Place-Based Policies and the Geography of Corporate Investment

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Motivation: regional industrial policy & spatial inequality

- Sharp increase in spatial inequality in income + prime-age employment since 1970s
  - Ganong & Shoag (2017); Austin, Glaeser, Summers (2018); Gaubert et al. (2021) Evidence
  - Decline of rustbelt due to shift from traditional manufacturing (Fort, Pierce, Schott 2018)
- Industrial policy instruments try to combat this problem:
  - Targeted local tax subsidies: governments compete to attract companies
  - Opportunity Zones (2017 TCJA): deferred capital gains taxes + capital lock-in
  - **Federal catchment areas:** U.S. tech hubs named in Oct. 2023 under CHIPS Act
- Two main issues place-based policies [PBPs] try to address:
  1. Targeting: directing resources where "needed the most" $\longrightarrow$ spatial misallocation
  2. Retention: prevent firms from capturing benefits then exiting **(Okun's "leaky bucket")**

Recent failures: the Wisconsin-Foxconn deal

- Gov. Scott Walker and Pres. Donald Trump brokered 2017 deal with Foxconn to bring 13k jobs and $10 bil. to area around Racine, WI
- In exchange, pledged $4 bil. in subsidies to Foxconn (mostly refundable tax credits)
- **Toe-dipping:** by end of 2019 Foxconn hired only 281 workers and invested 2.8% of its promise into an empty facility
- Revised 2021 deal: $672 mil. in inv. and 1,500 jobs in exchange for $80 mil. subsidy

More than $15 billion has been raised by funds that invest in opportunity zones. The 2017 tax law created capital gains tax breaks for investments in designated zones, like this Chicago neighborhood.

Photographer: Daniel Acker/Bloomberg

Opportunity Zones Keep Drawing Billions During Pandemic

Source: Bloomberg Tax, February 3, 2021

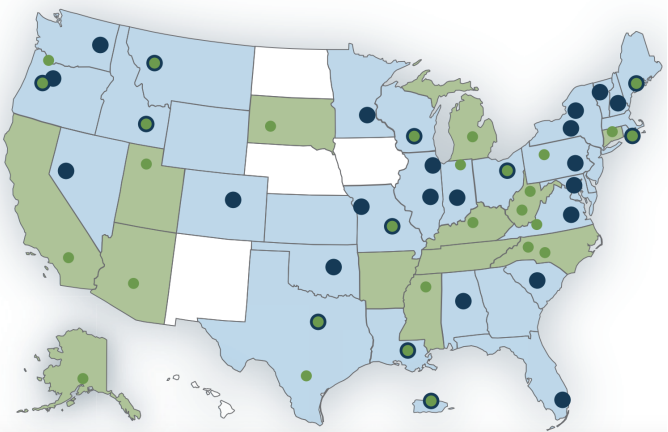
- Governors designate qualifying Census tracts as OZs where CGT deferred, basis step-up after 5 years, and eliminated if investors stay $\geq$ 10 years
- Mixed evidence of effectiveness + no info on long-run effects yet

Tech hubs under the CHIPS act aimed at regional development

Of the Designated Tech Hubs:

- Six include a tribal government;
- 22 significantly benefit small and rural communities;
- Four are headquartered in low population states;
- Four include coal communities;
- 12 include strong participation from labor organizations; and
- 14 include states that have historically received lower levels of federal research dollars.

All Designated Tech Hubs are focused on technologies and innovation critical to U.S. economic and national security.



Source: U.S. Economic Development Administration, Tech Hubs Fact Sheet.

This paper: role of corporate geography in spatial policy

1. National PBP in 1980s/1990s Japan aimed at strengthening industry clusters
   - Bonus depreciation lowers relative cost of physical capital at certain locations
   - Firm level: eligibility $\implies$ 0.29 s.d. $\uparrow$ in construction, 0.40 s.d. $\uparrow$ in non-RE CAPX
   - Plant level: biggest job gains accrue to untreated plants in major cities (leakage)

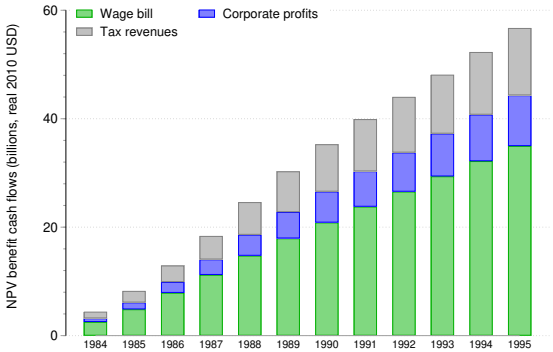
2. Heterogeneity: larger effects if firms rely on **long-lived** capital (e.g. buildings)
   - Or if younger/smaller $\longrightarrow$ higher discount rate for future cash flows
   - Or if already have plants close to treated areas (transport + span of control costs)

3. Overall, no evidence of within or cross-region trade spillovers among large firms

4. **Policy paid for itself!** PDV total surplus of \$56.7 bil. ($\approx 1\%$ of annual GDP)
   - \$15k – \$20k cost per job when we use observed cash flows from bonus claims

Why was this policy welfare improving?

Benefits = actual − counterfactual



- $\approx$ 60% of gains accrue to labor
- For corporate sector, tax base (i.e. profits) grows $\longrightarrow$ **no revenue tradeoff!**
- Subsidies solve underinvestment problem of firms with high discount rates relying on slowly amortizing assets
- Since hiring occurs in productive, but ineligible areas, gains would have been more muted if not for leakage
  - Hsieh & Klenow (2009): misallocation wedges across plants
  - Gaubert (2018): PBPs limit gains from agglomeration externalities

Related work

- Empirical studies of place-based policies (PBPs)
  - Broad PBPs (e.g. "zones") vs. targeted subsidies/credits
  - We extend Zwick & Mahon (2017) by examining bonus depreciation as a PBP
- Firm internal capital markets
  - Local shocks propagate via plant networks (e.g. Giroud & Mueller 2019; Giroud et al. 2021)
  - Our paper: intra-firm spillovers of local corporate capital subsidies
- Macro-trade literature on firm sorting
  - Typically no dynamic investment problem in these models (intermediate inputs)
  - We show evidence for mechanisms such as transport/span of control costs (Oberfield et al. 2023) but emphasize reallocation of resources *within* firm

Full literature

Related work

- Empirical studies of place-based policies (PBPs)
- Firm internal capital markets
- Macro-trade literature on firm sorting

What we contribute...

1. **Insert balance sheets and corporate geography into the analysis of PBPs.**
2. **Show tax breaks for local investment may ultimately flow to other areas within the firm's network $\implies$ difficult to target big companies.**
3. **Empirical evidence of long-run welfare implications of policy leakage.**

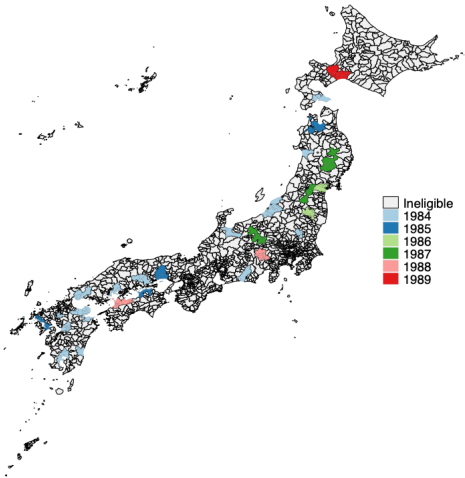
Full literature

Policy Background & Data

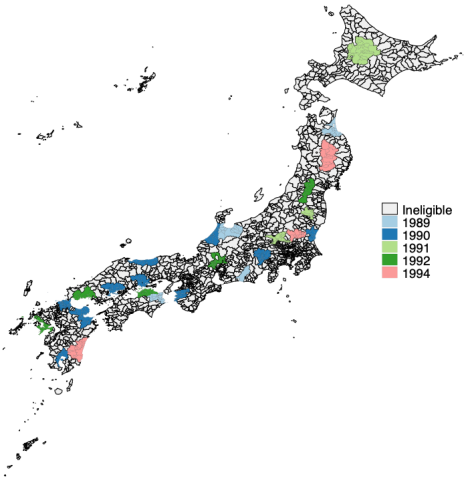
Tax incentives to promote industry clusters in Japan

- Staggered rollout of two policies aimed at jump-starting high-tech industrial clusters
  1. **Technopolis (1984-89):** parent firms in 55 mfg. JSICs eligible
  2. Intelligent Location (1989-94): eligibility extended to firms in high-tech services
- Both policies offered bonus depreciation rates for CAPX in eligible areas
- Catchment area selection criteria:
  - Already home to a well-developed high-tech mfg. sector
  - Near major research university with a strong engineering department
  - Contains regional hub city with 200k-300k population
- Eligible munis generally have more non-heavy mfg. capacity, but quantitatively small differences in economic fundamentals Summary stats

Technopolis (1984 – 1989)



Intelligent Location (1989 – 1994)



