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Choosing Models

Just Execute RCTs, IV, Diff-in-Diff? Some Cautionary Tales

(Lecture 4)

Robert M. Townsend

Elizabeth & James Killian Professor of Economics, MIT

Massachusetts Institute of Technology

Lecture 4: Just execute RCT, IV, Diff-in Diff? Some Cautionary Tales (3/5)

*Townsend, R.M. and Urzua, S., 2009. Measuring the impact of financial intermediation: linking contract theory to econometric policy evaluation." Macroeconomic Dynamics, 13(S2), pp. 268-316

Heckman, James J. and Vytlacil, Edward J. (2001) Local instrumental variables. In Cheng Hsiao, Kimio Morimune, and James L. Powell (eds.), Nonlinear Statistical Modeling: Proceedings of the Thirteenth International Symposium in Economic Theory and Econometrics: Essays in Honor of Takeshi Amemiya, New York: Cambridge University Press, pp. 1-46.

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Tiago Florido, “Nonlinear Difference-in-Differences and Noisy Trends,” March 2017

Imbens and Angrist (1994) "Identification and Estimation of Local Average Treatment Effects"

CONDITION 1 (Existence of Instruments): *Let Z be a random variable such that (i) for all $w \in \mathfrak{Z}$ the triple $(Y_i(0), Y_i(1), D_i(w))$ is jointly independent of Z_i, and, (ii) $P(w) = E[D_i | Z_i = w]$ is a nontrivial function of w.*

CONDITION 2 (Monotonicity): *For all $z, w \in \mathfrak{Z}$, either $D_i(z) \geqslant D_i(w)$ for all i, or $D_i(z) \leqslant D_i(w)$ for all i.*

THEOREM 1: *If Conditions 1 and 2 hold, then we can identify the following average treatment effect:*

$$\alpha_{z,w} = E\left[Y_i(1) - Y_i(0) | D_i(z) \neq D_i(w) \right]$$

from the joint distribution of Y, D, and Z, for all z and w in the support of Z such that $E[Y_i | Z_i = z]$ and $E[Y_i | Z_i = w]$ are finite, and $P(z) \neq P(w)$.

Macro Development Models Based on Occupation Choice

- Jeong and Townsend
- Gine and Townsend

Some Troubling Specifics

- Townsend, Robert M., and Sergio Urzua (2009) "Measuring the Impact of Financial Intermediation: Linking Contract Theory to Econometric Policy Evaluation"

The occupational choice of the individual is between enterprise and wage work. These two alternatives can be described by their associated potential outcomes. Specifically, for individual i we have that end-of-period wealth is the sum of initial wealth plus within-period earnings,

$$W_i = \begin{cases} w + \theta_i^W + b_i & \text{if wage earner} \\ \pi(\theta_i^E, b_i, w) + b_i & \text{if entrepreneur.} \end{cases} \tag{1}$$

Here w is the market wage for (unskilled) labor[2] and $\pi(\theta_i^E, b_i, w)$ represents the profit function obtained after solving the production/profit maximization problem

$$\pi(\theta_i^E, b_i, w) = \max_{\{k,l\}} f(k,l) - wl - k - \theta_i^E \tag{2}$$

$$\text{subject to } 0 \leq k \leq b_i - \theta_i^E \tag{3}$$

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Townsend-Urzua (cont.)

Therefore, if we denote by D a binary variable such that $D = 1$ if the agent becomes an entrepreneur, and 0 otherwise, we can write

$$D(\theta_i^E, \theta_i^W, b_i, w) = \begin{cases} 1 & \text{if } \pi(\theta_i^E, b_i, w) > w + \theta_i^W \\ 0 & \text{if } \pi(\theta_i^E, b_i, w) \leq w + \theta_i^W . \end{cases}$$

$$Y_i \equiv D_i \left(\pi(\theta_i^E, b_i, w) + b_i\right) + (1 - D_i) \left(w + \theta_i^W + b_i\right).$$

where without additional structure profits are non-linear in entrepreneur talent $\left(\theta_i^E\right)$, wealth (b_i), and market wage (w). However, the empirical literature primarily uses linear and separable models. That is,

$$\pi(\theta_i^E, b_i, w) \simeq \phi_w w + \phi_\theta \theta_i^E + \phi_b b_i. \tag{4}$$

which can be expressed as a linear regression model

$$Y_i = w + b_i + (\phi_b b_i + (\phi_w - 1)\, w)\, D_i + \varepsilon_i \tag{5}$$

where $\varepsilon_i = \theta_i^W + \left(\phi_\theta \theta_i^E - \theta_i^W\right) D_i$, and the term in parenthesis $(\phi_b b_i + (\phi_w - 1)\, w)$ represents the gain in gross income that does not depend on unobserved talent.

