasons for borrowing and measures of the tightness of credit markets (interest rates, default and informal borrowing).
  - Consumption and its different components: grains, dairy, meat, fuel, clothes, home repair, vehicle repair, eating out, tobacco, alcohol, ceremonies, and education.
  - Income and productive decisions: asset and income growth, and components of net income (agriculture by component, business, and wages/salaries), investment (agricultural and business), and input use (wages paid and fertilizer/pesticides), wages by type of activity
  - Differential impacts on the above variables in female-headed households (Microcredit is often targeted toward women)

KT (2012) - Method

- Outcome $y_{n,t}$ for household n at time t depends on the amount of short-term Village Fund credit household receives, $VFCR_{n,t}$.

$$y_{n,t} = \alpha VFCR_{n,t} + \sum_{i=1}^{I} \beta_i X_{i,n,t} + \phi_t + \phi_n + \varepsilon_{n,t}$$

- X_i: Household control variables such as number of adult males, adult females, children, dummy for male head, age of HH head, age of head squared, years of schooling of the head.
- Time specific effect ϕ_t and household-specific effect ϕ_n.

KT (2012) - Instrument

- Instrument used is the interaction between the inverse number of households in the village ($invHH_n$) and the post-program year dummies, $\chi_{t=t^*}$ for progrma year t^*.
- First stage regression:

$$\begin{aligned} VFCR_{n,t} &= \lambda_2 invHH_n \times \chi_{t=2002} + \lambda_3 invHH_n \times \chi_{t=2003} \\ &\quad + \sum_{i=1}^{I} \delta_i X_{i,n,t} + \phi_t + \phi_n + \mathrm{u}_{n,t} \end{aligned}$$

- Orthogonality Assumptions:

$$\begin{aligned} \varepsilon_{n,t}, u_{n,t} &\perp invHH_n \times \chi_{t=2002} | X_{i,n,t}, \phi_t, \phi_n \\ \varepsilon_{n,t}, u_{n,t} &\perp invHH_n \times \chi_{t=2003} | X_{i,n,t}, \phi_t, \phi_n \end{aligned}$$

KT (2011): Overview

Overview of Structural Paper

- Few rigorous, structural estimates of the real returns to microfinance, and how they compare to direct transfer schemes.
- KT use the variation introduced by a large-scale governmental microfinance program 'The Thai Million Baht Village Fund' program.
- Build a dynamic, structural model of credit constrained and buffer-stock building households and estimate it on the pre-program data. Then use post-program data for validating their model.
- Why do we need the structural model here? Many of the impacts in KT (2012) are puzzling without an explicit theory of credit-constrained behavior.
  - HHs increased their borrowing and their consumption roughly one for one with each dollar put into the funds (cannot match with a perfect credit model, such as a permanent income model, given that interest rates did not fall)
  - HHs not initially more likely in default, despite increase in borrowing.
  - Increase in *frequency* of investment, but unclear for level of investment (puzzling if investment is divisible).

KT (2011): What ingredients from data and reduced-form paper need to be captured by model?

- Precautionary savings model to capture uninsured income shocks seen in the data
- Add limited short-term borrowing (with constraints)
- Default exists in equilibrium, so does renegotiation, to match the data.
- Investment is rare but large when it occurs: indivisible, illiquid, high-yield project, with stochastic size process
- Income growth both high and very variable over households.

KT (2011): Model

- Based on standard buffer stock model of savings behavior under uncertainty (Aiyagari (1994), Deaton (1991)) with additional investment option.
- At time $t+1$, liquid wealth of a household includes the principal and interest on liquid savings from the previous period $(1+r)\,S_t$ and current realized income Y_{t+1}

$$L_{t+1} = Y_{t+1} + (1+r)\,S_t$$

- Current income consists of permanent component P_{t+1} and transitory one-period shock U_{t+1} :

$$Y_{t+1} = U_{t+1} P_{t+1}$$

- Permanent income:

$$P_{t+1} = P_t G N_{t+1} + R D_{I,t} I_t^*$$

where: first term is a random walk component based on shock with drift G and shock N_{t+1}, $D_{I,t} \in \{0,1\}$ is a decision of whether to undertake a lumpy investment project of size I_t^* or not.

KT (2011): Model

- Stochastic project size:

$$I_t^* = i_t^* P_t$$

so that project opportunities are increasing in permanent income (consistent with data).