- IL locations chosen to expand on existing Technopolis clusters

Technopolis bonus rate schedule

Time from start date	Non-RE Bonus Rate	RE Bonus Rate
Within 5 years	30%	15%
Between 5 and 7 years	25%	13%
Between 7 and 8 years	20%	10%
Between 8 and 10 years	15%	8%
Between 10 and 12 years	14%	7%
$>$ 12 years	0%	0%

- Kink points: maximize rate by investing within 5 years of implementation
- Big incentives for real estate investment IL schedule Detailed example
  - Buildings have depreciation lives ranging from 23 years (cold storage facilities) to 65 years (concrete office buildings)

Examples of eligible industries within 1-digit sectors

Heavy Manufacturing

Carbonaceous electrodes
Miscellaneous carbon and graphite products
Miscellaneous primary smelting and refining of non-ferrous metals
Rolling and drawing of copper and copper alloys
Rolling of aluminum and aluminum alloys, including drawing and extruding
Miscellaneous rolling of non-ferrous metals and alloys, including drawing and extruding
Electric wire and cable, except optical fiber cable
Non-ferrous metal products, n.e.c.
Mechanical power transmission equipment, except ball and roller bearings
Valves and fittings
Ball and roller bearings
Foundry equipment
Machinery for fabrication of plastic and its equipment
Metal machine tools
Metalworking machinery and its equipment, except metal machine tools
Parts and accessories for metal working machines and machine tools, except machinists' precision tools, molds and dyes
Machinists' precision tools, except powder metallurgy products

Electronics

Office machinery and equipment
Manometers, flow meters and quantity gauges
Precision measuring machines and instruments
Analytical instruments
Testing machines
Miscellaneous measuring instruments, analytical instruments, testing machines, surveying instruments and physical and chemical instruments
Medical instruments and apparatus
Microscopes and telescopes
Cameras, motion picture equipment and their parts
Movie machines and their pats
Optical lenses and prisms
Electron tubes
Semiconductor element
Integrated circuits
Miscellaneous electronic components
Generators, motors and other rotating electrical machinery
Electrical relay switches
Auxiliary equipment for internal combustion engines
X-ray equipment

- $\Longrightarrow$ these are mostly upstream firms in machine mfg. sectors

Geocoded database of corporate investment

- Corporate balance sheet data for listed firms from Development Bank of Japan (DBJ)
  - Firms report total bonus depreciation claims $\longrightarrow$ **first stage effects**
  - Physical capital investment recorded by type (buildings, land, structures, machines, tools, vehicles) $\longrightarrow$ input structure Details Example Sampling Sectors Stats
- Plant-level information from two sources:
  1. Census of Manufacturers (COM): all plants with ≥ 4 employees
  2. For listed firms, digitize facility itemizations from Form 10-K equivalent (LaPoint 2021)
  3. Hand match firms between two sources based on company name $\longrightarrow$ 842 listed firms with plant-level data (740 mfg.firms)
- Value-added shares and I-O tables $\longrightarrow$ regional trade links and upstream measures
- Historical stock prices and shares outstanding from Nikkei NEEDS

Main Empirical Results

Staggered diff-in-diff (DD) with three-dimensional treatment

- Consider standard firm-level staggered DD event study specification:

$$y_{j,k,t} = \gamma_j + \delta_t + \sum_{t=1, t \neq t_0}^{T} \beta_t \cdot Treatment_{j,k,t} + \eta' \cdot \mathbf{X}_{j,k,t} + \varepsilon_{j,k,t} \quad (1)$$

- $Treatment$ dummy equal to 1 if all three sequential criteria satisfied:
  1. **Firm j level:** "eligible" if firm has plant located in a Technopolis area as of 1980
     - ⋆ We show later that multi-plant firm entry is on intensive margin
  2. **Industry k level:** firm is in one of the targeted 4-digit JSICs
  3. **Timing t:** if first two criteria apply, set dummy to 1 if t after first possible eligibility year

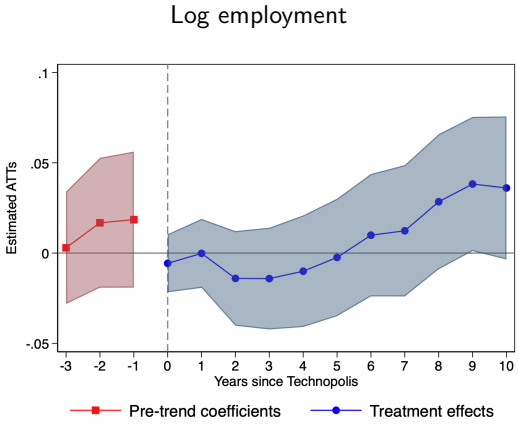
- Or, $Treatment_{j,k,t} = Treated_{j,k} \times Post_{j,t}$, and $Post_{j,t}$ stacks up several potential within-firm treatment events $\longrightarrow$ tie breaker if firm has plants in several Technopolises

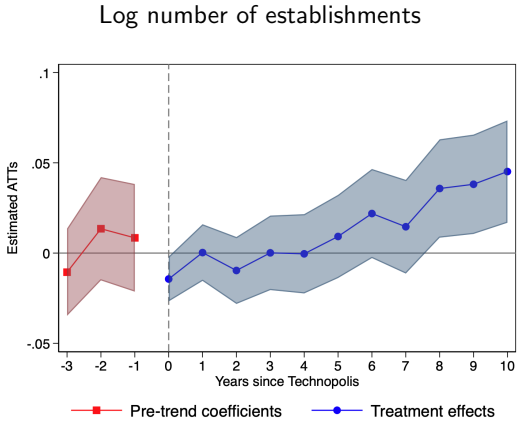
Comment on staggered DD estimators in this setting

- Explosion of recent papers on problems with estimating by OLS
- Basic idea: treatment/control groups are changing over time, so can get negative weights on ATEs for some group-time cells (Goodman-Bacon 2021)
- OLS delivers nearly identical results to other estimators, including:
  - **Borusyak, Jaravel, Spiess (2023)** [*BJS*]: two-step imputation which uses never-treated and not-yet treated firms, allows for anticipatory leads
  - de Chaisemartin & D'Haultfœuille (2020): uses not-yet treated as control group
  - Sun & Abraham (2021): uses never-treated firms as control group
  - Callaway & Sant'Anna (2021): w/o time-varying covariates same as Sun & Abraham
- We use *BJS* in our main analysis to account for anticipation effects from Technopolis sites being announced 1 year in advance

Clear growth in # of plants at city level

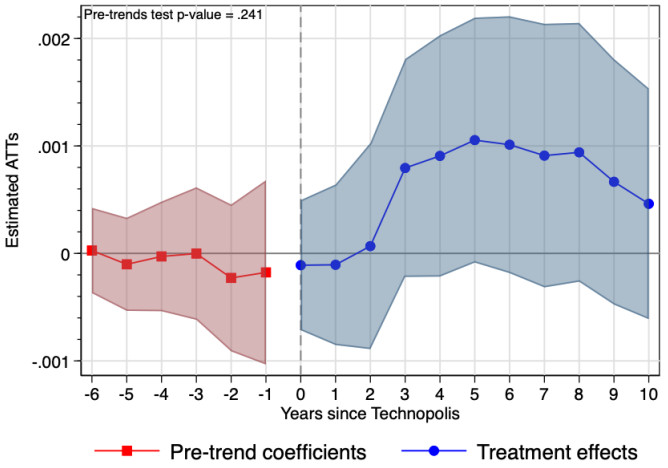
Main deck





- Pre-trend: we already know that eligible sites chosen with specific criteria in mind
- Using firm-level eligibility criteria helps difference out local macro trends

First stage effect: bonus claiming peaks at initial kink point



- 0.18 s.d. increase in $ value of bonus claims
- Big spike in claims around policy year 2 $\implies$ time to build in construction
- First stage effect $\implies$ not just identifying ITT effects
- Pre-trend testing: 0.24 p-value on joint significance of leads
- Wide CIs: many firms don't take up policy ($bonus = 0$)

Cash flows

Note: We do not use a one-year anticipatory lead to perform the pre-trend test.

Bonus claims driven by extensive margin response

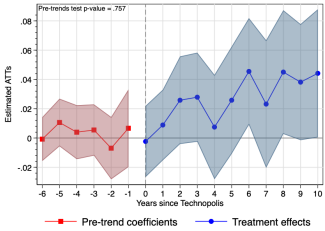
$$\mathbb{1}\{bonus > 0\}_{j,k,t} = \gamma_j + \delta_t + \beta \cdot Treatment_{j,k,t} + \eta' \cdot \mathbf{X}_{j,k,t} + \varepsilon_{j,k,t}$$

	(1)	(2)	(3)	(4)	(5)	(6)
$Treatment$	0.091^{***}	0.072^{**}	0.086^{***}	0.094^{***}	0.070^{**}	0.090^{***}
	(0.028)	(0.029)	(0.027)	(0.028)	(0.030)	(0.028)
Estimator	OLS	OLS	OLS	*BJS*	*BJS*	*BJS*
Firm FEs	✓	✓	✓	✓	✓	✓
Financial controls		✓			✓	
Controls × year FEs			✓			✓
N	38,374	34,578	38,360	38,374	34,578	38,360
# Firms	1,508	1,408	1,507	1,508	1,408	1,507
Adj. R^2	0.535	0.547	0.551	0.535	0.547	0.551

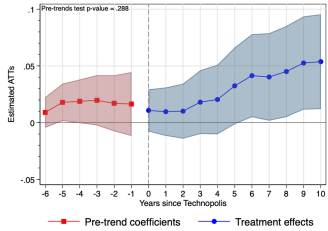
Notes: Financial controls include OCF, EBITDA, and the Q ratio. For the *BJS* estimator, we include a one-year lead to account for potential anticipation effects from the announcement of Technopolis sites. Controls × year FEs includes size/age quintiles and Census region of the corporate HQ.