Townsend-Urzua (cont.)

Specifically, we assume the existence of an exogenous subsidy that increases ex-post profits at the end-of-period by ψ. This subsidy is randomly assigned in the population, so that ψ is a random variable with $\psi > 0$ and known to the econometrician even if the choices of the household is to be a wage earner. Intuitively, it can be interpreted as an experiment or exogenous policy treatment affecting the occupation choices of the individuals but received only if the choice is to setup a firm. However, this subsidy cannot be used to finance k and so the constraint $0 \leq k \leq b - \theta^E$ is unaltered.

The policy distortion impacts the decision rule:

$$D(\theta_i^E, \theta_i^W, b_i, \psi_i, w) = \begin{cases} 1 & \text{if } \pi(\theta_i^E, b_i, w) + \psi_i > w + \theta_i^W \\ 0 & \text{if } \pi(\theta_i^E, b_i, w) + \psi_i \leq w + \theta_i^W \end{cases}$$

Townsend-Urzua (cont.)
LATE and Monotonicity

Indeed, suppose that the subsidy can take on two values $\overline{\psi}$ and $\overline{\psi}$. In this case, and without imposing a linear separable model for profits, we can use the instrument ψ to estimate

$$\Delta^{IV}\left(\overline{\overline{\psi}}, \overline{\psi}; b\right) = \frac{E\left(Y_i|\psi_i = \overline{\overline{\psi}}, b_i = b\right) - E\left(Y_i|\psi_i = \overline{\psi}, b_i = b\right)}{E\left(D_i|\psi_i = \overline{\overline{\psi}}, b_i = b\right) - E\left(D_i|\psi_i = \overline{\psi}, b_i = b\right)},$$

which, under the assumption of uniformity, identifies the local average treatment effect (LATE) in income for those in the population induced to enter entrepreneurship due to the change of ψ from $\overline{\psi}$ to $\overline{\overline{\psi}}$ (the treatment here is to become an entrepreneur), or more formally

$$\Delta^{LATE}\left(\overline{\overline{\psi}}, \overline{\psi}; b\right) = E\left[\pi(\theta_i^E, b_i, w) - w - \theta_i^W \,\middle|\, D_i(\overline{\overline{\psi}}) = 1, D_i(\overline{\psi}) = 0, b_i = b\right]$$

This parameter does not pick up the earnings difference for those who would be entrepreneurs, versus wage earners, regardless of the value of the instrument. Instead, the local average treatment effect Δ^{LATE} naturally provides the answer to a policy experiment.[5]

$$\Delta^{TT}(b) = E\left(\pi(\theta_i^E, b_i, w) - \left(w + \theta_i^W\right) | D_i = 1, b_i = b\right) \quad (6)$$

$$\Delta^{ATE}(b) = E\left(\pi(\theta_i^E, b_i, w) - \left(w + \theta_i^W\right) | b_i = b\right). \quad (7)$$

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Townsend-Urzua (cont.)

2.3.1 Using Cross-Sectional Information to Estimate the Effect of Occupational Choice

Table 2 presents the sorting into occupations obtained from model generated cross-sections of 25,000 individuals.

Table 2. Sorting by Occupational Choices

Model of Occupational Choice - Simulated Cross-sectional Data

Occupational Choice	Sample Size
Wage Earners	6,109
Entrepreneur	18,891
Constrained	*14,519*
Unconstrained	*4,372*
Total	25,000

Table 3. OLS and IV Estimates

Model of Occupational Choice - Estimates from Cross-sectional Data

Parameter	Estimates	
	Δ^{OLS}	Δ^{IV}
κ_0	0.606**	1.189**
κ_1	1.155**	1.142**
κ_2	-0.136**	-0.082
κ_3	0.457**	-0.356*
Average Effect $(\kappa_2\bar{b} + \kappa_3)$	0.303**	-0.450

$$Y_i = \kappa_0 + \kappa_1 b_i + \kappa_2 b_i D_i + \kappa_3 D_i + \varepsilon_i$$

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Townsend-Urzua (cont.)

