

Building Economic Models for Quantitative Research

ECS Research Workshop

4 February 2025

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NUS, Economics



Agenda





**RESEARCH
QUESTION AND
CONTRIBUTION**

**Q₁ Why is this research
question worth studying?**

Q1 Why is this research question worth studying?



1.1 Does the question help us understand the causality?

Q1: “Is the number of Nobel Prize winners **correlated** with chocolate consumption?”

✗ Correlation

Q2: “Does early-life nutrition **affect** cognitive development and later innovation?”

✓ Causality

Q1 Why is this research question worth studying?



1.2 Is the answer already obvious?

Q1: “Do higher prices reduce demand?”

✗ **Basic economic intuition** already gives a clear answer.

Q2: How do price increases affect demand for essential goods versus luxury goods?”

✓ Intuition alone is not enough; **mechanisms may differ.**

Q1 Why is this research question worth studying?



1.3 Do reasonable people disagree?

Q1: “Do people prefer higher income to lower income?”

✗ **Little disagreement** in theory or evidence.

Q2: “Does migration increase or reduce native workers’ wages?”

✓ **Competing mechanisms** and **mixed empirical results.**

Q1 Why is this research question worth studying?



1.4 Does the question matter for important outcomes?

Q1: “Do people prefer studying in the morning or at night?”

✗ depends mainly on **personal preference** and has **limited implications** beyond individuals

Q2: “How does study time allocation affect academic performance?”

✓ involves **systematic mechanisms** and **has policy implication**

Q1 Why is this research question worth studying?



1.5 Does the research question consider internal and external validity?

Q: “Did Policy X affect outcomes in City A in 2019?”



Weakly motivated if

- Does not explain why City A is the most suitable setting
- Unclear what we learn beyond this case



Well-motivated if

- Provides rich **data** that allow us to answer the question with fewer **identification** concerns (**internal validity**)
- Clarifies what **general question** we aim to answer (**external validity**)

Q1 Why is this research question worth studying?



Summary

- Not only correlative, but causal
- When underlying mechanisms may differ
- With mixed empirical results
- With clear policy implications
- With internal and external validity

Q1 Why is this research question worth studying?



2. Why do economists focus on debates

When choosing research questions, economists pay attention to debates because they arise when:

1. Empirical evidence is **mixed**
2. Multiple mechanisms point in **different directions**
3. Theory exists, but empirical evidence is **limited or weak**

So, how can new research help move the debate forward?

Q1 Why is this research question worth studying?



3. Identify the research gap and contribution

Research gap:

- something not yet explored that is important for resolving a debate, or not well explained (e.g. identification limitation, data constraint, unclear mechanism...)

Contribution:

- **new** data, settings, or methods that help fill this gap

Then, the paper makes a clear contribution to the existing literature.

Q1 Why is this research question worth studying?



Start from the literature

- Read recent **handbooks**, **Annual Review of Economics** and **Journal of Economic Literature** to understand where the field is going.
- Identify **what has been done** and where the **gaps or unresolved issues** lie.
- **Ask yourself:** “*What contribution would my study add to this conversation?*”
- **Example**
- You’re interested in “minimum wage and employment.” Reading the ***Handbook of Labor Economics*** shows the field is mature.
But maybe there’s less evidence on *informal workers* or *developing countries* → potential niche.

Tips: Find Literature

- [Google Scholar](#)
- [ScienceDirect.com](#) | Science, health and medical journals, full text articles and books.

Good to install add-on: [LibKey Nomad](#)

The screenshot displays the LibKey Nomad interface. The top left section, with a dark blue background, features the LibKey Nomad logo and tagline "Discovery starts everywhere." It explains that the service connects library resources with scholarly articles from PubMed, Wikipedia, and other publisher websites. It also includes a link for questions and answers, and a note about being a Third Iron technology supported by the library.

The top right section, with a white background, shows the "Options" menu and the "National University of Singapore" logo. Below this is a "Select Organization" dropdown menu, which is currently expanded to show a list of organizations, including "25Test_Philips", "3M Company", "A.T. Still University", "Aaron University", "AbbVie Inc.", "Abdus Salam International Centre for Theoretical Physics (ICTP)", "Abertay University Library", "Aberystwyth University", and "Abington - Jefferson Health".

The main content area shows the article "Minimum wage increases and vacancies" from the journal "Labour Economics", Volume 97, December 2025, 102765. The article is by Marianna Kudiyak, Murat Tasci, and Didem Tüzemen. The interface includes links for "Article preview", "Abstract", "Introduction", "Section snippets", and "References (40)". There are also buttons for "Access through your organization", "Purchase PDF", "Add to Mendeley", "Share", and "Cite". A "Download PDF" button is visible at the bottom left of the article page. A "Highlights" section on the right side of the article page lists key findings: "Vacancies have not been studied much in the large empirical minimum wage literature.", "At-risk occupations have a larger share of workers earning close to the minimum wage.", "Minimum wage increases reduce vacancies in at-risk occupations relative to others.", and "Negative effects start three quarters prior to the minimum wage increase."



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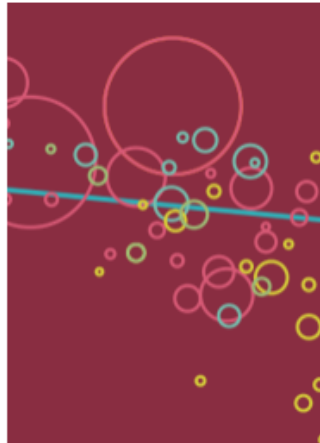
Research article  Abstract only

Chapter 8 - Labor market monopsony: fundamentals and frontiers

Patrick Kline
2025

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Journal of Economic Literature

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The *Journal of Economic Literature*, first published in 1969, is designed to help economists keep abreast of the vast flow of literature. The journal publishes four issues per year containing commissioned, peer-reviewed analytic guides to bodies of work, as well as review essays, book reviews, an annotated bibliography of new books classified by subject matter, and an annual index of dissertations from North American universities.

Q1 Why is this research question worth studying?



Tips: From the conclusion of the literature

Alesina & Zhuravskaya (2011)

The dataset that we have assembled will allow other researchers to pursue additional studies on the causes and consequences of segregation in a cross section of countries. For instance, one could investigate the quality of public good provisions at the national versus local level and the question of whether decentralization improves efficiency of government in more or less segregated countries. These studies, however, require a substantial investment in data collection, as data are not available for a large cross section of countries at the moment. Another interesting application is to civil wars and ethnic violence.

Bryan, Chowdhury, and Mobarak (2014)

(2011)). Two important caveats are that our research does not capture long-term psychological and social effects of migration, and the scale of our experiment does not permit us to analyze potential adverse general equilibrium effects in destination labor markets if the government were to contemplate scaling up such a program.⁴⁴

⁴⁴There is mixed evidence in the literature on whether these effects are substantial (Ottaviano and Peri (2012), Borjas (2003), Borjas and Katz (2007), Card (2009)). Moreover, general equilibrium effects may be positive in net, if spillover benefits at the origin exceed external costs at the destination. Migrants form a much larger part of the village economy at the origin compared to the destination urban economy.



**PRACTICAL
APPROACH**

**Q2 What empirical setting
can answer the question?**

Q2 What empirical setting can answer the question?



✗ A common pitfall

“Starting with a question that is too broad to be answered.”

E.g. Does Singapore’s Ethnic Integration Policy improve social cohesion and reduce inequality in the long run?

Why this is problematic

- Policies are **complex and long-running**
- **No clear counterfactual**
- **Endogeneity**

A realistic setting does not guarantee a credible answer.

Q2 What empirical setting can answer the question?



Before choosing a setting, ask:

Could the data answer the question?