Dynamic effects on cash flows, employment, CIP, non-RE CAPX

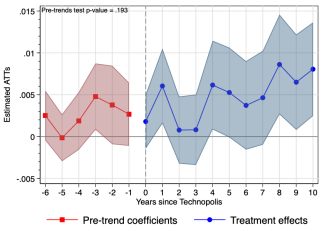
Operating cash flow



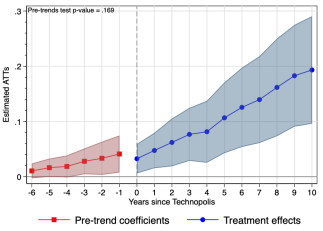
Employment



Construction in progress



Non-RE purchases



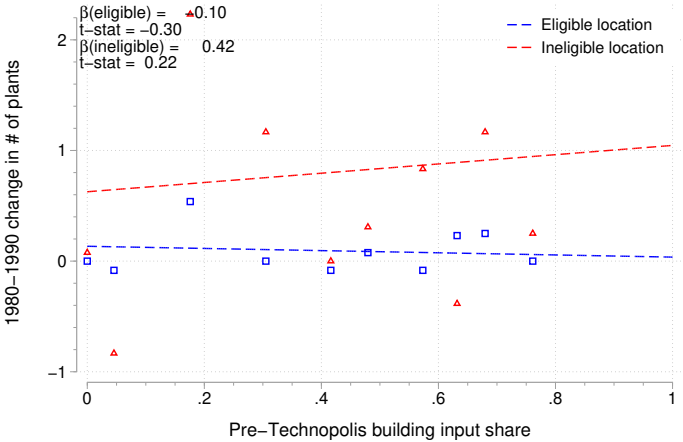
- Clear spikes in OCF which correspond to first two kink points in bonus schedule
- Big effects on employment, new construction (0.3 s.d.), non-RE asset purchases (0.4 s.d.) capping out around 8-10 years after reform
- Pre-trend testing: p-value of 0.76 for OCF, 0.29 for employment, 0.19 for CIP, and 0.17 for non-RE purchases

Old geo | Estimators | Linear trends | Logs | City level | Other outcomes

Internal firm markets from matched plant-firm analysis

- In response to subsidies, how do firms move resources within their **internal network?**
- Same definition of treatment as before, except now plant is eligible if located in Technopolis muni
  - **Eligibility along industry dimension still based on JSIC of parent firm**
  - Subset to eligible firms with $bonus > 0$ and plants in both eligible and ineligible locations
- Data limitation: plant and firm identifiers only available in Census starting in 1986
- Simple exercise: compare change in # plants, $\%\Delta$ emp. between 1980–1995 among eligible/ineligible plants
  - Rank parent firms based on "exposure" to reform: financing constraints, **LL asset share**
  - "Reduced form" effect because LL asset share $\propto$ capital subsidy rate

Construction response involves expansion of existing plants

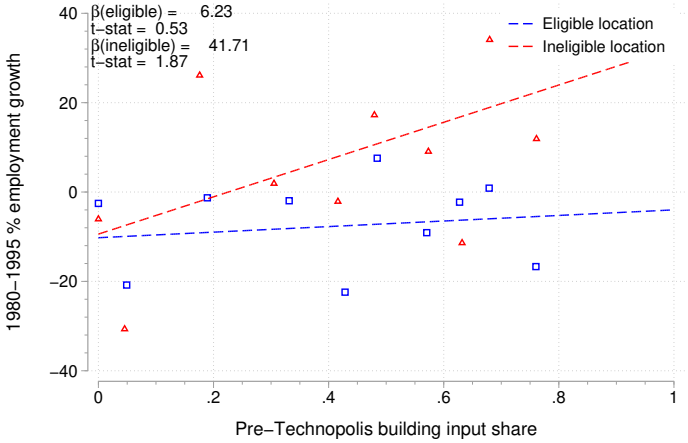


Notes: Each point on the graph corresponds to plant totals among either Technopolis ineligible (red) or eligible (blue) locations within a listed mfg. firm. Points reflect decile bins following Cattaneo et al. (2023).

- Flat relationship between LL asset share and establishment growth
- Corroborates construction data showing CIP response coming from expansion of existing plants
- x-axis $\omega_{build} \in [0, 1]$ corresponds to subsidy rate ranging from 0.9% to 3.6%

Simulation

Leakage of tax breaks to untreated areas within firm



Notes: Each point on the graph corresponds to plant totals among either Technopolis ineligible (red) or eligible (blue) locations within a listed mfg. firm. Points reflect decile bins following Cattaneo et al. (2023).

- Much larger ΔL to LL share gradient for ineligible areas vs. eligible areas
  - $\Longrightarrow$ cash flows financing hires outside targeted areas
- This implies a large **semi-elasticity** w.r.t. subsidy rate of $\varepsilon = \beta/\Delta\tau$
  - In ineligible areas $\varepsilon = 41.7/(3.6\% - 0.9\%) = 15.4$
  - $\varepsilon = 2.3$ in eligible areas (statistically insignificant)

Decomposing employment growth into hiring/firing decisions

$$\mathbb{1}\{\Delta L \lessgtr 0\}_{g,j,k} = \alpha + \beta_1 \cdot Treatment_{j,k} + \beta_2 \cdot Takeup_{j,k} + \beta_3 \cdot Treatment_{j,k} \times Takeup_{j,k} + \eta' \cdot \mathbf{X}_{j,k} + \varepsilon_{g,j,k} \quad (2)$$

- $g \in \{T, NT\}$ indexes whether employment changes ΔL occur in Technopolis (T) or non-Technopolis (NT) areas
- $Takeup_{j,k} = 1$ if firm j claims bonuses during Technopolis period
- $\mathbf{X}_{j,k}$ controls include size/age bins, Tobin's Q, EBITDA, operating cash flow
- **Thought experiment:** compare two mfg. firms with similar starting size, age, valuation, income, who both claim bonus depreciation, but one does so under Technopolis
- **Labor hoarding** if firing probability goes down before 1990s crash
  - Subsidies help financially constrained firms retain productive workers (Giroud & Mueller 2017)

Firms less likely to hire in eligible areas

	Hiring $\mathbb{1}\{\Delta L > 0\}$				Firing $\mathbb{1}\{\Delta L < 0\}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treatment$	0.042	0.035	0.052	0.035	-0.096^{***}	-0.076^{**}	-0.071^{**}	-0.081^{**}
	(0.040)	(0.041)	(0.041)	(0.043)	(0.032)	(0.031)	(0.031)	(0.033)
$Takeup$	0.133^{***}	0.136^{***}	0.089^{**}	0.051	0.017	0.015	-0.039	-0.048
	(0.044)	(0.044)	(0.044)	(0.047)	(0.039)	(0.039)	(0.040)	(0.044)
$Treatment \times Takeup$	-0.143^{**}	-0.151^{**}	-0.154^{**}	-0.134^{**}	-0.001	0.005	0.026	0.055
	(0.064)	(0.064)	(0.063)	(0.067)	(0.050)	(0.051)	(0.051)	(0.057)
1-digit sector FEs		✓	✓	✓		✓	✓	✓
Size & age bins			✓	✓			✓	✓
Financial controls			✓	✓			✓	✓
Exclude if $\omega_{build} = 0$				✓				✓
# Firms	740	740	729	627	740	740	729	627
Adj. R^2	0.010	0.009	0.072	0.059	0.015	0.024	0.070	0.075

- No evidence of labor hoarding among Technopolis plants

Firms more likely to hire and hoard workers in ineligible areas

	Hiring $\mathbb{1}\{\Delta L > 0\}$				Firing $\mathbb{1}\{\Delta L < 0\}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treatment$	0.015	-0.018	-0.018	-0.039	-0.015	0.018	0.019	0.039
	(0.049)	(0.049)	(0.049)	(0.052)	(0.049)	(0.049)	(0.049)	(0.052)
$Takeup$	0.002	0.004	0.001	-0.056	-0.007	-0.010	-0.008	0.048
	(0.050)	(0.050)	(0.052)	(0.055)	(0.050)	(0.050)	(0.052)	(0.056)
$Treatment \times Takeup$	0.161^{**}	0.150^{**}	0.165^{**}	0.225^{***}	-0.155^{**}	-0.144^{*}	-0.159^{**}	-0.217^{***}
	(0.074)	(0.074)	(0.075)	(0.081)	(0.074)	(0.074)	(0.075)	(0.081)
1-digit sector FEs		✓	✓	✓		✓	✓	✓
Size & age bins			✓	✓			✓	✓
Financial controls			✓	✓			✓	✓
Exclude if $\omega_{build} = 0$				✓				✓
# Firms	740	740	729	627	740	740	729	627
Adj. R^2	0.015	0.028	0.052	0.062	0.014	0.027	0.052	0.062

- Effects attenuated if look at firing later in the policy period $\implies$ precautionary behavior

What types of jobs are being created?