2.3.2 Using the Structure of the Model to Generate Counterfactual Outcomes and The Causal Effects of Occupational Choices

Given our knowledge of the model, we can study the consequences of exogenous policy changes. Specifically, we provide individuals that did not receive a subsidy when it was originally assigned with the subsidy. We then use the sample of individuals switching occupation due to the change in subsidy status (from $\psi = 0$ to $\psi = 1$) to compute the model generated local average treatment effect ($\Delta^{LATE}(1,0)$) (i.e., the average effect of the treatment for those individuals switching occupations as a result of a change in the instrument).

Table 4. Model Generated Treatment Paramaters

Model of Occupational Choice - The Causal Effects of Occupation on Income

Parameter	Value
Δ^{ATE}	0.619
Δ^{TT}	1.270
$\Delta^{LATE}(1,0)$	-0.459

Townsend-Urzua (cont.)

3 Occupational Choice Under Financial Intermediation

We denote by Q_i the individual-specific cost of using the intermediated sector. Examples of Q_i include travel time to district center or branch office, whether or not a particular intermediary has been active in a city or village according to history, particular policies of financial institutions which vary in effectiveness,

As before, denote by D_i a binary variable such that $D_i = 1$ if agent i decides to become an entrepreneur, and 0 otherwise. Thus, the occupation choice when the agent is participating in the intermediated sector can be described by:

$$D(\theta_i^E, \theta_i^W, w, r) = \begin{cases} 1 & \text{if } \pi(\theta_i^E, w, r) + b_i(1+r) - Q_i + \psi_i > w + \theta_i^W + b_i(1+r) - Q_i \\ 0 & \text{otherwise} \end{cases}$$

$$Y_I\left(\theta_i^E, \theta_i^W, b_i, w, r\right) = D(\theta_i^E, \theta_i^W, w, r)\left(\pi(\theta_i^E, w, r) + b_i(1+r)\right) + \left(1 - D(\theta_i^E, \theta_i^W, w, r)\right)\left(w + b_i(1+r) + \theta_i^W\right) \tag{14}$$

Townsend-Urzua (cont.)

where again for simplicity we use Υ_i instead of $\Upsilon\left(\theta_i^E, \theta_i^W, b_i, w, r, Q_i\right)$.

$$\xi_i = \Upsilon_i \times Y_I\left(\theta_i^E, \theta_i^W, b_i, w, r\right) + (1 - \Upsilon_i) \times Y_A\left(\theta_i^E, \theta_i^W, b_i, w\right)$$

$$\Delta^{IV(Q)}\left(\overline{\overline{Q}}, \overline{Q}; b\right) = \frac{E\left(\xi_i | Q_i = \overline{\overline{Q}}, b_i = b\right) - E\left(\xi_i | Q_i = \overline{Q}, b_i = b\right)}{E\left(\Upsilon_i | Q_i = \overline{\overline{Q}}, b_i = b\right) - E\left(\Upsilon_i | Q_i = \overline{Q}, b_i = b\right)} \qquad (19)$$

Importantly, one cannot interpret this parameter as the effect of financial intermediation on profits for entrepreneurs or on income for wage earners. This is because the change in Q also induces changes in occupational decisions in a non-uniform way. That is, changes in Q may endogenously induce individuals to switch from the wage sector to entrepreneurship and vice-versa.

Table 8. Model Generated Local Average Treatment Effects

Model of Occupational Choice and Financial Intermediation

Parameter	Value	Number of Movers	Direction
$\Delta^{LATE(\psi)}(1,0)$	**-0.466**	**2,219**	**From Wage Earner to Entrepreneur**
	-0.444	1,548	From Wage Worker under Autarky to Entrepreneur under Autarky
	-0.278	278	From Wage Worker under Autarky to Entrepreneur under Financial Intermediation
	-0.724	322	From Wage Worker under Financial Intermediation Entrepreneur under Autarky
	-0.519	71	From Wage Worker under Financial Intermediation to Entrepreneur under Financial Intermediation
$\Delta^{LATE(Q)}(0.25,1)$	**0.388**	**3,757**	**From Autarky to Financial Intermediation**
	0.355	911	From Wage Worker under Autarky to Wage Worker under Financial Intermediation
	-0.203	176	From Wage Worker under Autarky to Entrepreneur under Financial Intermediation
	0.752	75	From Entrepreneur under Autarky to Wage Worker under Financial Intermediation
	0.430	2,595	From Entrepreneur under Autarky to Entrepreneur under Financial Intermediation

Note: The numbers in the table are obtained using the factual and counterfactual information on income generated by the economic model. Specifically, for each individual in the sample we analyze the consequences of modifying the values of the instruments initially assigned. We study the individual's changes in occupational choices as well as the changes in decisions involving the financial system. Then, for each individual modifying her decisions as a result of the changes in Q or ψ, we compute the associated effects on income. This table presents the average effects on income generated using this logic. It also displays the number of individuals switching decisions as a result of the changes in the instrument (column Number of Movers).