- Liquid savings can be negative, but borrowing is bound by a limit $S_t \geq \underline{s} P_t$. $\underline{s}$ is the key parameter to calibrate the intervention (more credit will make it more negative).
- Household maximizes expected discounted utility:

$$V\left(L_0, I_0^*, P_0; \underline{s}\right) = \max_{\substack{\{C_t>0\} \\ \{S_{t+1}\} \\ \{D_{I,t}\}}} E_0 \left[\sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\rho}}{1-\rho}\right]$$

$$C_t + S_t + D_{I,t} I_t^* \leq L_t$$

where all variables are as defined above.

KT (2011): Model

- Expectations taken over all shocks:
  - N_t is random walk for permanent income: $\log(N_t)$ follows $N(0, \sigma_N^2)$
  - U_t is transitory income shock: $u_t = \log(U_t)$ follows $N(0, \sigma_u^2)$
  - i_t^* is project size relative to permanent income: $\log(i_t^*)$ follows $N(\mu_i, \sigma_i^2)$
- Default: allow for a minimal consumption level $\underline{c}P_t$ and default if consumption would fall lower:

$$\begin{aligned} D_{def;t} &= 1 \text{ if } (\underline{s} + \underline{c}) P_t > L_t \\ &= 0 \text{ else} \end{aligned}$$

in which case policies become: $C_t = \underline{c}P_t$, $S_t = \underline{s}P_t$, $D_{I,t} = 0$.

KT (2011): Estimation

R = Income/Assets = .11
homogeneous

- Parameters to be estimated: $\{r, \sigma_N, \sigma_u, \sigma_E, G, \underline{c}, \beta, \rho, \mu_i, \sigma_i, \underline{s}\}$
- R is estimated using separate data and procedure.
- σ_E is the variance of a classical measurement error on income with log variance σ_E.
- Use MSM (method of simulated moments) with optimal weighting matrix.
- Use only five years pre-intervention (1997-2001)
- Remove demographic, etc., from data by OLS

KT (2011): SMM Intuition

- Without going into full procedure, some intuition for moment conditions used
- Of course, all parameters are identified jointly from all moment conditions, but intuitions are useful:

$$\begin{aligned} \varepsilon_s(X, r) &= Earned\_int_t - rS_{t-1} \\ \varepsilon_{cr}(X, r) &= Owed\_int_t - rCR_{t-1} \end{aligned}$$

  where $Earned\_int_t$ and $Owed\_int_t$ are earned and owed interest on liquid savings/borrowings respectively.
- Need to solve for consumption, investment and default decisions: $C(L_t, P_t, I_t^*; \theta)$, $D_I(L_t, P_t, I_t^*, \theta)$, $D_{def}(L_t, P_t; \theta)$. Data is observed on actual decisions C_t, I_t, Def_t and the states L_t and Y_t.
- Define deviations of actual from predicted variables, conditional on the states. By Law of iterated expectations, these deviations should be zero and are used as moment conditions.
- With simulated method of moments: conditional expectation is computed by drawing a series of shocks for U, N and I^* and measurement error E and taking averages.

KT (2011): SMM Intuition

- Income process moments help identify the income process.
- For example; for the drift component G:

$$\varepsilon_g\left(L_t, Y_t, Y_{t+1}; \theta\right) = \log\left(Y_{t+1}/Y_t\right) - E\left[\log\left(Y_{t+1}/Y_t\right)|L_t, Y_t\right]$$

- Additional moment conditions: Define

$$\begin{aligned}
\varepsilon_C\left(C_t, L_t, Y_t, \theta\right) &= C_t - E\left[C_t|L_t, Y_t\right] \\
\varepsilon_D\left(D_{I,t}, L_t, Y_t, \theta\right) &= D_{I,t} - E\left[D_{I,t}|L_t, Y_t\right] \\
\varepsilon_I\left(D_t, I_t, L_t, Y_t, \theta\right) &= D_t I_t - E\left[D_t I_t^*|L_t, Y_t\right]
\end{aligned}$$

then use:

$$E\left[\varepsilon_C\right] = E\left[\varepsilon_D\right] = E\left[\varepsilon_I\right] = 0$$

and in addition, remember Matzkin: exogenous and endogenous variables, observed and unobserved variables, assumptions about distributions

Kaboski-Townsend (2011)

5.1. *Relaxation of Borrowing Constraints*

We incorporate the injection of credit into the model as a surprise decrease in $\underline{s}$.[43] That is, for each of 64 villages, indexed by v, we calibrate the new, reduced constraint under the Million Baht Fund intervention $\underline{s}_v^{\text{mb}}$ as the level for which our model would predict one million baht of additional credit relative to the baseline at $\underline{s}$. We explain this mathematically below.