- If creating manufacturing jobs, then firms' respond to subsidies by shifting workforce towards high MPL areas
  - Hsieh & Klenow (2009) show aggregate TFP is much higher when firms allocate resources to set MPL_i equal across plants
  - $\implies$ Regional industrial policies like Technopolis create misallocation wedges by subsidizing activity in low MPL areas

- Skill reoptimization hypothesis: hiring in ineligible areas reflects complementary inputs to physical capital investment in eligible areas
  - Example: firms hire managers, administrative staff in larger cities who oversee operations in the regional Technopolis plants

- Employees in our data are at mfg.plants except if the HQ shares a location with a branch office or factory HQ results
  - No effect on hiring/firing for ΔL in the HQ city $\implies$ **adjustment is for mfg. workers**

Heterogeneity: Take-up Determinants & Spillovers

Sources of heterogeneous responses

Jump to welfare

1. Effects driven by financially constrained firms Jump
   - Consistent with younger/smaller firms valuing future cash flows with high discount rates
2. Span of control and transport costs: take-up greater for firms with more plants proximate to treated areas Jump
3. **Capital inputs matter:** effects driven by firms relying on longer-lived assets Jump
   - Q theory-based structural approach to recover capital input shares
4. No pos. spillovers to ineligible firms in treated areas Jump
5. No evidence of cross-regional spillovers due to trade networks Jump

Policy Cost-Benefit Analysis

Partial equilibrium cost-per-job (CPJ) estimates

- Fiscal cost = PDV of **forgone tax revenues** from offering bonus depreciation:

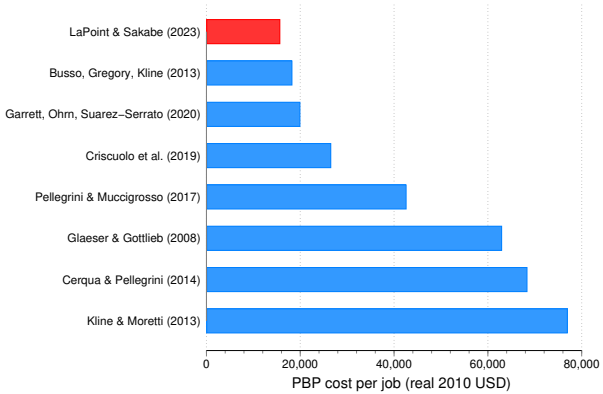
$$\text{Fiscal cost} = \sum_{t=1984}^{1995} \frac{\tau_t}{(1+r)^t} \times \left(D_t^{bonus} - D_t^{normal} \right) \times \text{Take-up}_t \tag{3}$$

- Compute the *ex post* benefit $D^{bonus} - D^{normal}$ then scale by take-up = $Treatment \times \mathbb{1}\{bonus > 0\}$ $\implies$ fiscal cost $\approx$ 2% per qualifying CAPX dollar
  - $\implies$ avg. tax elasticity of $\epsilon_{K,1-\tau_c} \approx 2.1$ (large, but real estate is subsidized!)

- Applying this rate to total eligible CAPX during policy and our DD estimate of 5-7% gain in employment $\implies$ **$15k-$20k cost per job** CIT rates | Definitions | Other methods

- Caveat: partial equilibrium measure does not take into account spillovers through reallocation across locations within the firm
  - Local and inter-regional trade spillovers minimal to non-existent in our setting

Our CPJ estimates are on the low end w.r.t. other PBPs



Notes: Estimates from studies reporting CPJ estimates for PBPs featuring investment subsidies. Following Criscuolo et al. (2019), we converted all estimates to real 2010 USD using historical annual average exchange rates from OFX and UBC Saunder Pacific Exchange Rate Service.

- Finer nature of DiD in our setting + **firm-level first stage**
  - Exception: Cerqua & Pellegrini (2014) observe take up
- CPJ for large listed vs. general sample of firms may be different
  - Fixed costs of hiring may be lower for large firms, but are generally small
- Hiring search costs lower in thicker labor markets where jobs being created
  - Specialized manufacturing skills harder to find in peripheral cities
  - Jobs unlikely to be office/admin roles

Reduced form estimates of welfare change

- **Idea:** compare forgone CIT revenue to profits and wage bills generated
  - Building on approach of Busso, Gregory, & Kline (2013), among others
  - Similar to fiscal cost per job, but also take into account *changes in size of tax base*
  - Fiscal cost measure only computes spending on investment subsidy
- Compute gap for actual vs. counterfactual profits $\widetilde{\pi}$ and wage bill $\widetilde{w}$:
  - Gain in corporate profits $= \pi - \widetilde{\pi} = \pi \cdot \widehat{\beta}^{profits}/(1 + \widehat{\beta}^{profits})$
  - Gain in wage bill $= w - \widetilde{w} = w \cdot \widehat{\beta}^{wages}/(1 + \widehat{\beta}^{wages})$
- Then compare actual taxes paid to counterfactual taxes $= \tau \cdot \widetilde{\gamma} = \tau \cdot \gamma/(1 + \widehat{\beta}^{base})$
  - γ is a measure of π that already **nets out depreciation** write-offs (e.g. net income + taxes)

Cost-benefit analysis shows sizeable welfare gains

	Actual value	$\widehat{\beta}$	Counterfactual value	Benefits
Wage bill	591.0	0.063	556.0	35.0
Corporate profits	380.3	0.025	370.0	9.3
Tax revenue	106.3	0.132	93.9	12.4

- **PDV total surplus** $= 35.0 + 9.3 + 12.4 = 56.7$ billion (real 2010 USD) Regressions
  - About 40% of annual avg. total listed firms' profits ($\approx$ 1% of annual GDP) PDV flows
- Caveat: only includes pie generated by activities of listed firms
  - Effects might be bigger for small firms (direct + spillovers)
  - **Evidence:** for city $\times$ 2-digit industry-level data covering all mfg. firms, $\widehat{\beta}^{wage} = 14\%$

Implications for other regional industrial policies

- Strong parallels between Technopolis and the tech hubs designated under CHIPS
  - 26 regional Technopolises vs. 31 Designated CHIPS Tech Hubs
  - Similar industrial focus: semi-conductors, computing, biotech, green energy
  - $500 million in seed funding with $10 billion authorized over next 10 years
- Innovation Hubs program under CHIPS has as one of its main goals: *"catalyzing the creation of good jobs for American workers at all skill levels, equitably and inclusively."*
  - "Good" = high-tech mfg., and "equitably" = outside largest cities
  - Our results suggest local production subsidies may result in good jobs flowing elsewhere
- Common features of industrial policies worldwide (Juhász, Lane, Rodrik 2023)
  - Focus on regional redistribution, public-private partnerships, university R&D
  - **Targeting large firms adds extra scope for leakage of public funds**

Conclusion: leaky buckets in industrial policy not all bad

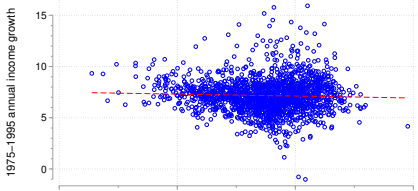
- We study a regional industrial policy which subsidized the cost of long-lived capital and find large effects on new construction and machine CAPX, but limited spillovers
- **Internal firm networks matter for PBPs to help peripheral economies**
  - Incentives providing immediate cash flows generate large investments
  - Retention: tying tax breaks to long-lived assets helps mitigate toe-dipping
- On targeting side, multi-plant firms mitigate spatial misallocation of PBPs
  - **Leakage:** multi-plant firms can redirect cash flows elsewhere
  - Welfare change (+) but attenuated by subsidies to low marginal productivity areas
  - Evidence points to mfg. hiring in ineligible but high MPL areas
- Implications for tech hubs under CHIPS: good news for the aggregate economy, but may not lead to local job creation **(equity-efficiency tradeoff)**

THANK YOU!