4 Dynamics, Risk Sharing, Unobserved Heterogeneity and Occupational Choice

In this section we follow the analysis of Greenwood and Jovanovic (1999) (from hereafter GJ), Townsend and Ueda (2006, 2009), Jeong and Townsend (2008), and Felkner and Townsend (2007)

Household i maximizes discounted expected utility

$$E_0 \sum_{t=0}^{\infty} \beta_i^t u(c_{it})$$

where $u(\cdot)$ is strictly concave and initial wealth is $k_{i,0} = b_{i,0}$. $E_0(\cdot)$ denotes the expectation given the information available at $t = 0$. We incorporate unobserved heterogeneity by allowing the individuals to differ in their discount factors. Specifically, we assume $\beta_i = \overline{\beta} + \theta_i$, where θ_i is an individual specific component known to the agent only, and $\overline{\beta}$ is common knowledge.

In autarky there is a law of motion for wealth as a function of savings, investment in specific occupations, and an exogenous random endowment. Let s_{it} denote the savings rate of household i at date t expressed as a fraction of wealth k_{it} at date t. Let Ψ_t^E be the proportion of the savings invested in a risky enterprise sector and Ψ_t^W be the proportion invested in wage sector activities. Additionally, one unit of wealth invested in enterprise E yields $\delta_t^E + \varepsilon_{it}^E$ units of capital (wealth), whereas one unit invested in wage activity W yields an ex-post rate of return of $\delta_t^W + \varepsilon_{it}^W$. The returns δ_t^E and δ_t^W are realized at the end of date t and are unknown when within-period decisions are made.

The law of motion for wealth in autarky is thus

$$k_{it+1} = s_{it} \times \left[\Psi_t^E \times \left(\delta_t^E + \varepsilon_{it}^E\right) + \Psi_t^W \times \left(\delta_t^W + \varepsilon_{it}^W\right)\right] \times k_{it}. \tag{23}$$

Consumption in autarky at t c_{it}^A is the residual, i.e., $c_{it}^A = (1 - s_{it})\, k_{it}$.

The value function W_0 associated with financial autarky, A, exists under standard regularity conditions. It satisfies the Bellman equation:

$$W_0(k_{it},\theta_i) = \max_{\Psi_i^E,\Psi_i^W,c_{it},s_{it}} u(c_{it}) + \beta_i E\left(W_0(k_{it+1},\theta_i)\right)$$

subject to (23). The function $W_0\left(k_{it},\theta_i\right)$ is strictly concave in k_{it}. Under general preferences, the saving and investment policies are functions of wealth k_{it}. However, for CRRA preferences $(u(c_{it}) = c_{it}^{\gamma})$ they are constant. More precisely, under these preferences

$$\text{Savings} = \beta_i$$

Therefore, and since by definition $\beta_i = \bar{\beta} + \theta_i$, we can write the equation describing optimal consumption in autarky A as:

$$\begin{aligned} c_{it}^A &= \left(1 - \overline{\beta} - \theta_i\right) y_{it} \\ &= \alpha^A y_{it} + \varepsilon_{it}^A \end{aligned}$$

where y_{it} is the sum of all sources of income $\left(y_{it} = y_{it}^E + y_{it}^W\right)$, $\alpha^A = 1 - \overline{\beta}$, and where $\varepsilon_{it}^A = -\theta_i y_{it}$ is the unobserved component.

Participation in the intermediated sector on the other hand, allows household to share any idiosyncratic shock and, as in GJ, get perfect advanced information on aggregate shocks δ_t^E, δ_t^W.[20] The bank directs all investment as if each household were exchanging shares in its own return stream for shares in a common mutual fund. The law of motion for wealth is then

$$k_{it+1} = s_{it}k_{it} \max\left\{\delta_t^W, \delta_t^E\right\}(1-\tau) \tag{24}$$

where τ is the marginal intermediation transaction cost. The value function V_I for those in the intermediated sector, I, satisfies the Bellman equation

$$V_I(k_{it}, \theta_i) = \max_{c_{it}, s_{it}} \left[u\left(c_{it}\right) + \beta_i E\left(V_I\left(k_{it+1}, \theta_i\right)\right)\right]$$

subject to (24).