- Data coverage: does the dataset capture the population, region, or time period you care about?
- Measurement: are the key observable or proxied?
- Identification: does the data contain variation to separate cause from correlation?
- Access & feasibility: is the data publicly available, or realistic to obtain/collect?

Could any identification strategy answer the question?

- Is there a plausible counterfactual?
- Is there a policy rule, cutoff, shock, or comparison group?

Does the Ethnic Integration Policy (EIP) in HDB public housing lead to unequal access to housing across ethnic groups?



Example: Singapore's Ethnic Integration Policy (EIP) in public housing (HDB)

A unique and explicit policy rule

- Within Singapore's HDB public housing system, the Ethnic Integration Policy enforces ethnic quotas at the block or neighborhood level ([link](#)).

Direct relevance to a broader question

- Many countries face ethnic segregation and integration concerns, but few have a policy that directly constrains residential choices.

Clear link to causality

- The EIP creates binding constraints on transactions at the block or neighborhood level.

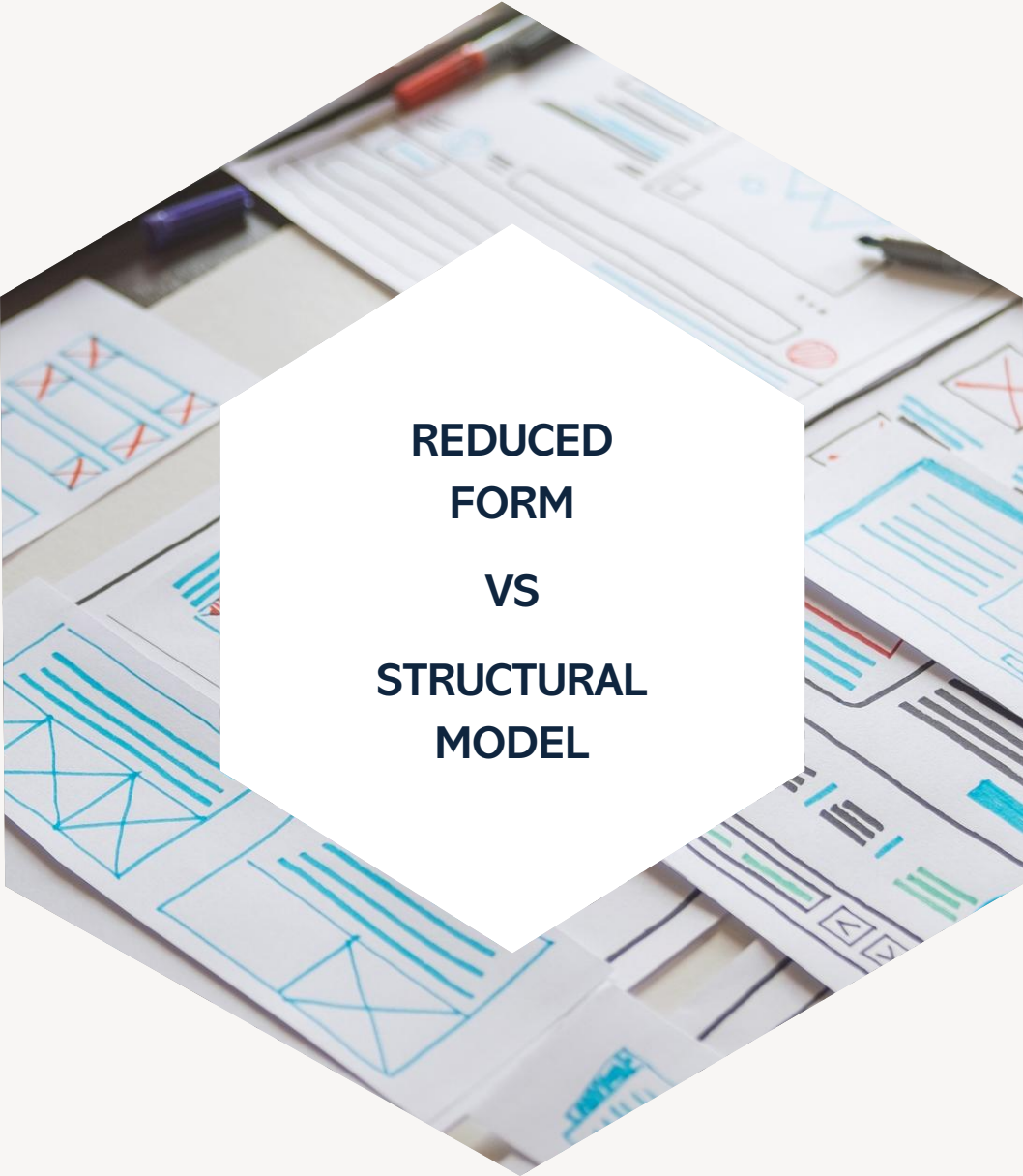
Data availability

- [HDB Resale Flat Prices Dataset](#); [Census-based ethnic shares](#)₂₂

If no credible identification exists, even the best idea remains just a “question,” not research.

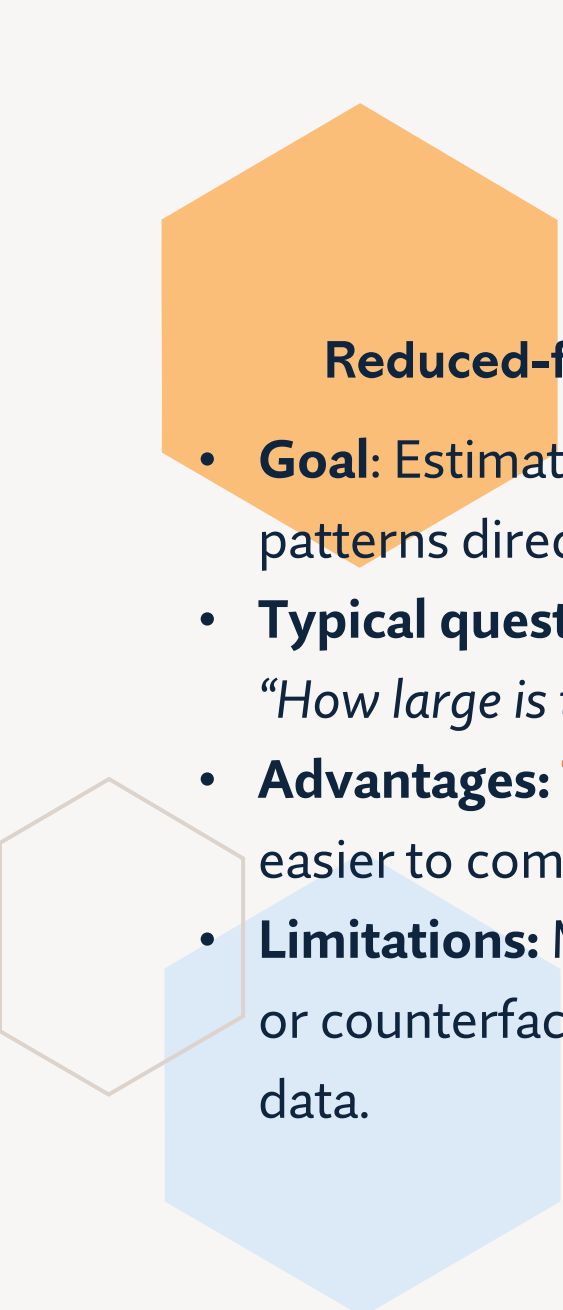
Next, let’s discuss how do economic models help answer the question.





**REDUCED
FORM
VS
STRUCTURAL
MODEL**

Q3 How do economic models help answer the question in a given setting?



Reduced-form (“Evidence-first”)

- **Goal:** Estimate causal effects or empirical patterns directly from data.
- **Typical questions:** “Does X affect Y ?” / “How large is the effect?”
- **Advantages:** **Transparent, data-driven**, easier to communicate policy relevance.
- **Limitations:** May not capture mechanisms or counterfactuals far from observed data.