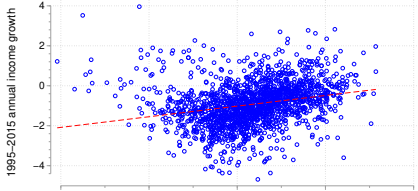
Appendix

Income divergence and increasing directed migration (Japan)

Main deck



β = −0.19
s.e. = 0.10
N = 1710
R-squared = 0.00



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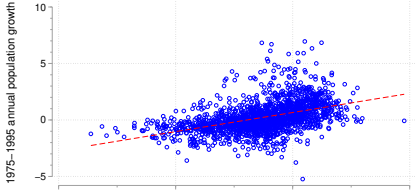
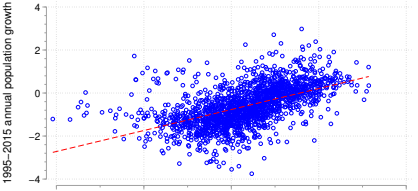
s.e. = 0.13
N = 1710
R-squared = 0.06



β = 1.69
s.e. = 0.07
N = 1710
R-squared = 0.20



β = 1.95
s.e. = 0.09
N = 1710
R-squared = 0.29

Related work

Main deck

- Empirical studies of place-based policies (PBPs) [non-exhaustive list!]
  - Devereux, Griffith, Simpson (2007); Neumark & Kolko (2010); Busso, Gregory, Kline (2013); Kline & Moretti (2014); Criscuolo et al. (2019); Lu, Wang, Zhu (2019); Bartik (2020); Arefeva et al. (2021); Siegloch, Wehrhöfer, Etzel (2021); Corinth & Feldman (2022); Kennedy & Wheeler (2022)
- Firm internal capital markets
  - Spatial: Desai, Foley, Hines (2004); Chaney, Sraer, Thesmar (2012); Giroud & Mueller (2015, 2019); Dougal, Parsons, Titman (2015); van Straelen (2018); Ma, Murfin, Pratt (2021); LaPoint (2021)
  - Tax incentives: House & Shapiro (2008); Edgerton (2010); Zwick & Mahon (2017); Giroud & Rauh (2019); Garrett, Ohrn, Suárez Serrato (2020); Curtis et al. (2021); Basu, Kim, Singh (2022)
- Macro-trade literature on firm sorting
  - Holmes (2005, 2011); Jia (2008); Kerr & Kominers (2015); Gaubert (2018); Fajgelbaum et al. (2018); Walsh (2019); Ziv (2019); Giroud et al. (2021); Oberfield et al. (2023)
  - **Most of these papers only have extensive margin sorting and no phys. capital**

Summary Statistics for Technopolis Eligible vs. Ineligible Sites

Main deck

	Eligible	Ineligible	Difference	p-value
Log mfg. employment	8.79	8.37	0.42	0.00
Log mfg. establishments	5.44	5.12	0.32	0.01
Log mfg. plant capital stock	14.46	13.91	0.55	0.00
Log per capita income	6.36	6.42	−0.06	0.02
Log Census population	11.27	10.85	0.42	0.00
Log median price/m^2 for CRE	10.87	11.17	−0.30	0.02
Population density (1000s/km^2)	0.47	1.29	−0.82	0.00
Unemployment rate (%)	2.23	2.13	0.10	0.33
Ratio of govt. expenditure to revenue	0.98	0.97	0.01	0.03
Heavy industry employment share	0.18	0.21	−0.03	0.33
Housing expenditure share	0.09	0.10	−0.01	0.59
$\%\Delta^{1980-83}$ mfg. employment	9.21	6.21	3.00	0.05
$\%\Delta^{1980-83}$ establishments	5.97	7.39	−1.42	0.27
$\%\Delta^{1980-83}$ CRE price/m^2	57.74	67.88	−10.14	0.18

Full sample IL balance

Summary Statistics for Intelligent Location Eligible vs. Ineligible Sites

Main deck

	Eligible	Ineligible	Difference	p-value
Log mfg. employment	8.56	8.38	0.18	0.08
Log mfg. establishments	5.26	5.13	0.13	0.18
Log mfg. plant capital stock	14.15	13.93	0.22	0.07
Log per capita income	6.35	6.43	−0.08	0.00
Log Census population	10.99	10.87	0.12	0.19
Log median price/m^2 for CRE	10.89	11.19	−0.30	0.01
Population density (1000s/km^2)	0.65	1.33	−0.68	0.00
Unemployment rate (%)	2.42	2.07	0.35	0.00
Ratio of govt. expenditure to revenue	0.97	0.97	0.00	0.03
Heavy industry employment share	0.18	0.22	−0.04	0.19
Housing expenditure share	0.09	0.10	−0.01	0.03
$\%\Delta^{1980-83}$ mfg. employment	6.86	6.49	0.37	0.76
$\%\Delta^{1980-83}$ establishments	5.76	7.60	−1.86	0.07
$\%\Delta^{1980-83}$ CRE price/m^2	64.28	66.88	−2.60	0.70

All eligible vs. ineligible Technopolis city codes

Main deck

	Eligible		Ineligible	
	Mean (s.d.)	[min,max]	Mean (s.d.)	[min,max]
Total mfg. employment	9,524 (13,887)	[136, 109,649]	5,706 (23,648)	[0, 723,990]
Heavy industry employment share	0.175 (0.128)	[0.025, 0.516]	0.212 (0.150)	[0.013, 0.875]
Establishments w/$>$ 4 employees	370 (576)	[10, 4,769]	241 (1,389)	[1, 47,196]
Mfg. plant capital stock	3,527 (7,190)	[0, 5,961]	1,620 (4,605)	[0, 7,570]
Per capita income	556 (104)	[292, 764]	553 (158)	[196, 1,446]
Census population	119,885 (186,727)	[4,824, 1,401,757]	64,110 (279,303)	[225, 8,351,856]
Population $>$ 65 y.o.	11,439 (14,653)	[568, 87,440]	5,783 (22,151)	[27, 686,436]
Median price/m^2 for CRE	63.93 (35.83)	[6.60, 180.00]	100.91 (95.33)	[6.35, 571.00]
Housing expenditure share	0.091 (0.024)	[0.027, 0.141]	0.096 (0.036)	[0.028, 0.241]
$\%\Delta^{1980-83}$ mfg. employment	9.8 (20.7)	$[-32.0, 136.6]$	6.3 (20.8)	$[-100, 219.1]$
$\%\Delta^{1980-83}$ establishments	7.1 (12.0)	$[-12.5, 72,7]$	6.4 (18.6)	$[-72.7, 200.0]$
$\%\Delta^{1980-83}$ CRE price/m^2	57.7 (40.1)	[10.3, 203.0]	69.8 (64.1)	$[-37.1, 722.5]$
# of municipalities	141		1,568	

All eligible vs. ineligible IL city codes

Main deck

	Eligible		Ineligible	
	Mean (s.d.)	[min,max]	Mean (s.d.)	[min,max]
Total mfg. employment	6,466 (11,999)	[34, 109,649]	5,919 (24,873)	[0, 723,990]
Heavy industry employment share	0.178 (0.127)	[0.025, 0.516]	0.214 (0.152)	[0.013, 0.875]
Establishments w/$>$ 4 employees	246 (445)	[3, 4,769]	252 (1,472)	[1, 47,196]
Mfg. plant capital stock	2,334 (6,571)	[0, 7,570]	1,650 (4,416)	[0, 5,687]
Per capita income	536 (115)	[229, 803]	557 (162)	[196, 1,446]
Census population	75,536 (159,918)	[1,360, 2,153,666]	67,122 (293,185)	[225, 8,351,856]
Population $>$ 65 y.o.	7,339 (13,063)	[178, 167,476]	5,997 (23,213)	[27, 686,436]
Median price/m^2 for CRE	66.22 (41.65)	[6.60, 180.00]	103.16 (97.50)	[6.35, 571.00]
Housing expenditure share	0.084 (0.023)	[0.027, 0.141]	0.100 (0.037)	[0.028, 0.241]
$\%\Delta^{1980-83}$ mfg. employment	6.8 (19.2)	$[-100, 136.6]$	6.5 (21.2)	$[-100, 219.1]$
$\%\Delta^{1980-83}$ establishments	6.1 (13.8)	$[-66.7, 87.5]$	6.5 (19.0)	$[-72.7, 200.0]$
$\%\Delta^{1980-83}$ CRE price/m^2	62.9 (46.0)	$[-9.2, 276.1]$	69.5 (64.7)	$[-37.1, 722.5]$
# of municipalities	319		1,390	

Intelligent Location bonus rate schedule

Main deck

Time from start date	Non-RE Bonus Rate	RE Bonus Rate
Within 2 years + Tokyo HQ	36%	18%
Within 3 years	30%	15%
Between 3 and 5 years	24%	12%
Between 5 and 7 years	20%	10%
$>$ 7 years	0%	0%

- Rate schedule similar to Technopolis, but with shorter clock and Tokyo-specific provision
- We do not find any additional effects of imposing an IL on a Technopolis site
  - For this reason, we focus on Technopolis in our main analysis
  - IL policy offered bonus depreciation for CAPX to mostly intangible capital firms

Scenario

Consider a firm which invests $1 million in construction of a new site in a Technopolis area, plus $1 million in computers to be installed at the new plant when it is finished in 2 years (e.g. concrete office building).