Following our previous analysis, we can write:

$$c_{it}^I = \alpha^I A_t + \varepsilon_{it}^I$$

where $\alpha^I = 1 - \overline{\beta}$ and $\varepsilon_{it}^I = -\theta_i A_t$ is the unobserved component.

4.1 Once-And-For-All Participation Decisions and Participation Costs as Instruments

Initially at $t = 0$, given k_{i0}, the household decides whether to participate in the financial sector or not. Once decided there is no going back. Let Z_i denote an individual specific participation costs. This subtracts from wealth k_{i0}. Again this cost is meant to capture exogenous variation in the ability to access intermediation, through either policy variation of physical infrastructure. These can be thought of as household specific transaction costs (with any correlation across individuals

Then, with V_I and W_0 strictly concave in k_{it}, the decision to participate depends on participation cost Z_i and wealth k_{i0}. More precisely, if we denoted by I_{i0} the participation decision, we can write

$$I_{i0} = 1 \Leftrightarrow V_I\left(k_{i0} - Z_i, \theta_i\right) \geq W_0\left(k_{i0}, \theta_i\right).$$

Additionally, we can write observed consumption at t as a function of potential consumption levels (c_{it}^I, c_{it}^A) and the participation decision I_{i0}:

$$
\begin{aligned}
c_{it} &= c_{it}^A (1 - I_{i0}) + c_{it}^I I_{i0} \\
c_{it} &= \alpha^A y_{it} + \left(\alpha^I A_t - \alpha^A y_{it}\right) I_{i0} + v_{it}
\end{aligned} \tag{25}
$$

where $v_{it} = \varepsilon_{it}^A + I_{i0} \left(\varepsilon_{it}^I - \varepsilon_{it}^A\right)$. Equation (25) shows how, if intermediation is effective for those

Notice that the error term in (25), v_{it}, depends on the decision made at $t = 0$, I_{i0}, so there is a selection bias argument that prevents the researcher of using OLS in the estimation of (25). In this context, an IV strategy becomes an appealing alternative.

The obvious issue is then how to come up with a valid instrument. Interestingly, the economic model delivers a natural instrument, namely Z_i. In order to see this, notice that under autarky and the assumption of CRRA preferences, optimal saving rates and proportions of savings invested in each sectors do not depend on k_{it}. As a result of this, potential consumption in the intermediated and autarky sectors do not depend on the choice of intermediation other than at $t = 0$ (when the costs are paid). Consequently, although Z_i affects the initial choice of intermediation sector versus

Using the instrument Z_i the researcher can identify LATE, a causal relationship between financial intermediation and consumption.

effects. In this context, we can show that under the assumption of a uniform response of I_{i0} to changes in Z_i (for all i), the instrumental variable estimator will indeed identify a causal effect of I_{i0} on c_{it}

4.2 Sequential Participation Decisions

Now suppose the choice of sector takes place each period t, not just initially.

Bellman equation

$$W_0\left(k_{it},\theta_i\right)=\max_{\Psi_t^E,\Psi_t^W,c_{it},s_{it}}\left\{U(c_{it})+\beta_i E\max\left\{W_0(k_{it+1},\theta_i),V_1(k_{it+1}-Z_i,\theta_i)\right\}\right.$$

subject to $k_{it+1}=s_{it}\times\left[\Psi_t^E\times\left(\delta_t^E+\varepsilon_{it}^E\right)+\Psi_t^W\times\left(\delta_t^W+\varepsilon_{it}^W\right)\right]\times k_{it}$.

There is a critical family of values $k^*\left(Z_i,\theta_i\right)$ which define thresholds for participation. Unde some regularity conditions entry is permanent. However, saving $s_t(k_{it})$ and investments $\Psi_t^E\left(k_{it}\right)$ $\Psi_t^W\left(k_{it}\right)$ are generally functions of wealth k_{it} even with CRRA utility. It can be established, i fact, that savings and investment in risky assets will rise with k_{it} as that wealth approaches critica entry $k^*\left(Z_i,\theta_i\right)$. See Townsend and Ueda (2006).

