Exploiting spatial and temporal difference in rollout Panel analysis

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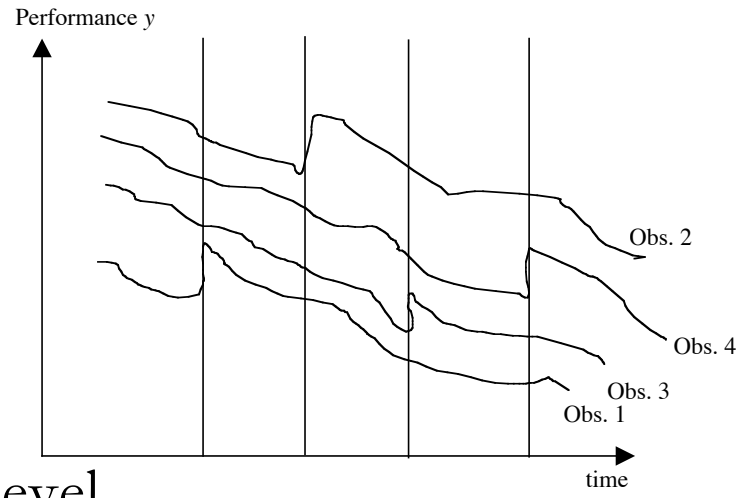
Extension of the double difference method.

Obs.1 gets the program in year 1
Obs. 2 gets it in year 2
….



There is cross sectional variation in level.
There is variation over time.
Impact of the program measured by jumps at entry.
- Each year: a double difference between Treated and Not treated
- If high frequency observations, each observation suggests a RD

Very common feature of large programs, because of budget constraints, technical constraints, etc.

Examples:

- Conditional cash transfer Progresa rollout 1998-2000
  Weather-index insurance in Mexico rollout 2001-2006
  Administrative constraints
- School construction program in Indonesia in the 1970s
  Budget constraints
- Construction of telephone tower 2001-2007 in Niger
  Technical constraint
- Privatization of water delivery in Argentina, 1990-1999
  Idiosyncratic decisions of cities

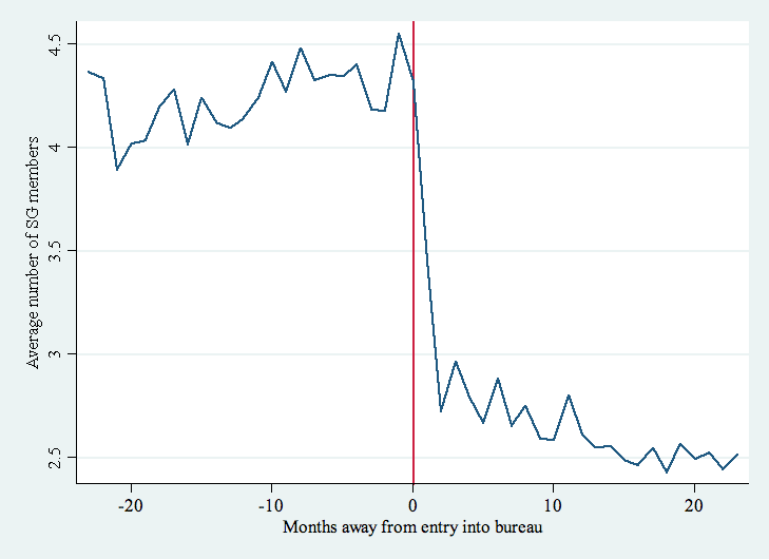
Example: Large microfinance in Guatemala:

Use of credit information sharing system (credit bureau)

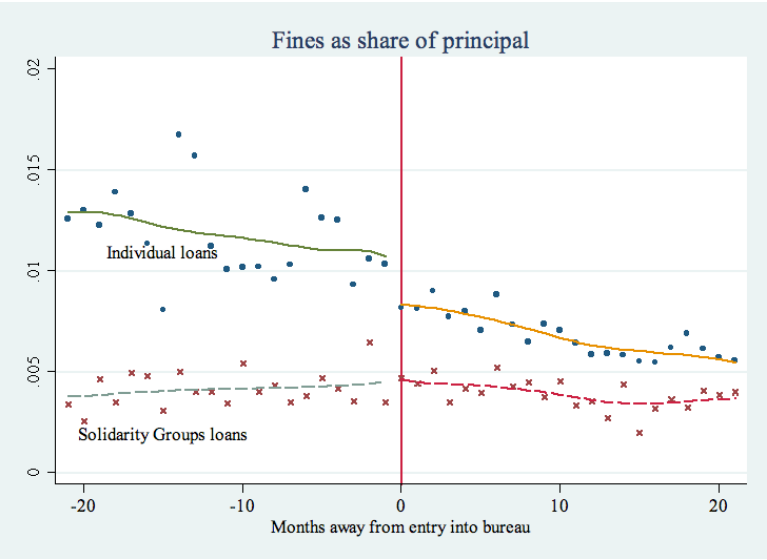
Rollout of the 40 branches between Aug. 2001 and Sept. 2003

Nice picture of the treatment effect: Align all entry date at 0

without a smoother



with smoother



The econometric model

The analysis is done in a regression framework with panel data:

$$Y_{it} = \beta T_{it} + \mu_i + \nu_t + \varepsilon_{it}$$

where the unit fixed effects μ_i account for the cross-sectional difference in performance (the levels), the time fixed effects ν_t for whatever changes over time common to all units (on the graph, the downward trend), and T_{it} is the treatment variable, equal to 1 after unit *i* has entered the program, and 0 before.