Year	1	2	3	4	5	...	**Total**	**PDV** ($r = 7\%$)
Straight-line (linear)								
Cash flow (PCs)	90	90	90	90	0	...	360	326
Cash flow (CRE)	0	0	5.5	5.5	5.5	...	360	73
Declining balance (default)								
Cash flow (PCs)	175	98.5	55.5	31	0	...	360	**341**
Cash flow (CRE)	0	0	14	13.5	13	...	360	**124.5**
Bonus (Technopolis) + default								
Cash flow (PCs)	242.5	69	39	10	0	...	360	**349**
Cash flow (CRE)	0	0	72	11.5	11	...	360	**158**

How spatial bonus depreciation works

Main deck

- Corporate income tax (CIT) bill for income I, asset book value P, and dep. rate θ is

$$\tau^{CIT} \cdot (I - \theta \cdot P) \tag{4}$$

- Total immediate cash flow benefit with bonus claims is then: Accounting

$$\tau^{CIT} \cdot P_{i,0} \times \left(\theta_{i,c}^{bonus} + (1 - \theta_{i,c}^{bonus}) \cdot \theta_0^{normal} \right) \tag{5}$$

- Normal methods: straight-line (linear) and declining-balance depreciation (default)
  - Accounting method chosen by parent firm rather than by plants
  - 93% of our firms use declining balance for some capital types
  - Remaining 7% use a combination of linear and other accounting methods

Depreciation accounting methods

Main deck

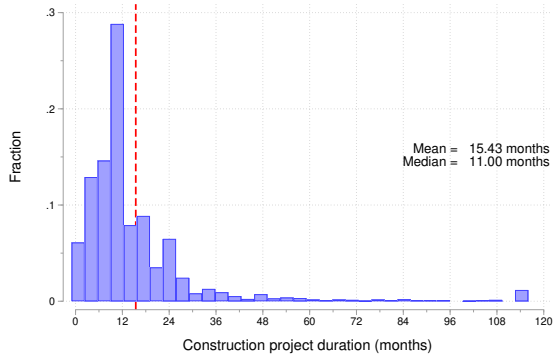
- Parent firms choose between straight-line [SL] and declining balance [DB] accounting for amortizing asset acquisition costs
  - Can use separate methods for different capital types
  - Can then exercise bonus claims on top of normal method
  - Default is declining balance, which 80% of firms use exclusively

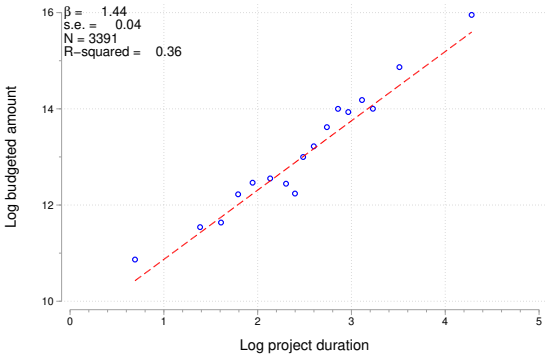
1. SL (linear) method: for lifespan x years, $\theta_t = 1/x, \forall t$
2. DB (recursive) method: $P_t = P_0 - \sum_{k=1}^{t} \theta_{t-k} \cdot P_{t-k}$, given θ_0 set by tax authority
3. With bonus claims: $\theta_t = \begin{cases} \theta^{bonus} + (1 - \theta^{bonus}) \cdot \theta_t^{normal} & \text{if } t = 0 \\ (1 - \theta^{bonus}) \cdot \theta_t^{normal} & \text{if } 0 < t \leq x \end{cases}$

- DB method strictly dominates SL in terms of PDV of cash flows for vast majority of capital types and discount rate combos

Construction project duration and budgets

Main deck

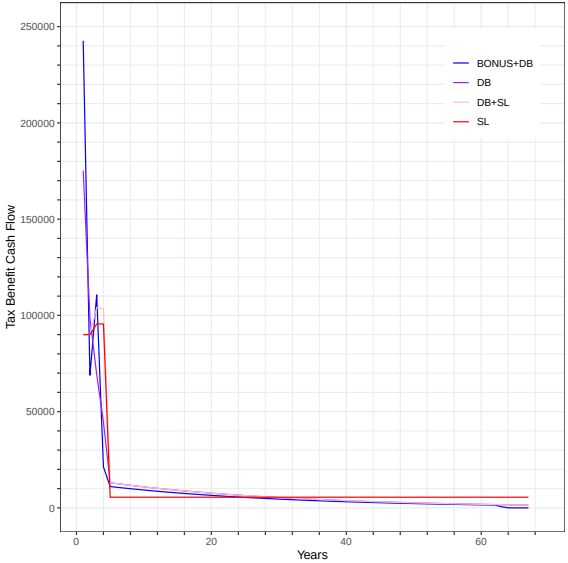




- Average firm has 3 ongoing projects in filing year (median 3.3)
- 1% increase in project duration associated with 1.44% increase in budget

Example: full sequence of tax benefit flows

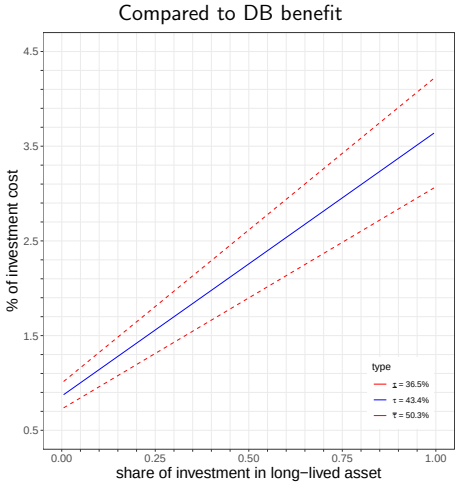
Main deck

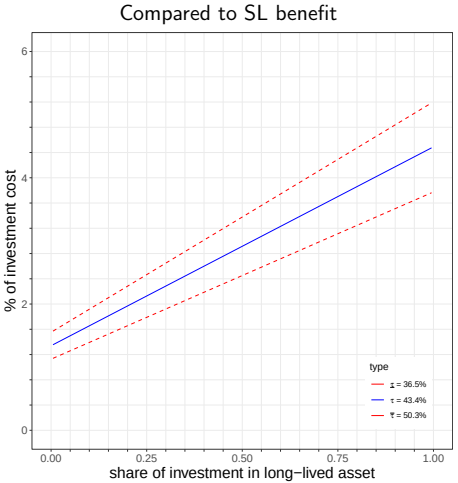


- Clear jump in immediate cash flows with bonus rates
- SL method strictly dominated by DB method
- DB method also shortens amortization schedule by 2 years

Simulation: bonus benefit grows linearly in LL asset share

Main deck





- Possible effective tax rates (including local): $\tau \in [36.5\%, 50.3\%]$

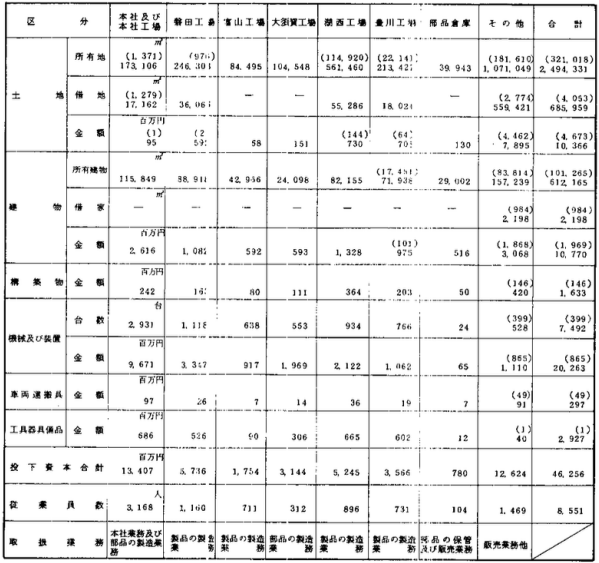
Details on plant-level data from filings

Main deck

- Form 10-K equivalent for Japan requires firms to itemize their facility locations and construction projects in progress
  - Prior to 1991 locations known up to municipality level
  - Typically includes (net) book values of land, buildings, structures, vehicles, employees, and rent/own status by facility site
  - More comprehensive than Schedule III for real estate firms and locations in U.S. 10-K filings
  - CIP tables include project purpose, start/projected end date, budgeted amount, current outlays, and financing method (internal financing vs. ST/LT bank debt)
- Using layout parser tool to fill in rest of the plant-level panel **[in progress]**

Example: Suzuki Motor 1980 facilities

Main deck



区分		本社及び本社工場	磐田工場	富山工場	大須賀工場	静西工場	豊川工場	部品倉庫	その他	合計
土地	所有地	㎡ (1,371) 173,106	(970) 246,301	84,495	104,548	(114,920) 561,460	(22,141) 213,427	39,943	(181,610) 1,071,049	(321,018) 2,494,331
	借地	㎡ (1,279) 17,162	36,064	—	—	55,286	18,024	—	(2,774) 559,421	(4,053) 685,959
	金額	百万円 (1) 95	(2 59	58	151	(144) 730	(64) 705	130	(4,462) 7,895	(4,673) 10,366
建物	所有建物	㎡ 115,849	88,911	42,936	24,098	82,155	(17,451) 71,938	29,002	(83,814) 157,239	(101,265) 612,165
	借家	㎡ —	—	—	—	—	—	—	(984) 2,198	(984) 2,198
	金額	百万円 2,616	1,082	592	593	1,328	(101) 975	516	(1,868) 3,068	(1,969) 10,770
構築物	金額	百万円 242	141	80	111	364	203	50	(146) 420	(146) 1,633
機械及び装置	台数	台 2,931	1,118	638	553	934	766	24	(399) 528	(399) 7,492
	金額	百万円 9,671	3,347	917	1,969	2,122	1,062	65	(865) 1,110	(865) 20,263
車両運搬具	金額	百万円 97	26	7	14	36	19	7	(49) 91	(49) 297
工具器具備品	金額	百万円 686	526	90	306	665	602	12	(1) 40	(1) 2,927
投下資本合計		百万円 13,407	5,716	1,754	3,144	5,245	3,566	780	12,624	46,256
従業員数		人 3,168	1,160	711	312	896	731	104	1,469	8,551
取扱業務		本社業務及び部品の製造業務	製品の製造業	製品の製造業	部品の製造業務	製品の製造業務	製品の製造業務	製品の保管及び販売業務	販売業務他	