Structural Model (“Mechanism-first”)

- **Goal:** Build an explicit economic model of behavior and estimate its parameters.
- **Typical questions:** “Why does X affect Y ?” / “What would happen under alternative policies?”
- **Advantages:** Can simulate **counterfactual** policies and **uncover mechanisms**.
- **Limitations:** Requires stronger assumptions and model validation.

Randomized Controlled Trials (RCTs)

Idea:

- **Random assignment** creates an as-if counterfactual.

Goal:

- Make treated and control groups identical on average, except for the treatment.

Example:

- Giving cash transfers to half of villages at random → compare outcomes.

Strength:

- Strong **internal validity**.

Limitation:

- Expensive, sometimes unethical or unfeasible; **external validity** may be limited.

Quasi-experiments

Idea:

- Use **naturally occurring or policy-driven variation** (time, location, thresholds) to mimic random assignment.

Goal:

- Construct a credible comparison group from observed data.

Example:

- Staggered policy rollout across regions → compare early vs late adopters.

Strength:

- Often high **external validity**.
- Can capture general equilibrium effects.

Limitation:

- Identification relies on **assumptions**.

Example1

"Labor Market Effects of Social Programs:
Evidence from India's Employment
Guarantee"

Imbert & Papp (2015, AEJ)

Example2

"Working over time: Dynamic inconsistency
in real effort tasks"

Augenblick et al. (2015, QJE)

Reduced-form + Quasi-experiments

Structural Model + RCT

These papers do not differ because the authors prefer different methods.
They differ because the empirical settings demand different tools.

"Labor Market Effects of Social Programs: Evidence from India's Employment Guarantee"

Imbert & Papp (2015, AEJ)

Building Economic Models for Quantitative Research



Motivation and Research Question

Motivation

- There is limited empirical evidence on the **general equilibrium (GE) effects** on labor market of large social programs.

Research Question

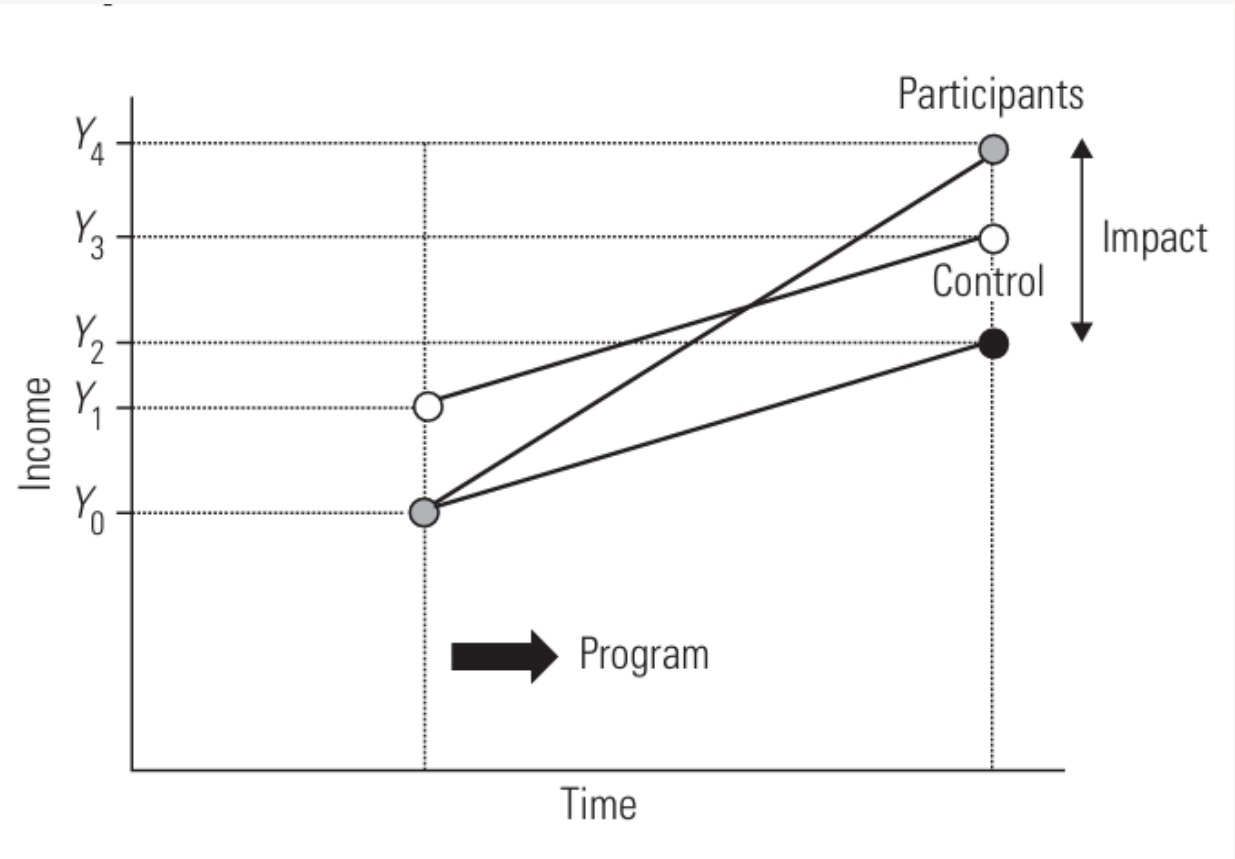
- What are the labor market impacts of a large workfare program on **nonparticipants**.

Setting

- NREGA (National Rural Employment Guarantee Act)
 - Enhance livelihood security in rural areas by providing adult members volunteer to do unskilled manual work.
 - Paid a piece rate or a fixed daily wage.
 - Create durable assets (e.g., roads).

Key assumption for identification

- **Parallel trends assumption:**
In the absence of the program, early- and late-phase districts would have experienced similar changes in employment and wages over time.



Source: Palmer-Jones (2010)

Implementation of NREGA

- Phase1: February 2006 - 200 of the poorest districts
- Phase2: April 2007 – extending to 130 districts
- Phase3: April 2008 - rest of rural India