Define first the expected borrowing of a household n with the Million Baht Fund intervention,

$$E[B_{n,t,v}^{\text{mb}}|L_{n,t}, Y_{n,t}; \underline{s}_v^{\text{mb}}] = E\{\mathcal{I}_{<0}[L_t - C(L_t, P_t, I_t^*; \underline{s}_v^{\text{mb}}) - D_I(L_t, P_t, I_t^*; \underline{s}_v^{\text{mb}})I_t^*]|L_{n,t}, Y_{n,t}\},$$

and in the baseline without the intervention,

$$E[B_{n,t,v}|L_{n,t}, Y_{n,t}; \underline{s}] = E\{\mathcal{I}_{<0}[L_t - C(L_t, P_t, I_t^*; \underline{s}) - D_I(L_t, P_t, I_t^*; \underline{s})I_t^*]|L_{n,t}, Y_{n,t}\},$$

where $\mathcal{I}_{<0}$ is shorthand notation for the indicator function that the bracketed expression is negative (i.e., borrowing and not savings). On average, village funds lent out 950,000 baht in the first year, so we choose $\underline{s}_v^{\text{mb}}$ so that we would have hypothetically predicted an additional 950,000 baht of borrowing in each village in the pre-intervention data[44]:

$$\frac{1}{\mathcal{N}}\sum_{n=1}^{\mathcal{N}}\left\{E[B_{n,t,v}^{\text{mb}}|L_{n,t},\, Y_{n,t};\, \underline{s}_v^{\text{mb}}] - E[B_{n,t,v}|L_{n,t},\, Y_{n,t};\, \underline{s}]\right\}$$

$$= \frac{950{,}000}{\#\text{ HHs in village}_v}.$$

Here $\mathcal{N}$ represents the number of surveyed households in the pre-intervention data.

The resulting $\underline{s}_v^{\text{mb}}$ values average -0.28 across the villages, with a standard deviation of 0.14, a minimum of -0.91, and a maximum of -0.09. Hence, for most villages, the post-program ability to borrow is substantial relative to the baseline ($\underline{s} = -0.08$), averaging about one-fifth of permanent income after the introduction of the program.[45]

KT (2011): Prediction and Evaluation

- Million Baht Program modeled as a relaxation of the borrowing limit.
- First evaluate model's predictions for 2002 and 2003, along 5 dimensions: log consumption, investment probability, log investment levels, default probability and income growth.
- Draw series of shocks of U, N and I^* and measurement error from the distributions previously estimated and simulate the paths (500 times). Creates 500 artificial datasets, made of the pre-intervention years and predicted two years.
- Then ask whether reduced-form regressions would yield similar estimates using simulated data versus real data for post-intervention.
- Model performs quite well on post-intervention data
- Important lesson: Same regressions as impact evaluation in reduced-form paper but we need the structural model to interpret those correctly (see next two slides).

TABLE III

PARAMETER ESTIMATES AND MODEL FIT

Parameter Estimates			Pre-Intervention Averages		
Parameter	Estimate	Std. Err.	Variable	Data	Model
Borrowing/savings interest rate - r	0.054	0.003	C_t	75,200	75,800
Deviation of log permanent income shock - σ_N	0.31	0.11	D_t	0.116	0.116
Deviation of log transitory income shock - σ_U	0.42	0.07	I_t	4600	4600
Deviaion of log measurement error shock - σ_E	0.15	0.09	DEF_t	0.194	0.189
Exogenous income growth - G	1.047	0.006	$\ln(Y_{t+1}/Y_t)$	0.044	0.049
Minimum consumption - $\underline{c}$	0.52	0.01			
Discount factor - β	0.926	0.006	Test for Overidentifying Restrictions		
Intertemporal elasticity - ρ	1.20	0.01		Actual Value	0.05% Value
Mean log project size - μ_i	1.47	0.09			
Deviation of log project size - σ_i	6.26	0.72			
Borrowing limit - $\underline{s}$	-0.08	0.03	J-Statistic	113.5	12.6