Data requirement

- Demanding: Need panel data over the whole period of the rollout, preferably including some pre-program years. On the program itself and on outcome of interest.

- Outcome: usually secondary data, administrative data
  - Progresa: Rural infant mortality at the municipal level. Voting behavior at the locality level.
  - School construction in Indonesia: Number of years of education in census, by birthplace and birth year.
  - Water delivery privatization in Argentina: Infant mortality rate at municipality level
  - Weather index insurance in Mexico: production / yield at municipality level

Cell phone access in Niger: Monthly cereal prices on 42 markets

Although could be from panel survey data:

Cell phone access in three districts of Kerala: weekly survey of 300 sardine fishing units for 4 years.

- More convincing when *data frequency corresponds to the response frequency* (monthly data for outcomes that are monthly, such as repayment problems in MFI, achieved education for each age cohort, annual data for agricultural production, etc.) to catch the discountinuity, as opposed to simply panel with scattered point before and after.

- More convincing when there are *several rollout period*

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The context
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Data requirement
Validity of the method
Verifying the validity of the identification

Validity of the method

Key assumption

Changes observed in units not yet in the program are good counterfactual for the changes in treated units

The econometric model:

- The time "trend" ν_t is common to all observations
- T_{it} orthogonal to ε_{it}

Cannot verify these exact assumptions but can do checks on some potential violations

Verifying the validity of the identification:

- The "trend" in pre-program period is not correlated with the order of entry

  If the branches with worst improvement in payments were incorporated first, downward bias of impact.

  - Regress the changes in outcome on the order of entry in pre-program period, or contrast early and late cohorts in pre-program period

- No pattern that would reveal a potential endogenous sequence in the rollout, either in response to repayment problems (an Ashenfelter dip), or following an on going improvement in performance.

  - Can be seen on a graph, and verify by regression

Table 2. Tests of exogeneity of the credit bureau rollout

	Branch level monthly average performance				
	Loan more than 2 months delinquent		Late fees as share of loan size		Number of members
	SG	Individual	SG	Individual	SG
Panel A: Monthly average of loan-on-loan changes					
Month Crediref began	0.0013	-0.0009	0.0001	0.0003	0.0022
	(1.10)	(0.68)	(1.39)	(0.95)	(0.81)
Observations	983	1079	983	1079	983
R-squared	0.05	0.06	0.04	0.05	0.09
Panel B: Monthly average performance					
Month prior to Crediref	0.0239	0.0338	0.0018	0.0076	0.0033
	(0.41)	(0.61)	(0.67)	(1.26)	(0.02)
Month 2 prior to Crediref	0.0796	0.0210	0.0041	0.0068	0.3857
	(1.23)	(0.49)	(1.64)	(1.36)	(1.83)
Month 3 prior to Crediref	0.0033	0.0358	0.0012	0.0064	-0.0046
	(0.08)	(1.02)	(0.81)	(1.62)	(0.04)
Months 4-6 prior to Crediref	0.0089	0.0053	0.0002	0.0034	0.0717
	(0.27)	(0.19)	(0.09)	(1.35)	(0.78)
Observations	1433	1652	1433	1653	1433
Number of branches	35	36	35	36	35

Absolute value of t-statistics in parentheses, robust standard errors clustered at the branch level. * significant at 5%; ** significant at 1%.

Panel A: Branch/month level weighted regression with month fixed effects, for pre-treatment period, January 1998 to July 2001. "Month Crediref began" gives numerical month Crediref was introduced in each branch.

Panel B: Branch/month level regression with branch and month fixed effects, for pre-treatment period, January 1998 to entry into Crediref.

- Note that the Double-Difference method is a special case, where some observations never get the program, C, while others are treated T all at the same time.

  Validity of double difference with sample not generated by randomization or matching need to be checked in the same way.

  - Check that T observations and C observations had the same trend before any rollout.
  - Compare a difference between two periods before any rollout for the C and the T

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Some results
Summary

Some results

Credit information system
We found that the use of the credit information system induced the selection of much better clients (25% less likely to have repayment problems, 50% more likely to take another loan), and a huge increase in efficiency of the credit officers. It also favored the female clientele.

Cellular phone diffusion in Niger on market prices (Aker)
Aker showed that cell phone access reduce grain price dispersion across markets by 6.4% and intra-annual price variation by 12%

Cellular phone diffusion in India on the fisheries sector (Jensen)
Jensen found a dramatic reduction in price dispersion and the complete elimination of waste.

Summary

Advantages

- Standard econometric model, with standard data collection. Not an "impact" method per se, in which you construct a sample of counterfactuals. But apply well to many program evaluations when the program rollout produces spatial and time variation.

- Excellent source for ex-post impact evaluations based on "natural experiments". Rollout is very frequent.

- Key is to argue that the rollout was not done in a way that would create a bias.
  If it is not the case, but the treatment assignment follows some known rules, one can resort to Instrumental Variables as in

standard econometric problems, using the "rules" that are NOT correlated with any determinants of the outcome of interest.

- Can also be "engineered" in an experimental setting. If rollout is necessary (for budget or technical, or any other reason), why not randomize it, or set rules that would be well defined and not directly correlated with the outcome of interest.

- As always, do robustness checks.

Disadvantages

Rollout are not random, and rules often not clear/transparent/known

Frequently, the policy change responds to the outcomes it tried to affect, which makes identification impossible.