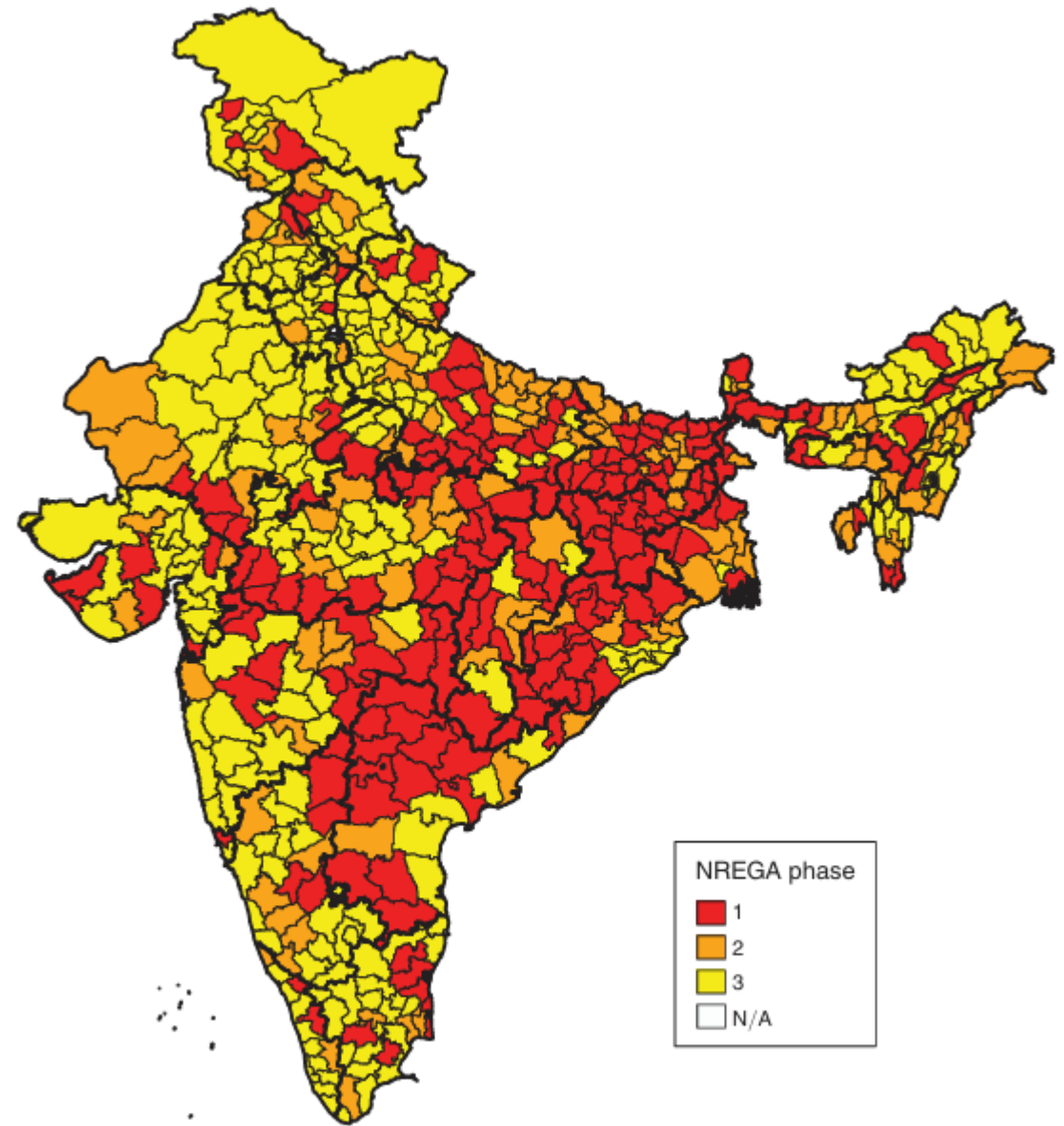


FIGURE 1. MAP OF EARLY AND LATE DISTRICTS

District Controls Summary Statistics

- DID estimates will be biased if outcomes in early districts are trending differentially from outcomes in late districts.
- → partly address this concern by including controls meant to capture differential changes across districts.

TABLE 1—DISTRICT CONTROLS SUMMARY STATISTICS

	Early (1)	Late (2)	<i>p</i> -value (3)	Star states (4)	Other states (5)	<i>p</i> -value (6)	Source (7)	Time- varying? (8)
Fraction scheduled castes (SC)	0.187	0.173	0.07	0.184	0.181	0.65	2001 census	No
Fraction scheduled tribes (ST)	0.134	0.048	0.00	0.144	0.083	0.00	2001 census	No
Agricultural productivity per worker (normalized)	−0.107	0.164	0.00	−0.064	0.023	0.08	Min of ag	No
log daily wage for agricultural casual labor	3.519	3.781	0.00	3.578	3.638	0.29	NSS 2004	No
Poverty rate	0.321	0.209	0.00	0.231	0.299	0.00	NSS 2004	No
Population density (per sq. km)	481	406	0.01	241	544	0.00	2001 census	No
Literacy rate	0.555	0.650	0.00	0.591	0.592	0.96	2001 census	No
Female labor force participation ratio	0.380	0.368	0.39	0.499	0.322	0.00	2001 census	No
Male labor force participation ratio	0.634	0.629	0.22	0.659	0.621	0.00	2001 census	No
Fraction ag casual laborers	0.195	0.162	0.00	0.226	0.164	0.00	NSS 2004	No
Fraction non-ag casual labor	0.046	0.062	0.00	0.060	0.049	0.01	NSS 2004	No
Fraction cultivators	0.284	0.259	0.03	0.323	0.254	0.00	NSS 2004	No
Fraction non-ag business	0.093	0.095	0.59	0.093	0.094	0.79	NSS 2004	No
Fraction salaried work	0.042	0.070	0.00	0.058	0.051	0.05	NSS 2004	No
Fraction labor force in agriculture	0.758	0.665	0.00	0.771	0.701	0.00	2001 census	No
Irrigated cultivable land per capita (ha)	0.082	0.117	0.00	0.113	0.088	0.00	2001 census	No
Nonirrigated cultivable land per capita (ha)	0.176	0.171	0.76	0.229	0.151	0.00	2001 census	No
Cumulative rainfall (normalized)	0.315	0.234	0.24	0.179	0.329	0.03	IMD	Yes
Election year	0.368	0.281	0.04	0.340	0.333	0.88	Gov website	Yes
PMGSY annual road construction (km)	15.8	12.6	0.03	21.4	11.6	0.00	Gov website	Yes
Number of districts	288	209		169	328			
Number of individual observations	219,012	137,624		112,388	244,248			

Empirical Strategy: DID

- Data: Employment and Unemployment Survey (NSS)
- Outcomes:
 - Employment (private sector work, public sector work, not in labor force, unemployed)
 - Wages (salaried, casual)

$$Y_{idt} = \beta T_{dt} + \delta \mathbf{Z}_d \times \mathbf{1}_{\{t > 2006\}} + \gamma \mathbf{X}_{dt} + \lambda \mathbf{X}_{dt} \times \mathbf{1}_{\{\text{Early}\}} + \alpha \mathbf{H}_i + \eta_t + \mu_d + \varepsilon_{idt}$$

where Y_{idt} is the outcome (e.g., earnings per day worked) for individual i surveyed in district d in quarter t , T_{dt} is a dummy equal to one for early phase districts in the post period (July 2007 to June 2008), $\mathbf{Z}_d$ are time-invariant district controls, $\mathbf{1}_{\{t > 2006\}}$ is a dummy variable equal to one after 2006, $\mathbf{X}_{dt}$ are time-varying district controls, $\mathbf{1}_{\{\text{Early}\}}$ is a dummy variable equal to one for observations within early districts, $\mathbf{H}_i$ are individual controls, η_t are year-quarter fixed effects, and μ_d are district fixed effects. All estimates are adjusted for correlation of ε_{idt} over time within districts by clustering at the district-level. For most specifications, we include interactions of T_{dt} with other variables such as season dummies or dummies for whether the district is in a star state, in order to exploit the variation in public employment provision across seasons and states.