TABLE V

REDUCED FORM REGRESSION ESTIMATES: ACTUAL DATA VS. "MILLION BAHT" SIMULATED DATA

	Consumption		Investment Probability		Investment		Default Probability		Income Growth	
Actual Data	$\gamma_{C,2002}$	$\gamma_{C,2003}$	$\gamma_{D,2002}$	$\gamma_{D,2003}$	$\gamma_{I,2002}$	$\gamma_{I,2003}$	$\gamma_{DEF,2002}$	$\gamma_{DEF,2003}$	$\gamma_{\Delta lnY,2002}$	$\gamma_{\Delta lnY,2003}$
"Impact" Coefficient[a]	**1.39**	**0.90**	**6.3e-6**	-0.2e-6	-0.04	-0.17	**-5.0e-6**	**6.4e-6**	-9.4e-6	**12.6e-6**
Standard Error	**0.39**	**0.39**	**2.4e-6**	2.4e-6	0.19	0.19	**2.4e-6**	**2.4e-6**	6.1e-6	**6.1e-6**
Simulated Data										
Average "Impact" Coefficient[a]	**1.10**	0.73	**5.6e-6**	3.6e-6	0.41	0.35	**-9.0e-6**	-0.2e-6	0.3e-6	0.3e-6
Average Standard Error	**0.48**	0.48	**2.5e-6**	2.5e-6	0.23	0.23	**2.3e-6**	2.3e-6	5.9e-6	5.9e-6
Chow Test Significance Level[b]	0.55		0.51		0.99		0.27		0.30	

[a]The impact coefficient is the coefficient on 950,000/number of households in the village interacted with a year dummy, the credit injection per household.

[b]This is the significance level of a Chow test on the actual post-intervention data and the pooled simulated data, where the null hypothesis is no structural break in the impact coefficients.

Bold face represents significance at a 5 percent level.

KT (2011): Results and Heterogeneity

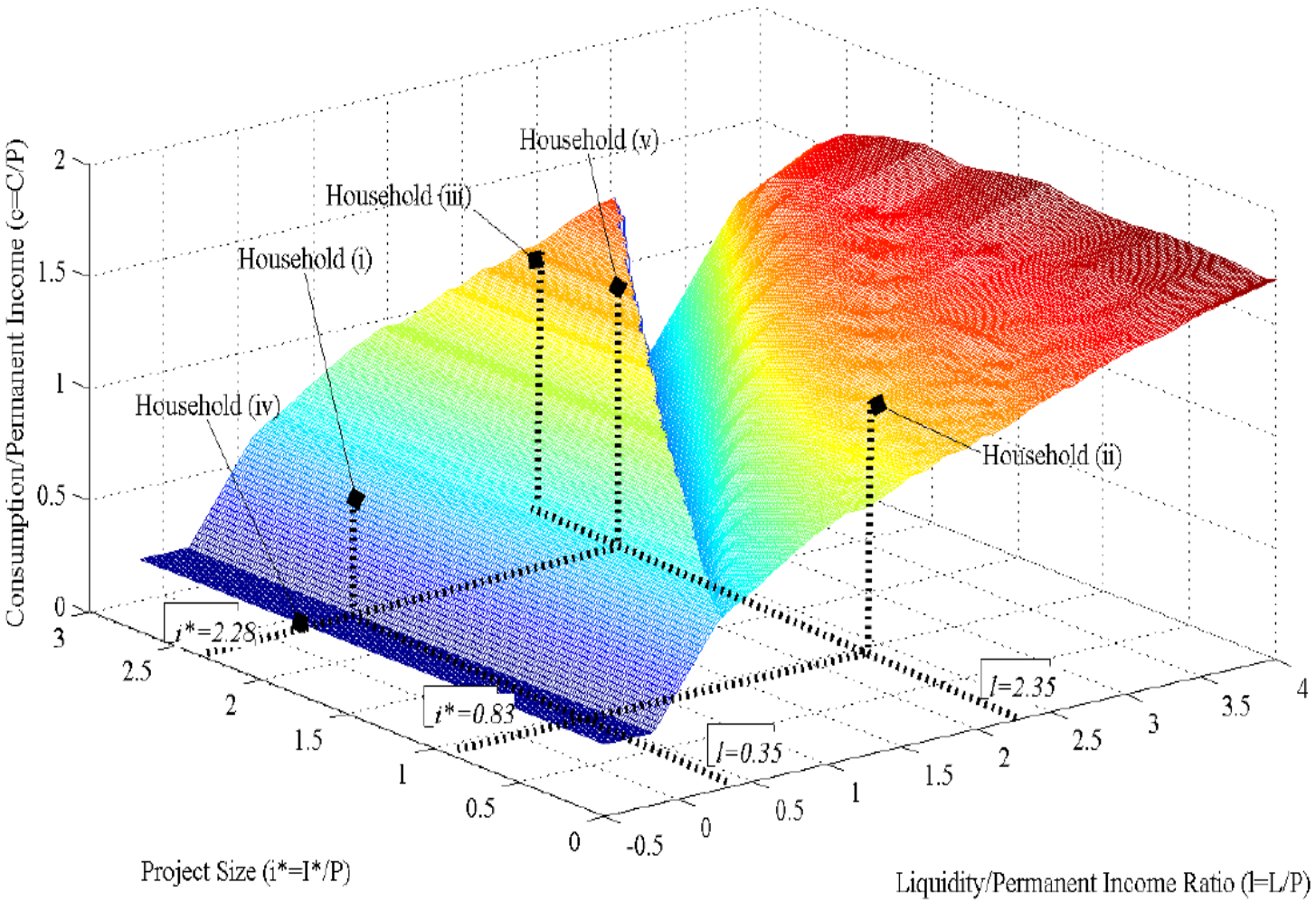
- Find large effects on consumption, but insignificant on investment and structural model can explain why.
- Average coefficients mask a lot of heterogeneity and this is where structural approach is more useful than sufficient statistics one.
- Consider the following figure, with different households being affected differently by the program
- Careful! Coefficients don't tell the full story.
  - Households who differ only in unobservables might respond differently
  - Effects may be nonlinear and time-varying