- Columns are locations, rows are units/book values
- Parentheses indicate rented real estate areas
- Transcription/geocoding follows methods outlined in LaPoint (2021)
- We do not distinguish between owned vs. partially owned or rented locations (makes no difference for treatment status)

Example: Suzuki Motor 1980 facilities (transcribed)

Main deck

Location	Land		Buildings		Construction	Employees	Ownership	Usage
Hamamatsu (Shizuoka)	173,106 m^2	95,000	115,849 m^2	2,616,000	242,000	3,168	Partial	HQ/factory
Iwata (Shizuoka)	246,301 m^2	592,000	38,911 m^2	1,082,000	165,000	1,160	Partial	Factory
Kosai (Shizuoka)	561,460 m^2	730,000	82,155 m^2	1,328,000	364,000	896	Partial	Factory
Ōsuka (Shizuoka)	104,548 m^2	151,000	24,098 m^2	593,000	111,000	312	Full	Factory
Toyokawa (Aichi)	213,427 m^2	705,000	71,938 m^2	975,000	203,000	731	Partial	Factory
Oyabe (Toyama)	84,495 m^2	58,000	42,986 m^2	592,000	80,000	711	Full	Factory
Tokyo	1,071,049 m^2	7,895,000	157,239 m^2	3,068,000	420,000	1,469	Partial	Branch office/agency
Total	2,454,386 m^2	10,226,000	533,176 m^2	10,254,000	1,585,000	8,447		

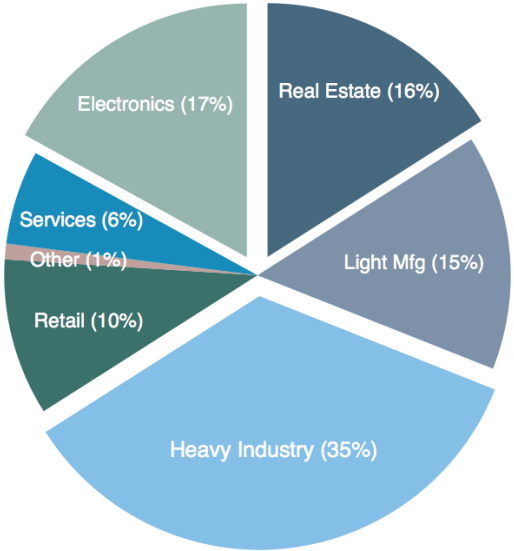
Sample restrictions & scaling variables

Main deck

- Standard sample restrictions
  - Firms must have non-missing total assets for at least 5 consecutive years spanning 1980-87 (covers pre/post first Technopolis start date)
  - Drop firms with fiscal year end dates in middle of year (May, June, July) or which change timing of reports within panel
  - Winsorize at median $\pm 5 \times IQR$, or at 2nd/98th pct. for mean zero variables
- Several methods to deal with skewness of outcomes
  1. Preferred method: scale monetary outcomes by total assets in year prior to sample start
     - ⋆ Addresses econometric critiques of running regressions with I_t/K_{t-1} (Welch 2020)
  2. Take logs: isolates the intensive margin response, but more of a pre-trend due to selection of firms who always invest/hire
  3. $\log(1+x)$ or $IHS(x)$ transform for spending variables

Sectoral composition of listed firms

Main deck



- Firms eligible for tax breaks under Technopolis mostly in the heavy industry and light mfg. categories
- Intelligent Location targets services + electronics + some light mfg.
- COM plant data covers the heavy industry + light mfg. + electronics sectors

Summary statistics for multi-plant firms

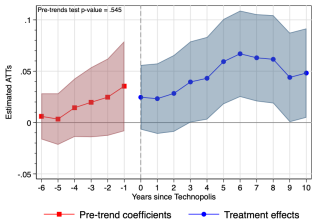
Main deck

	Full DBJ Sample				Matched DBJ-COM Sample			
	Mean	Median	10th pct.	90th pct.	Mean	Median	10th pct.	90th pct.
Construction in progress	0.02	0.01	0.00	0.11	0.03	0.01	0.00	0.11
Non-real estate assets	0.83	0.44	0.02	2.26	1.07	0.74	0.07	2.76
Real estate assets	0.64	0.33	0.07	1.91	0.72	0.47	0.11	1.74
PPE	1.61	0.93	0.17	4.18	1.90	1.37	0.28	4.31
CAPX	0.11	0.06	−0.02	0.57	0.09	0.06	−0.05	0.40
Employment	2,572	991	240	5,559	2,516	950	262	5,144
Long-term debt issues	0.01	0.00	−0.10	0.15	0.01	0.00	−0.14	0.19
Cash flow	0.03	0.01	−0.02	0.16	0.03	0.01	−0.04	0.16
EBITDA	0.22	0.13	0.02	0.57	0.24	0.16	0.00	0.64
OCF	0.31	0.18	0.03	1.15	0.30	0.20	0.03	0.82
Bonus depreciation	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
$\mathbb{1}\{bonus > 0\}$	**0.23**	0.00	0.00	1.00	**0.30**	0.00	0.00	1.00
# of firm-years			38,374				13,688	
# of 1980 plants			3,470				2,765	
# of firms			1,508				870	

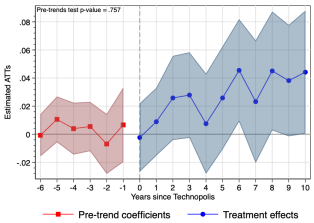
Comparing trajectories of cash flow measures

Main deck

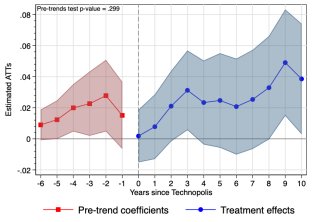
Bonus claim probability



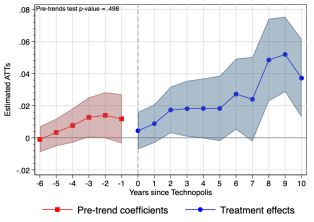
Operating cash flow



EBITDA



Cash flow



- Extensive margin bonus claim response again peaks around policy year 5
- Bonus claims included in OCF and cash flow but <u>not</u> EBITDA
- Effect on EBITDA coming from output of new investment
- Zwick & Mahon (2017): cash flow = net income before dep. after taxes paid

Main results imposing old geographic boundaries

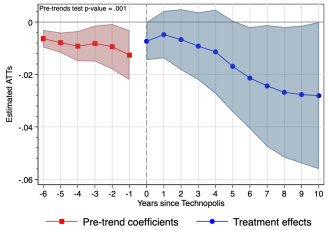
Main deck

- Upward trend in OCF after reform, but no clear spikes at kink points
- Nearly identical estimates for employment, new construction (0.3 s.d.), non-RE asset purchases (0.4 s.d.)
- Pre-trend diminishes, SEs ↑ when we impose 1980 municipal boundaries

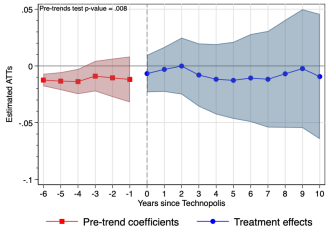
Limited response of other outcomes to bonus eligibility

Main deck

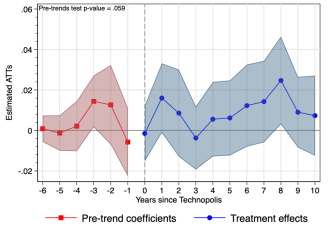
Land purchases



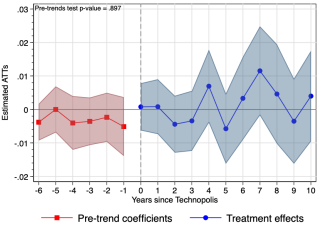
Net building purchases



Overall CAPX



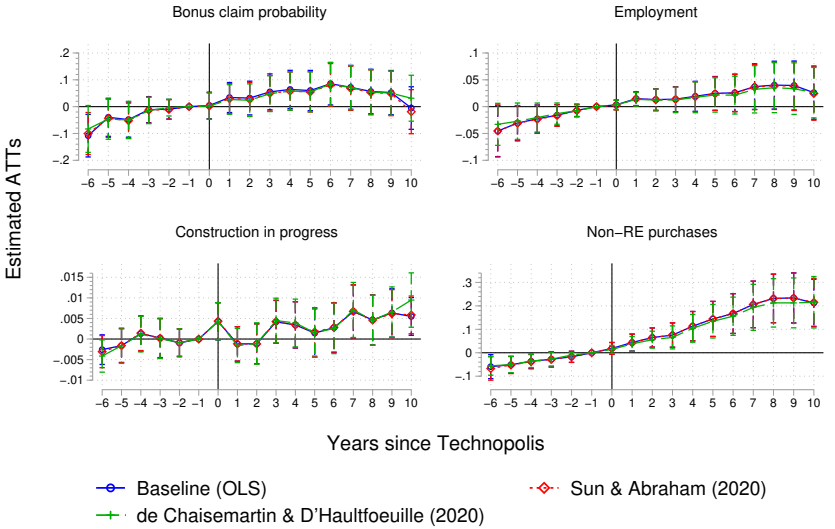
LT loan issues



- Substitution away from inv. in land (0.16 s.d.) $\longrightarrow$ doesn't depreciate!
- Muted bumps in overall CAPX due to decline in land purchases
- Spikes in loan issues around years 3 and 6 of program – subsidized credit from regional banks in Technopolis areas