Key Findings: public works

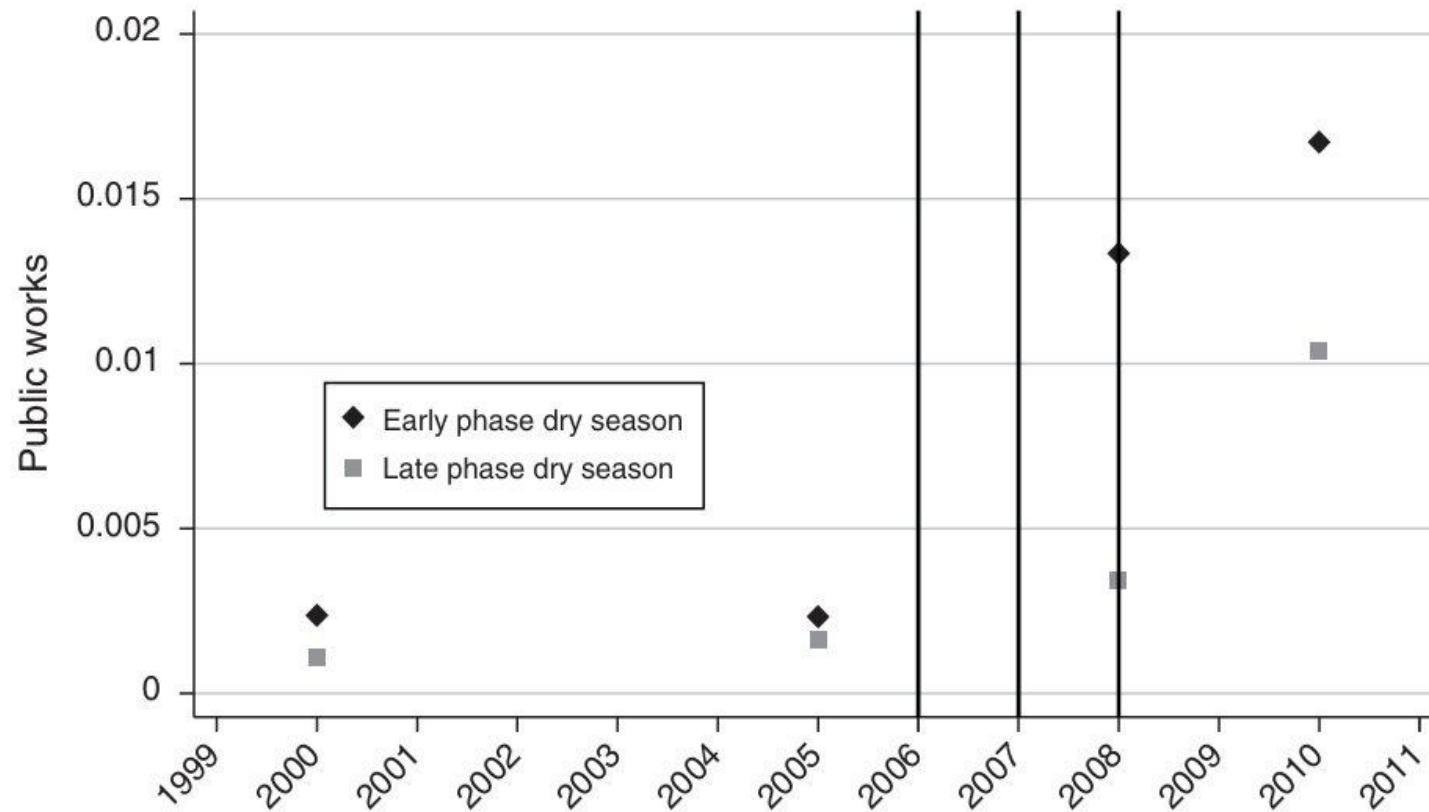


FIGURE 4. DIFFERENCE IN TIME SPENT ON PUBLIC WORKS DURING THE DRY SEASON BETWEEN EARLY AND LATE PHASE DISTRICTS

Key Findings: private sector work

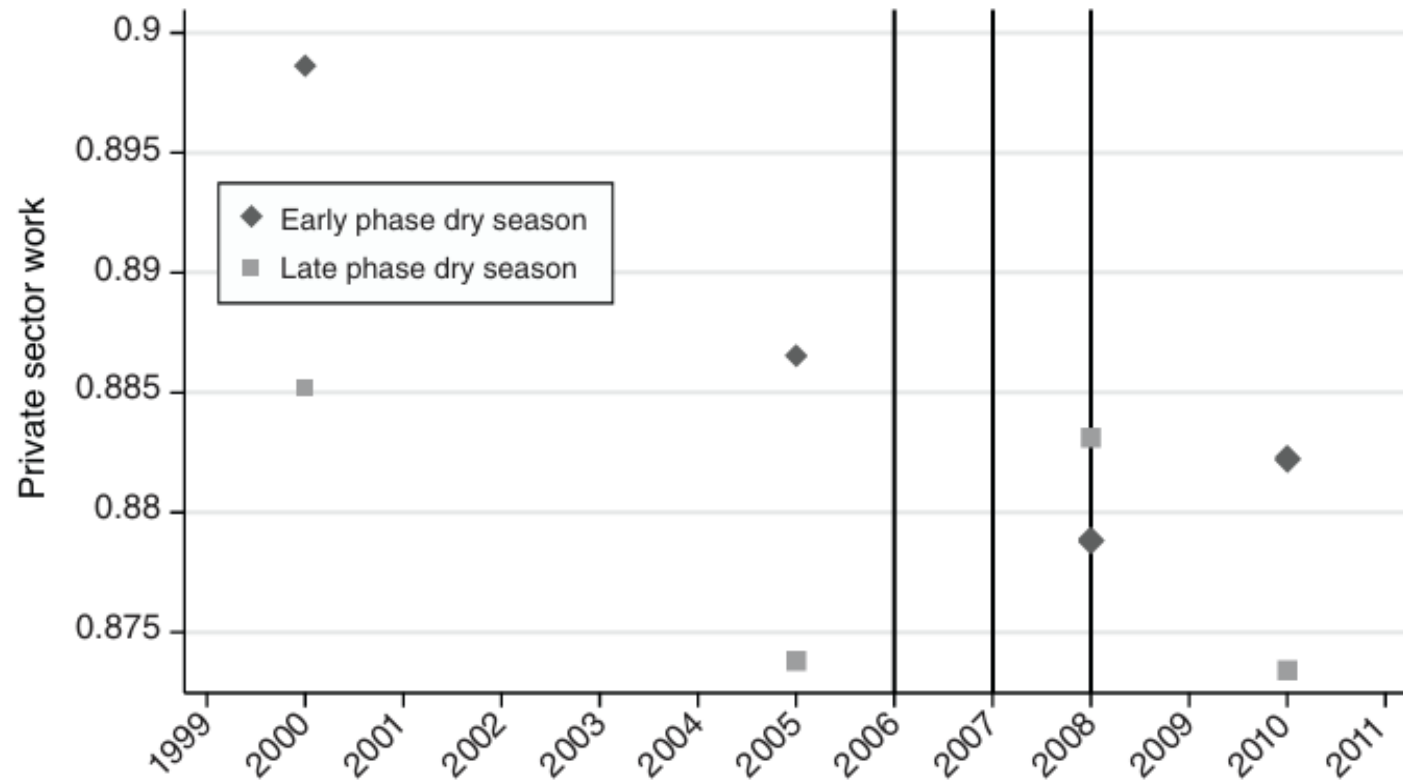


FIGURE 5. DIFFERENCE IN TIME SPENT ON PRIVATE SECTOR WORK DURING THE DRY SEASON BETWEEN EARLY AND LATE PHASE DISTRICTS

Key Findings: casual wage

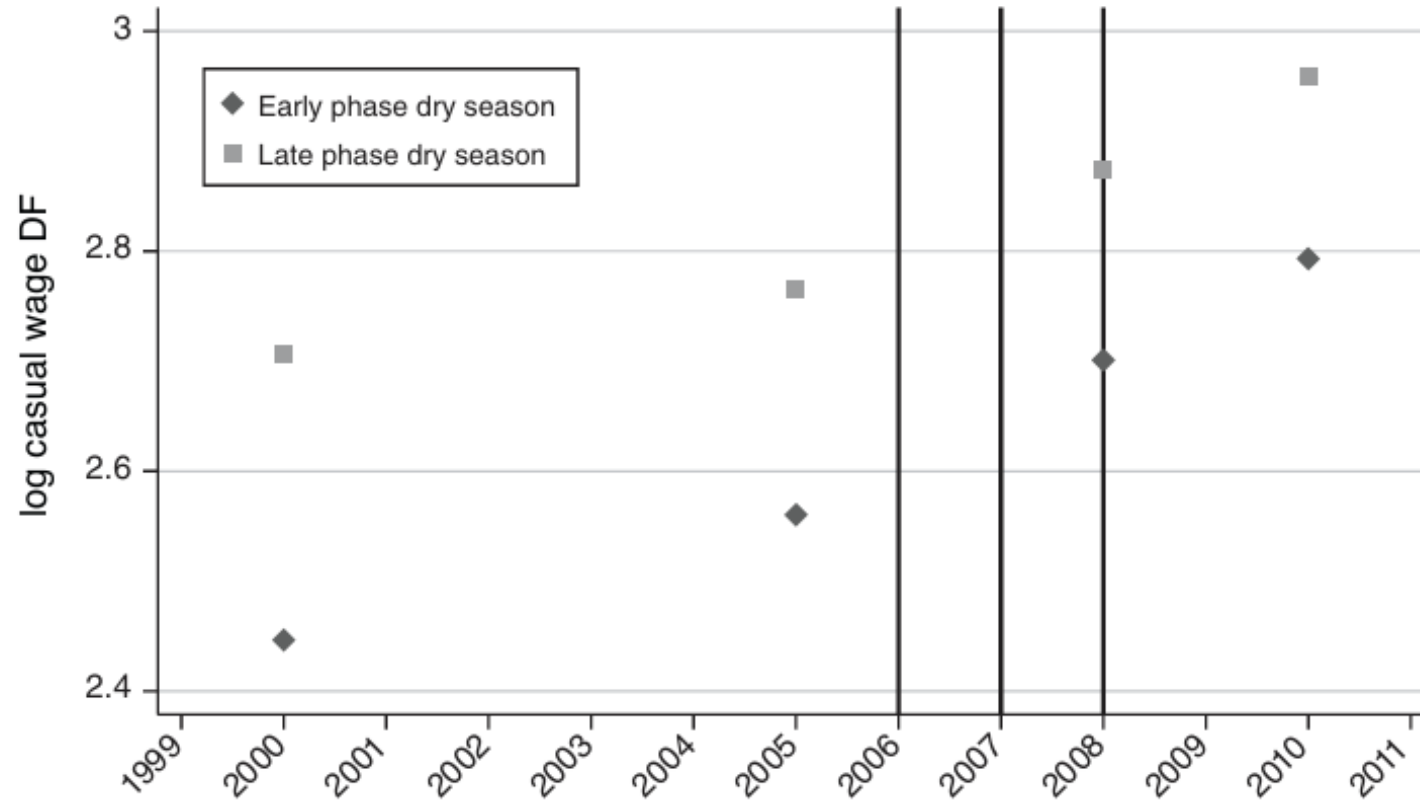
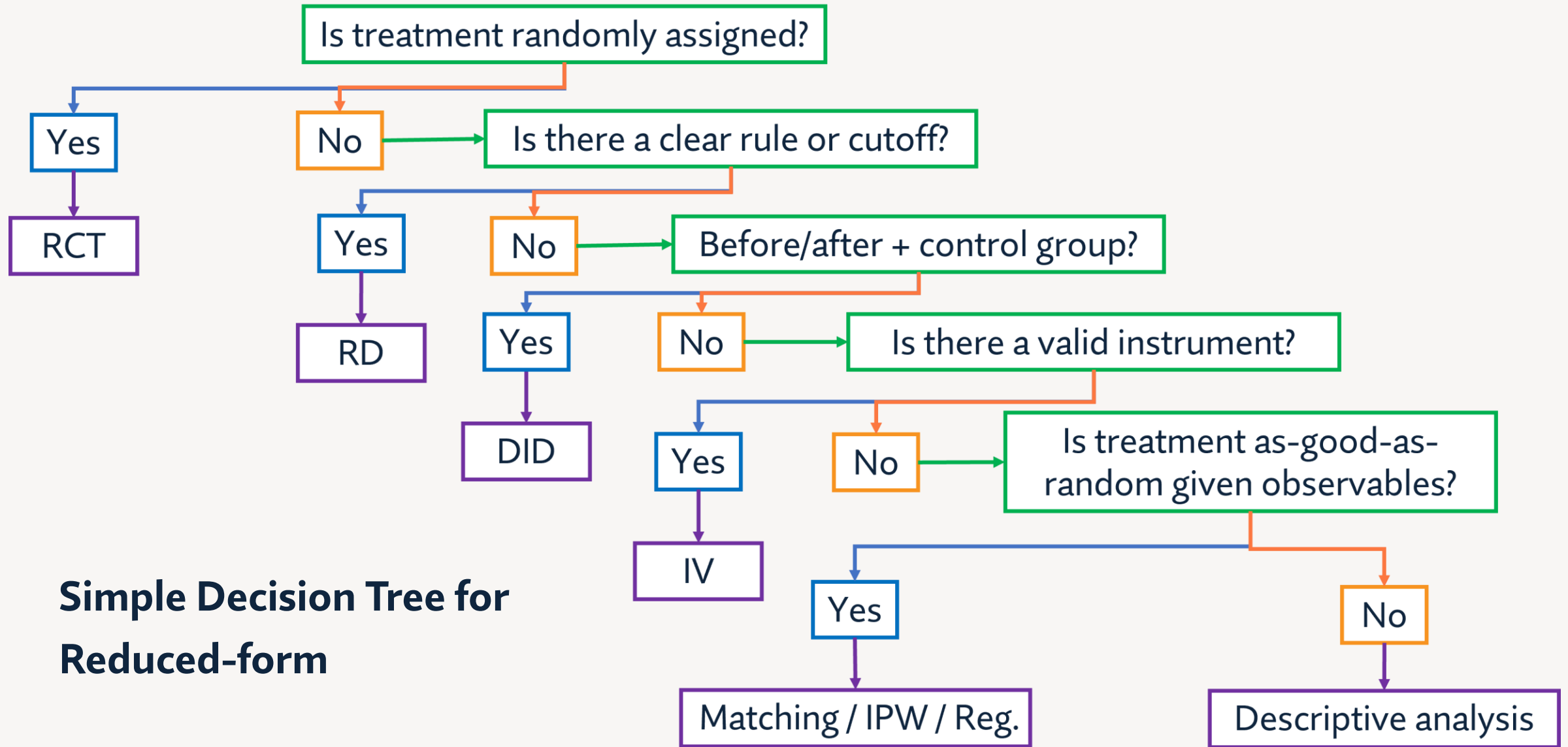


FIGURE 6. DIFFERENCE IN LOG DEFLATED CASUAL DAILY EARNINGS DURING THE DRY SEASON BETWEEN EARLY AND LATE PHASE DISTRICTS



Simple Decision Tree for Reduced-form

"Working over time:
Dynamic inconsistency in
real effort tasks"

Augenblick et al. (2015, QJE)



Motivation and Research Question

Motivation

- **Present bias** may be hard to detect in monetary choices due to confounds (e.g., payment reliability and risk preference).

Research Question

- Is present bias observable in **real effort choices** (negative leisure consumption)?

Experiment

- **Within-subject** longitudinal experiment (over a seven-week study period)

**"Working over time:
Dynamic inconsistency in
real effort tasks"**

Augenblick et al. (2015, QJE)



Summary of Longitudinal Experiment

	10 Effort allocations	Minimum work	Allocation that counts chosen	Complete work	Commitment choice	Receive payment
Week 1 (in lab)	x	x				
Week 2 (online)	x	x	x	x		
Week 3 (online)		x		x		
Week 4 (in lab)	x	x			x	
Week 5 (online)	x	x	x	x		
Week 6 (online)		x		x		
Week 7 (in lab)						x

**Difference between
plans and revisions**

=

**Evidence of present
bias**



Experiment Design

Task

- Subjects have to complete a *given amount of work*
- *Payment is fixed (B)* and does not depend on timing

Two decision moments

- Before the work: subjects plan how to split effort across two sessions
- At the work date: subjects can *revise* their plan

Key idea

- If preferences are *time-consistent*, plans should not change
- If subjects has present bias (procrastinate), they shift effort to the future

The Real Effort Tasks

Panel A: Job 1- Greek Transcription

20% Completed (2 out of 10).