KT (2011): Results

- Household *i*: would respond to increased borrowing by increasing consumption and borrowing to the limit in response to their lower than expected income
- Household *ii* had higher than expected income and would invest and not be constrained in consumption, and would not need to borrow
- Household *iii*, though not investing will also increase consumption without borrowing by reducing its bufferstock (since it now has a relaxed borrowing constraint)
- Households *i* to *iii* would hence increase consumption, yet are very different, since *ii* and *iii* would not borrow to do so.
- Household *iv*: is in default, no effect on consumption or investment, simply increases indebtedness
- Household *v*: this is the 'target' household of microcredit programs traditionally: would increase investment in response to credit.

KT (2011): Results

Figure 4: Consumption Policy as a Function of Liquidity and Project Size



KT (2011) - Counterfactual and Welfare Analysis

- Strength of structural model is that one can perform counterfactual analysis and do welfare calculations.
- Consider counterfactual policy: Pure transfer which also provides additional liquidity.
  - Advantage of Million Baht program: provides more than 1 mill. in potential liquidity since borrowers increase their credit by 1 mill., but nonborrowers also benefit from the increased potential liquidity from the relaxed borrowing constraint in the future. Borrowers have access to more liquidity than equally distributed pure transfer.
  - Disadvantage: liquidity in form of loan, hence interest costs which are high.
- Heterogeneity: Severely constrained households (in default or close) or non-constrained households prefer pure transfer. Constrained households prefer Million Baht Program.
- Compare cost of Million Baht program to transfer program which yields same expected utility.

KT (2011) - Counterfactual and Welfare Analysis (continued)

- Average equivalent transfer per HH is just 7000 baht, (30 % less than the 10,100 baht per HH from Million Baht)
- Masks a lot of heterogeneity: 10% value program at 16,200 baht or more, other 10% value it at 900 baht.
- Only 24% value program more than its cost.
- Many HHs benefit disproportionately from program because of increased liquidity, but most benefit much less because of interest cost.

ACCESS TO CREDIT AND PRODUCTIVITY

Evidence from Thailand

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December 3, 2019

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[3]Inter-American Development Bank

WHAT WE DO

Use the context of a large-scale lending program (Million Baht Village Fund) to study misallocation.

1. Use 5 years of pre-program data to estimate productivity
    - Control-function approach with novel proxy variable: entrepreneur beliefs
2. Use the Million-Baht program as a natural experiment to estimate marginal returns:
    - Expansion in credit supply **uncorrelated** with baseline productivity.
    - Prevents measurement error in baseline productivity from driving dispersion in returns.
3. Use 5 post-program years of data to test whether baseline productivity predicts:
    - Program borrowing
    - Returns to credit (program effects on profits)
4. Use quasi-experimental results to quantify gains from credit reallocation.

WHAT WE FIND

Evidence consistent with misallocation in credit markets:

- Large degree of dispersion in returns to credit based on baseline productivity.
  - High returns for the most productive entrepreneurs.
  - Starker differences within the non-ag. sector (stronger pre-program financial frictions).
  - Differences persist 5 years after the program's rollout.
- However, no differences in program borrowing based on productivity (Community-based program).

Markets partially offset these disparities:

- High-productivity firms increase non-program borrowing.

Gains from reallocating program credit to the most productive:

- 6-16% increase in average village-level output.

1-ESTIMATING PRE-PROGRAM CAPITAL PRODUCTIVITY (A)

Caveat: No data on labor usage.

- A =capital productivity—the ability to generate output while taking the stock of capital as given.