Thus variation in Z_i determines both k^* and pre participation outcomes. Therefore, Z_i canno be considered as a potential instrument. Careful researchers do take into account the impacts o intermediation on consumption. For example, assume a once-and-never-more policy shifting at some date t^* the cost of participation Z_i. Then period t^* can be interpreted as period zero and the earlier analysis applies (except we have pre-intervention data, and savings and investment are non

linear in wealth k_{it}). At period t^* we have pre-established positions for those not yet in, and the participation decision for them is:

$$I_{it^*} > 0 \Leftrightarrow V_1\left(k_{it^*} - Z_i, \theta_i\right) \geq W_1\left(k_{it^*}, \theta_i\right)$$

In effect, the policy change can be interpreted as a once-and-for-all wealth shock in the event of joining the financial sector. Consumption equations are as before. For $t > t^*$, we have

$$c_{it} = c_{it}^A \times (1 - I_{it}) + c_{it}^I \times I_{it}$$

Then, if the agent enters at t^*, induced by the sudden and temporary policy change, we can analyze this decision as if it would have been a "once for all" decision. In this case, the policy changes the entry decision, but it does not affect the potential outcomes at $t > t^*$.[22]

Optimal Contracting and Spatial Competition among Financial Service Providers

Gustavo Joaquim
(MIT)

Robert M. Townsend
(MIT)

Victor Zhorin
(UChicago)

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Reduced Form Evidence

- What are the effects of introducing a:
  1. Financial Service Provider in a region?
  2. New screening system to remove selection on observables?
- Data on $\approx$ 500 villages, half randomly receive a new FSP
  - 70 Small and Medium Enterprises per village, $\approx$ 35,000 HHs
  - $\approx$ 100 in both Control and Treatment had no FSP before intervention.
- For those with some FSP in baseline (300 Villages), half randomly receive the screening system

Reduced Form Evidence

- What are the effects of introducing a FSP in a region?

Table: Outcomes: Treatment - Control

	No FSP baseline	Had FSPs baseline
Δ Avg. Expedinture ($C + I$)	-0.0745***	0.6098***
	(0.0216)	(0.0074)
Δ Std. Dev. Expedinture	0.2810***	0.6169***
	(0.0290)	(0.0088)
Δ Avg. Production	3.8775***	0.0176
	(0.0652)	(0.0250)
Δ Std. Dev. Production	4.4624***	-0.0055
	(0.0839)	(0.0323)

- Expenditure Puzzle?

Reduced Form Evidence

- What are the effects of introducing village wide a screening system?
- Given previous table, model of welfare based on expenditure-production.
- Two subsamples: New FSP Treatment/Control, Screening Treatment/Control.
- Difference is in screening system.

	Got new FSP	Didn't get new FSP
Δ Welfare	0.0940***	-0.2662***
	(0.0106)	(0.0113)

- Information Structure puzzle.

Puzzles Resolved

- Experiment is done in the environment of a model.
- Expenditure-production Puzzle
- Information Structure Puzzle
  - Differences in welfare due to competition in intermediation.
  - Screening with little competition allows FSPs to extract rents, welfare of HHs $\downarrow$.s
  - FSPs does not know how to differentiate agents, it cannot extract rent $\rightarrow$ AdS is welfare improving.
  - Experiment changing obstacles, the information structure for contracts, depends on existing degree of competition.
- **This paper adds both ingredients: contracting + market structure model**

Nonlinear Difference-in-Differences and Noisy Trends

Tiago Flórido

Harvard

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Motivation

- Difference-in-Differences (DID) is a very popular method to estimate the effect of policy interventions
- Identifying assumption is that potential outcomes of treatment and control groups have parallel trends
- DID relies heavily on additivity and linearity assumptions
- Athey and Imbens (2006) seek to generalize DID to nonlinear environments: Changes-in-Changes (CIC) estimator
  - Allow outcomes to evolve non-linearly over time
  - Identify the entire counterfactual distribution of the treatment group
  - Model in which outcomes are determined by a monotone "production function" of unobservables

What I do/My contribution

- I show that CIC can suffer from severe bias when there are random shocks to the trend
  - Not really a generalization of the standard linear DID; trends can be noisy as long as they are parallel
  - Likely to be an issue in applications
- I compare the CIC with Quantile DID (QDID):
  - Tradeoff between non-monotonicity caused by noisy trends and non linearity
- I propose a deconvolution approach which may identify counterfactuals in nonlinear environments with random time shocks
  - I need at least two control groups (common in empirical work)
  - I assume the time shock has the same distribution across groups

Lecture 4: Just execute RCT, IV, Diff-in Diff? Some Cautionary Tales (3/5)

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