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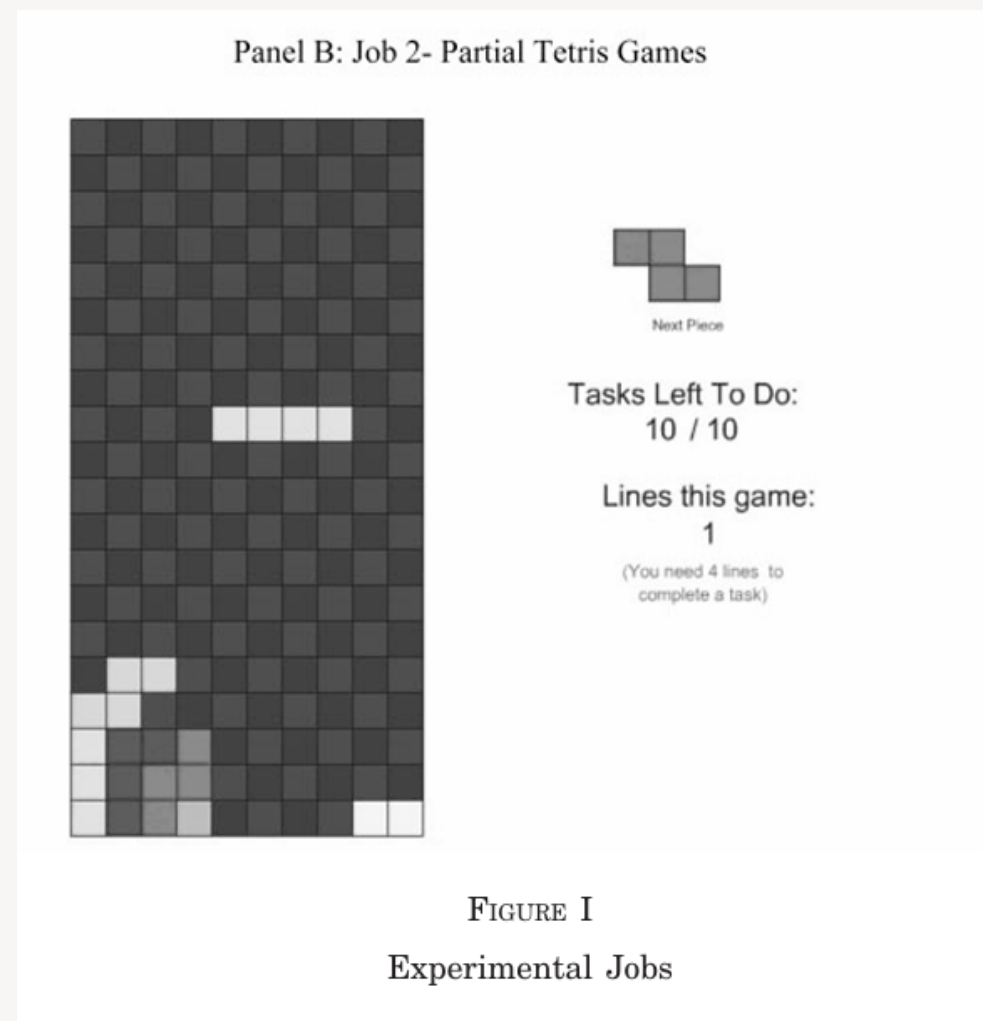
α β χ δ ε φ γ η λ . X

Submit

Greek-transcription task

(✓ one row of Greek text with 80% accuracy)

Building Economic Models for Quantitative Research



Boring version of Tetris

(✓ four rows of Tetris)

Allocation Environment

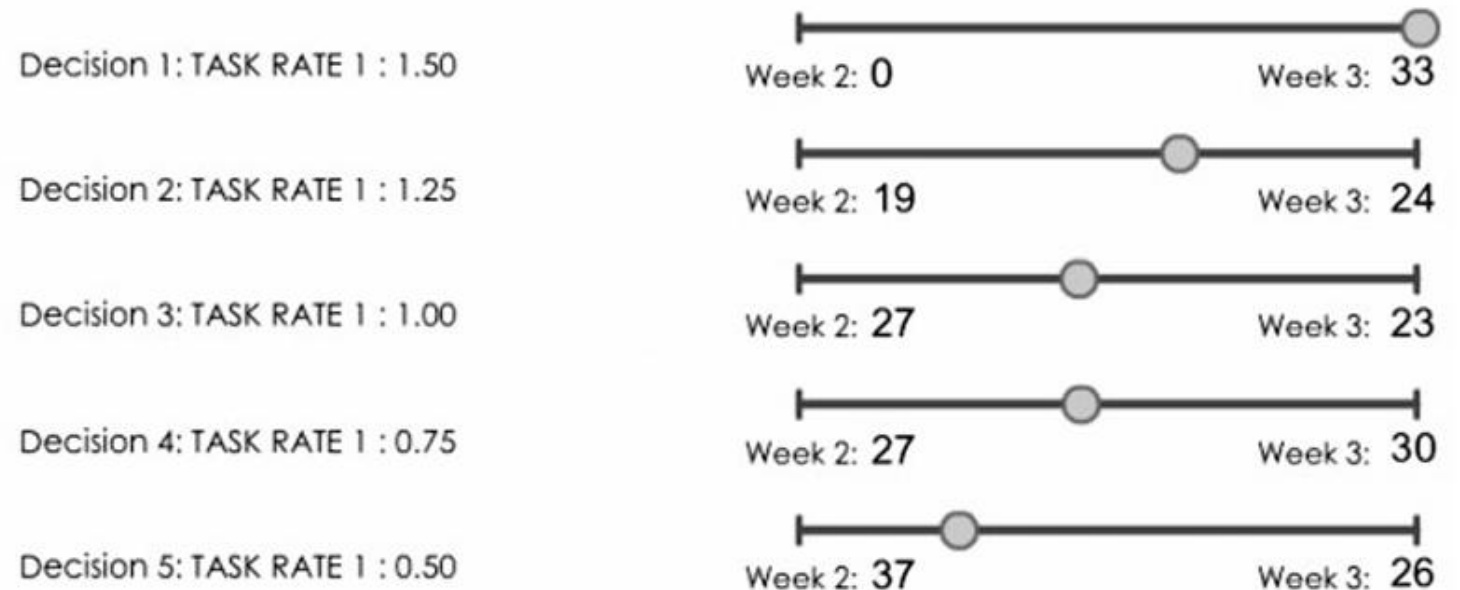
present-value budget constraint

$$e_t + R \cdot e_{t+k} = m.$$

- R : task rate
- m : total number of tasks
- e : effort

Job 1 Transcription

Please use the sliders to allocate tasks between Week 2 and Week 3.



Submit

Behavioral predictions for the experiment

Effort allocations made **one week ahead**. The individual maximizes

$$\max_{e_1, e_2} U_0 = \beta \delta^2 B - \beta (\delta c(e_1) + \delta^2 c(e_2)) \text{ subject to: } e_1 + R e_2 = 50$$

- δ : discount factor
- β : present bias
- R : task rate

Optimal behavior viewed from period 0 satisfies

$$c'(e_1) = \frac{\delta}{R} c'(e_2)$$

Present bias β does not affect effort choices made ahead of work.

Behavioral predictions for the experiment

Effort allocations made on **first work session**. The individual maximizes

$$\max_{e_1, e_2} U_1 = \beta\delta B - c(e_1) - \beta\delta c(e_2) \text{ subject to: } e_1 + Re_2 = 50$$

Optimal behavior viewed from period 1 satisfies

$$c'(e_1) = \frac{\beta\delta}{R} c'(e_2) < \frac{\delta}{R} c'(e_2)$$

Individual chooses lower work effort in $t = 1$ than planned in $t = 0$.