Log value-added (va_{it}) production function (measurement):

$$va_{it} = \beta_k k_{it} + \omega_{it} + \epsilon_{it} \tag{1}$$

- k_{it}: log stock of capital available at the beginning of t.
- Goal: recover $A_{i,t} = e^{\omega_{i,t}}$ using pre-program data.

Estimation:

- Control function approach (Olley-Pakes,Levinsonh-Petrin, ACF).
- Innovation: use subjective beliefs about profits as a proxy for $\omega_{i,t}$.

IDENTIFICATION OF THE PRODUCTION FUNCTION

Beliefs:

- Survey question: "What is your best guess about what the household's net profit will be next year?"
- Three scenarios: good, bad, average (we use normalized beliefs)

Identification assumption:

- Intuition: Conditional on the stock of capital (K), variation in household beliefs is related to unobserved variation in ω (monotonically).
- $\omega_{i,t}$ follows a first-order Markov process.
- Timing: Beliefs are measured after K is chosen.(We used lagged capital for estimations).
- β_k constant across firms due to sample-size limitations.

(Elasticities)

LINKING ACCESS TO CREDIT, PRODUCTIVITY AND RETURNS

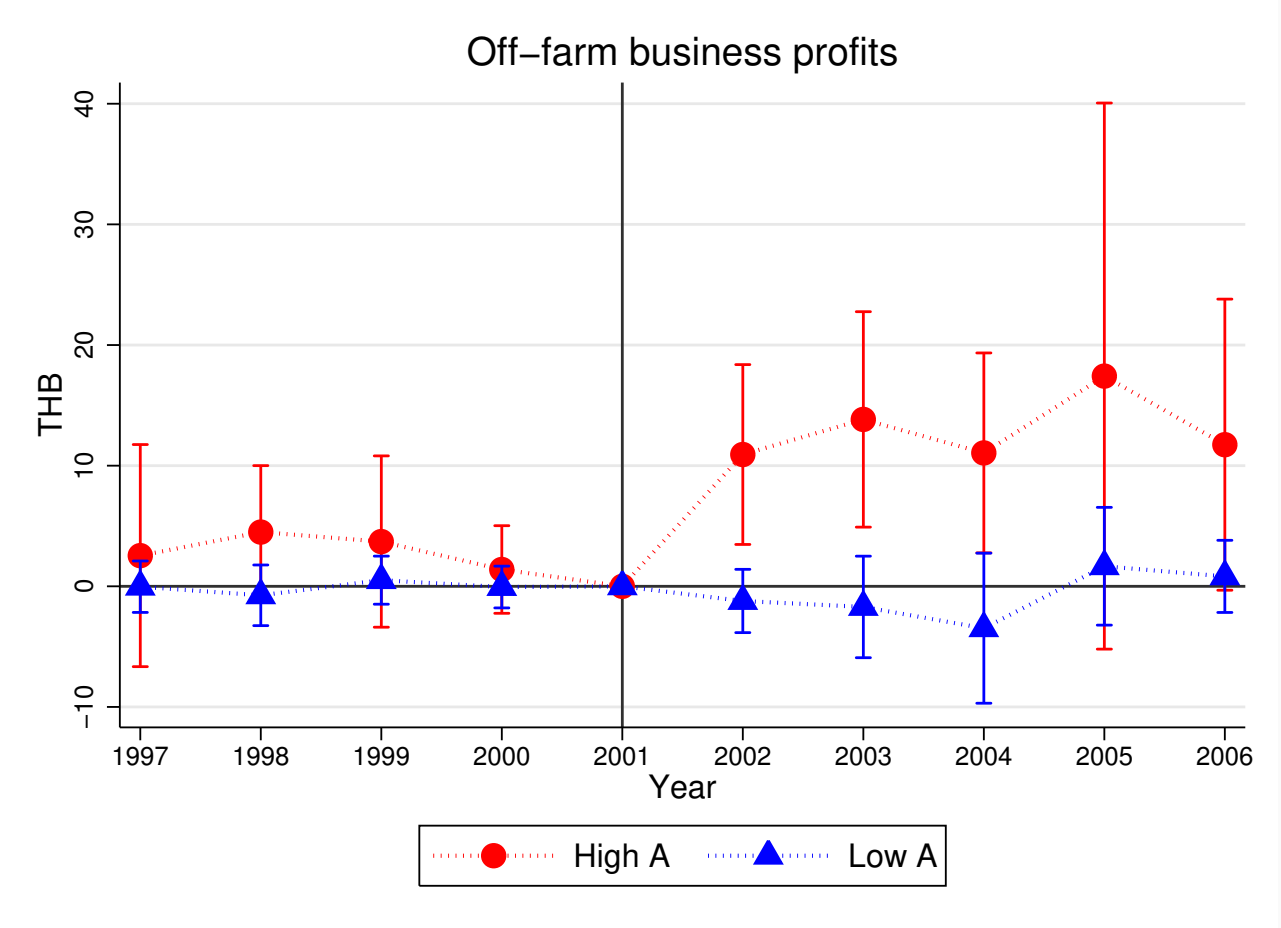
$$
\begin{aligned}
\text{VFCredit}_{i,v,t} &= \alpha_i + \delta_t + \theta^{VF}\text{Treatment}_v \times \text{Post}_t + \delta_t \times \hat{A}_{i,v} + \gamma X_{i,v,t} + e_{i,v,t} \\
\theta^{VF} &= \theta_1^{VF} + \theta_2^{VF}\hat{A}_{i,v} \\
\text{Profits}_{i,v,t} &= \alpha_i + \delta_t + \lambda\text{Treatment}_v \times \text{Post}_t + \delta_t \times \hat{A}_{i,v} + \gamma X_{i,v,t} + e_{i,v,t} \\
\lambda &= \theta_1^{P} + \theta_2^{P}\hat{A}_{i,v}
\end{aligned}
$$

- α_i, δ_t: household and year fixed effects.
- $\hat{A}$: Estimated pre-period productivity.
- Treatment: Treatment intensity (inverse village size (# of HHs)).
- Post_t: Post-period indicator.
- λ: Returns to increased supply of credit.

Misallocation: $\theta_2^P > 0$ and $\theta_2^{VF} \leq 0$

- Interpretation: high-A entrepreneurs exhibit higher returns to credit, but they do not obtain more program credit.

EVEN LARGER DIFFERENCES AMONG PREEXISTING BUSINESSES



Effect coincides with increases in business assets for high-A entrepreneurs. (See Table)

IV ESTIMATES OF THE RETURNS TO CREDIT AND THE RETURNS TO CAPITAL

IV estimates (Instrument total credit with Post $\times$ Treatment) suggest high financial returns to credit to high-A, non-ag businesses:

- THB 1.8 annual increase in profits per extra THB of total credit
  - Much higher than MBVF interest rates (7% annual).
- We detect large effects in biz. assets (3.7 THB per THB of total credit).
- Suggest annual returns to fixed capital of 48% (subject to exclusion restrictions).
- Comparable to estimates from capital/cash-grant programs(i.e., De Mel, McKenzie & Woodruff (2008)).

VILLAGE-LEVEL GAINS FROM REALLOCATING CREDIT TO HIGH-A ENTREPREN

Gains from within-village reallocation of loans				
	Within sectors		Across sectors	
	Output	Capital	Output	Capital
	(1)	(2)	(3)	(4)
Average gain	10.6%	3.6%	14.2%	5.3%
By terciles of village size				
Bottom	16.1%	6.3%	18.7%	8.6%
Medium	8.6%	1.8%	14.5%	3.0%
Top	6.5%	2.4%	9.0%	3.9%

Columns (1) and (2): Reallocation based on productivity rankings within sectors (Ag and Non-Ag) and villages. Columns (3) and (4): Reallocation based on within village productivity rankings.

Larger gains from within village reallocation are concentrated in smaller villages.

Literature Review on Interpreting Experiments Through Structural Models

Todd and Wolpin (2006) "Assessing the Impact of a School Subsidy Program in Mexico"

This paper uses data from a randomized social experiment in Mexico to estimate and validate a dynamic behavioral model of parental decisions about fertility and child schooling, to evaluate the effects of the PROGRESA school subsidy program, and to perform a variety of counterfactual experiments of policy alternatives. Our method of validation estimates the model without using post-program data and then compares the model's predictions about program impacts to the experimental impact estimates. The results show that the model's predicted program impacts track the experimental results. Our analysis of counterfactual policies reveals an alternative subsidy schedule that would induce a greater impact on average school attainment at similar cost to the existing program. (*JEL* I21, I28, J13, O15)

Attanasio,Meghir and Santiago (2011) "Education Choices in Mexico: Using a Structural Model and a Randomized Experiment to evaluate Progresa"

Abstract

In this paper we use an economic model to analyse data from a major randomised social experiment, namely PROGRESA in Mexico, and to evaluate its impact on school participation. We show the usefulness of using experimental data to estimate a structural economic model as well as the importance of a structural model in interpreting experimental results. The availability of the experiment also allow us to estimate the program's general equilibrium effects, which we then incorporate into out simulations. Our main findings are : (i) the program's grant has a much stronger impact on school enrolment than an equivalent reduction in child wages; (ii) the program has a positive effect on the enrollment of children, especially after primary school; this result is well replicated by the parsimonious structural model; (iii) there are sizeable effects of the program on child wages, which, however, reduce the effectiveness of the program only marginally; (iv) a revenue neutral change in the program that would increase the grant for secondary school children while eliminating for the primary school children would have a substantially larger effect on enrollment of the latter, while having minor effects on the former.