Present bias ($\beta < 1$) leads individuals to **procrastinate** and put off more work to $t = 2$ than originally planned in $t = 0$.

Results from the reduced-form

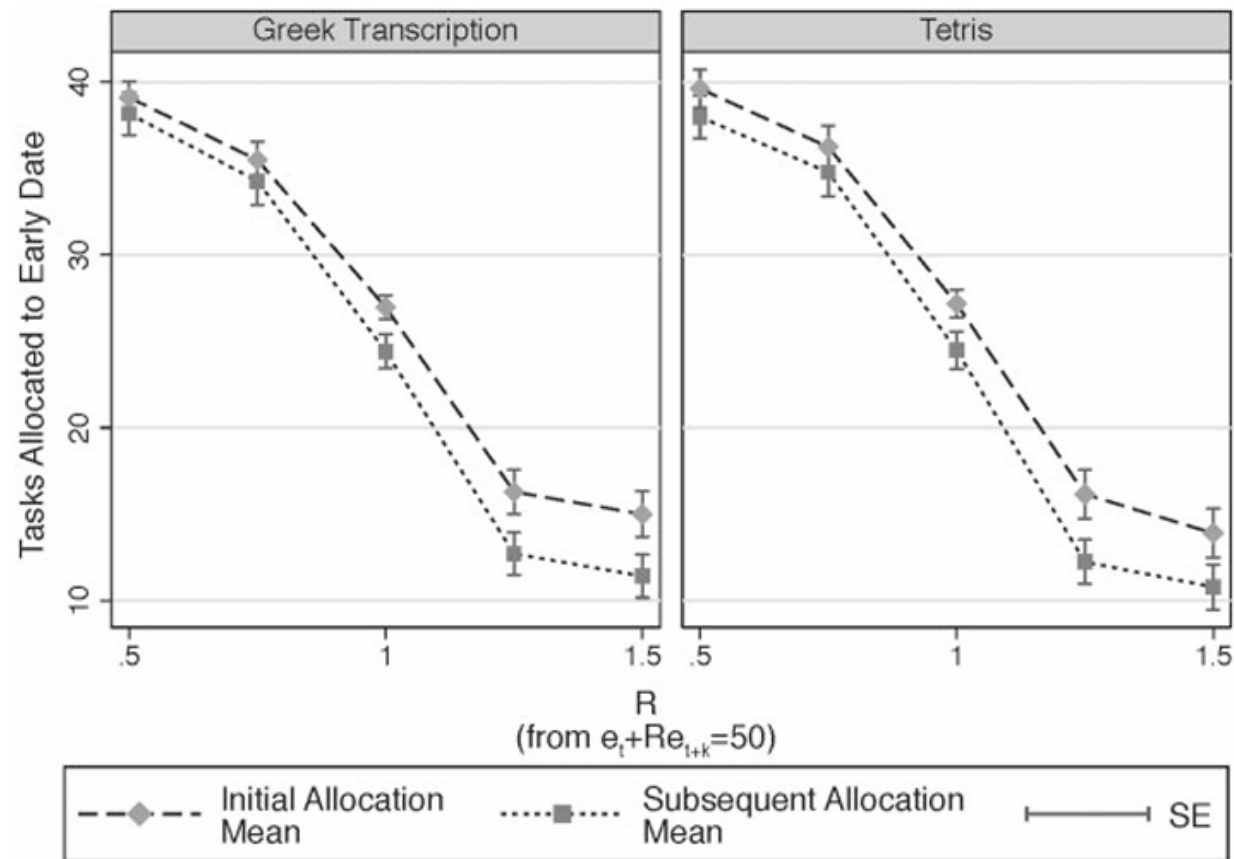


FIGURE V

Real Effort Discounting Behavior

"Working over time: Dynamic inconsistency in real effort tasks"

Augenblick et al. (2015, QJE)



Structural estimation of preference parameters

The basic idea

- Use the quantitative implications of an economic model to estimate behavioral parameters from observed choices.

Why structural estimation here?

- The experiment generates:
 - multiple choices per individual
 - variation in timing and incentives
 - incentive-compatible effort allocations
- These features allow us to separately identify:
 - present bias (β)
 - time discounting (δ)
 - effort costs (e)

**"Working over time:
Dynamic inconsistency in
real effort tasks"**

Augenblick et al. (2015, QJE)



Two approaches to parameter inference

A) Calibration

- Fix some parameters using plausible assumptions
- Useful when data are limited

B) Structural estimation

- Let the data discipline all parameters
- Requires rich, well-designed data

A) Calibration

Straightforward assumption - quadratic effort costs: $c(e) = \frac{1}{2}ce^2$

Marginal cost is linear: $c'(e) = ce$

How do we recover the parameters?

- At t=0 (planning stage): $ce_1^0 = \frac{\delta}{R}ce_2^0 \Rightarrow \delta = R \frac{e_1^0}{e_2^0}$
- At t=1 (execution stage): $ce_1^1 = \frac{\beta\delta}{R}ce_2^1 \Rightarrow \beta\delta = R \frac{e_1^1}{e_2^1}$

Identify
present bias



$$\beta = \frac{e_1^1/e_2^1}{e_1^0/e_2^0}$$

Interpretation

- If $\beta < 1$: individuals procrastinate
- If $\beta = 1$: no present bias

B) Structural estimation

Problem with calibration: it entails an assumption about effort costs. They need to be quadratic.

More general model: $c(e) = \frac{1}{\gamma} c e^\gamma$

How do we recover the parameters?

- At t=0: $c e_1^{0\gamma-1} = \frac{\delta}{R} c e_2^{0\gamma-1}$
- At t=1: $c e_1^{1\gamma-1} = \frac{\beta\delta}{R} c e_2^{1\gamma-1}$

linearization



$$\log e_2^0 - \log e_1^0 = -\frac{\log \delta}{\gamma - 1} + \frac{1}{\gamma - 1} \log R$$

$$\log e_2^1 - \log e_1^1 = -\frac{\log \beta}{\gamma - 1} - \frac{\log \delta}{\gamma - 1} + \frac{1}{\gamma - 1} \log R$$

B) Structural estimation

OLS model for estimation

$$\log e_{2ik}^t - \log e_{1ik}^t = \phi_0 + \phi_1 I(\text{choice for } t = 1) + \phi_2 \log R_k + \epsilon_{ikt}$$

Identify the parameters

$$\phi_2 = \frac{1}{\gamma - 1} : \text{the elasticity of effort with respect to } R$$

$$\log \delta = -\phi_0 / \phi_2 \Rightarrow \delta = \exp(-\phi_0 / \phi_2) : \text{discount factor } \delta$$

$$\log \beta = -\phi_1 / \phi_2 \Rightarrow \beta = \exp(-\phi_1 / \phi_2) : \text{present bias } \beta$$

Results from the structural estimation

	(1) Monetary discounting	(2) Effort discounting Greek
Present bias parameter: β	0.997 (0.005)	0.892 (0.056)
Weekly discount factor: $(\delta)^7$	0.998 (0.001)	1.009 (0.005)
Monetary curvature parameter: α	0.952 (0.009)	
Cost of effort parameter: γ		1.774 (0.167)
# Observations	1782	1710
# Clusters	99	95
$H_0 : \beta = 1$	$\chi^2(1) = 0.50$ ($p = .48$)	$\chi^2(1) = 3.73$ ($p = .05$)
$H_0 : \beta(\text{Col.1}) = \beta(\text{Col.2})$	$\chi^2(1) = 3.50$ ($p = .06$)	

More on economic model



Reduced-form

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Structural Model

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Summary

- Q1 Why is this research question worth studying?
- Q2 What empirical setting can answer the question?
- Q3 How do economic models help answer the question in a given setting?



Reference

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Thank you

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