Bryan, Chowdhury, and Mobarak (2014) "Under-investment in a Profitable Technology: The Case of Seasonal Migration in Bangladesh"

Hunger during pre-harvest lean seasons is widespread in the agrarian areas of Asia and Sub-Saharan Africa. We randomly assign an $8.50 incentive to households in rural Bangladesh to temporarily out-migrate during the lean season. The incentive induces 22% of households to send a seasonal migrant, their consumption at the origin increases significantly, and treated households are 8-10 percentage points more likely to re-migrate 1 and 3 years after the incentive is removed. These facts can be explained qualitatively by a model in which migration is risky, mitigating risk requires individual-specific learning, and some migrants are sufficiently close to subsistence that failed migration is very costly. We document evidence consistent with this model using heterogeneity analysis and additional experimental variation, but calibrations with forward-looking households that can save up to migrate suggest that it is difficult for the model to quantitatively match the data. We conclude with extensions to the model that could provide a better quantitative accounting of the behavior.

Lagakos, Mobarak and Waugh (2018) "The Welfare Effects of Encouraging Rural-Urban Migration"

ABSTRACT

In this paper we study the welfare effects of encouraging rural-urban migration in the developing world. To do so, we build a dynamic incomplete-markets model of migration that allows for sorting on permanent comparative advantage, idiosyncratic productivity shocks and migration risk, plus migration disutility that depends on past migration experience. We estimate the model to replicate the results of a field experiment that subsidized migration in rural Bangladesh, leading to significant increases in seasonal migration rates and consumption for induced migrants. To match the experimental evidence, the model requires that migration subsidies are more likely to induce migration from those with relatively low productivity and asset levels, and that the non-monetary disutility of migrating is substantial. We conclude that the welfare effects of migration subsidies arise through better insurance for vulnerable rural households rather than by relaxing credit constraints for those with high urban productivity but who are stuck in rural areas.

Meghir, Mobarak, Mommaerts and Morten (2019) "Migration and Informal Insurance"

Abstract

Do new migration opportunities for rural households change the nature and extent of informal risk sharing? We experimentally document that randomly offering poor rural households subsidies to migrate leads to a 40% improvement in risk sharing in their villages. We explain this finding using a model of endogenous migration and risk sharing. When migration is risky, the network can facilitate migration by insuring that risk, which in turn crowds-in risk sharing when new migration opportunities arise. We estimate the model and find that welfare gains from migration subsidies are 42% larger, compared with the welfare gains without spillovers, once we account for the changes in risk sharing. Our analysis illustrates that (a) ignoring the spillover effects on the network gives an incomplete picture of the welfare effects of migration, and (b) informal risk sharing may be an essential determinant of the takeup of new income-generating technologies.

Preference Parameters

- RCT practitioners also bring structure into evaluations, typically focusing on estimation of preferences.
  - Kremer et al. (2011) use randomized variation in water spring treatment in rural Kenya to estimate a revealed preference logit model. Using water trip patterns, they estimate a low willingness to pay for clean water, not inconsistent with the state of affairs before the intervention. They then use the structural model to evaluate the financial viability of various water institutions.
- Relatedly, Gabriel Kriendler uses the experimental price variation to structurally estimate a model of route and departure time choice for home to work commute, to deal with traffic congestion.
  - The model includes random utility shocks over routes and departure times, leading to a nested logit specification, and it accounts for the non-linear structure of incentives in the experiment. The paper combines the preference parameters and road technology using policy simulations of the equilibrium optimal congestion charge, which reveal notable travel time benefits, yet negligible welfare gains.
- Mahajan et al. (2019) use an randomized experiment on credit and insectide-treated bednets in India
  - Some contracts had a commitment aspect – purchasing (on credit) future retreatments at the time of bednet purchase – to estimate the heterogeneous structural discounting parameters of a dynamic discrete choice model. They found that 80% of the population was time-inconsistent discounters, including 50% who were naively time-inconsistent, and this mattered for positive and normative analysis of counter-factual subsidies.

Lecture 1: Interpreting Experiments through Structural Models (2/25)

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