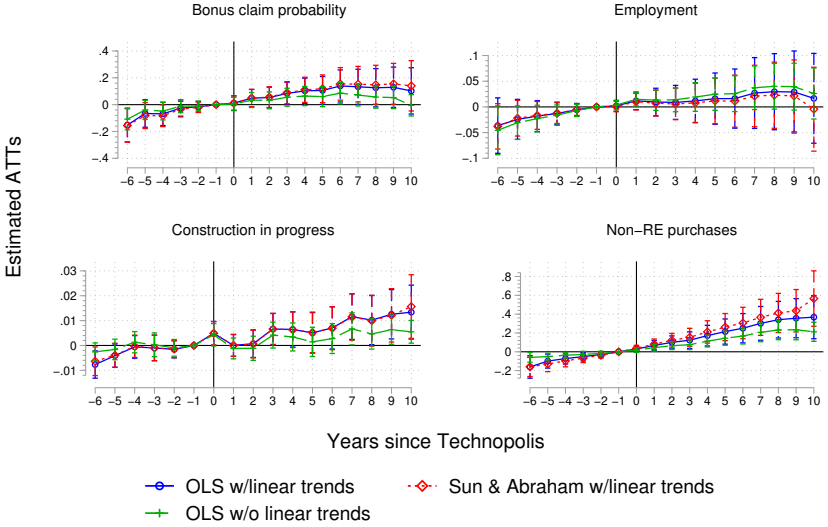
Similar results for other staggered DD estimators

Main deck



Similar results with linear firm time trends

Main deck



Intensive margin results using log outcomes

Main deck

$$y_{j,k,t} = \gamma_j + \delta_t + \beta \cdot Treatment_{j,k,t} + \eta' \cdot \mathbf{X}_{j,k,t} + \varepsilon_{j,k,t}$$

	Construction			Non-RE purchases			Employment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment	0.166**	0.111*	0.221***	0.184***	0.145***	0.189***	0.070**	0.035	0.074**
	(0.072)	(0.067)	(0.077)	(0.046)	(0.039)	(0.046)	(0.030)	(0.028)	(0.032)
Estimator	OLS	*BJS*	*BJS*	OLS	*BJS*	*BJS*	OLS	*BJS*	*BJS*
Firm FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓
Financial controls		✓			✓			✓	
Controls × year FEs			✓			✓			✓
N	26,996	24,408	26,985	36,396	32,829	36,383	38,340	34,578	38,326
# Firms	1,416	1,318	1,415	1,499	1,399	1,498	1,508	1,408	1,507
Adj. R^2	0.702	0.723	0.702	0.948	0.957	0.949	0.954	0.964	0.955

Notes: Sample time period: 1975 – 2000. Financial controls include OCF, EBITDA, and the Q ratio. We include a one-year lead to account for potential anticipation effects from the announcement of Technopolis sites. Controls × year FEs includes size/age quintiles and Census region of the corporate HQ.

- Govt. tried to amplify initial policy via bonuses to upstream, high-tech services firms
- Consider the multiple treatment regression:

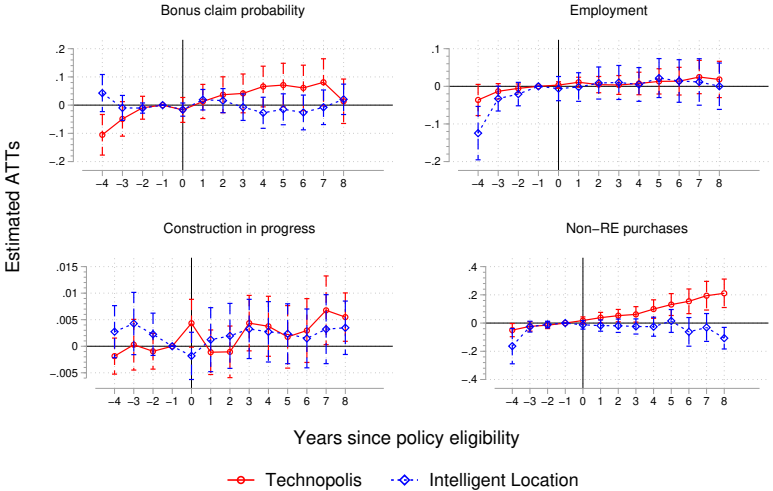
$$y_{j,k,t} = \gamma_j + \delta_t + \beta_1 \cdot Treatment^{T}_{j,k,t} + \beta_2 \cdot Treatment^{IL}_{j,k,t} + \varepsilon_{j,k,t} \tag{6}$$

- Difficult to interpret due to cross-contamination of treatment and control groups
- de Chaisemartin & D'Haultfœuille (2021) propose an estimator to isolate the second policy which restricts to obs. with $Treatment^{T}_{j,k,t} = 1$

$$y_{j,k,t} = \gamma_j + \delta_t + \sum_{t=1, t \neq t_0}^{T} \beta_{2,t} \cdot Treatment^{IL}_{j,k,t} + F^{T}_{j,t} + \varepsilon_{j,k,t} \tag{7}$$

- $F^{T}_{j,t}$ non-parametric trends w.r.t. first year where firm j obtains Technopolis eligibility

Multiple treatment by OLS $\Longrightarrow$ effect driven by 1st policy

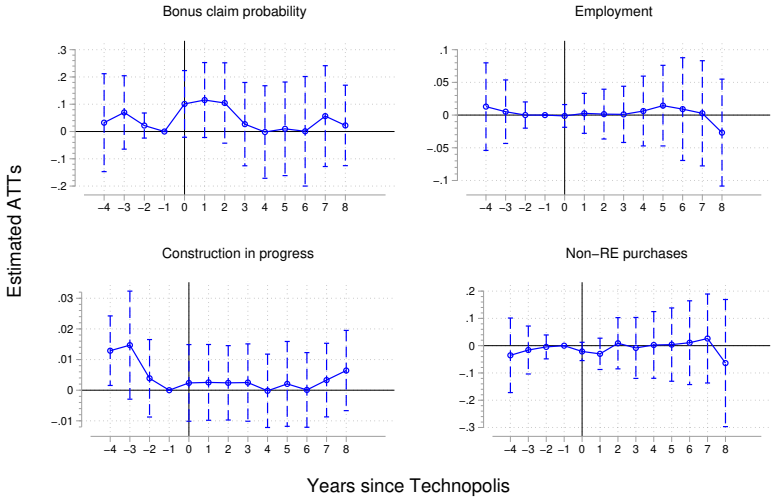


- Controlling for IL policy exposure results in little change in the dynamic effects of Technopolis
- Some evidence of spillover effects on employment

Main deck

No effects of layered bonuses to local upstream firms

Main deck



- Suggests poor targeting: high-tech services firms rely more on intangible capital
- Caveat: we lose power by restricting to firm-year obs. with $Treatment^{T}_{j,k,t} = 1$

Pooled OLS estimates of multiple treatment regression

Main deck

$$y_{j,k,t} = \gamma_j + \delta_t + \beta_1 \cdot Treatment^{T}_{j,k,t} + \beta_2 \cdot Treatment^{IL}_{j,k,t} + \varepsilon_{j,k,t}$$

	Bonus claim		Construction		Non-RE purchases		Employment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treatment^{T}$	0.093***	0.087***	0.163**	0.167**	0.172***	0.165***	0.060*	0.062**
	(0.028)	(0.028)	(0.072)	(0.072)	(0.046)	(0.047)	(0.031)	(0.030)
$Treatment^{IL}$	−0.023	−0.018	0.044	0.042	0.143**	0.138**	0.125***	0.119***
	(0.024)	(0.023)	(0.108)	(0.109)	(0.059)	(0.059)	(0.039)	(0.039)
Firm FEs	✓	✓	✓	✓	✓	✓	✓	✓
Controls × year FEs		✓		✓		✓		✓
N	38,374	38,360	26,996	26,985	36,396	36,383	38,340	38,326
# Firms	1,508	1,507	1,416	1,415	1,499	1,498	1,508	1,507
Adj. R^2	0.535	0.551	0.702	0.702	0.948	0.949	0.954	0.956

Notes: Sample time period: 1975 – 2000. We include a one-year lead to account for potential anticipation effects from the announcement of Technopolis sites. Controls × year FEs includes size/age quintiles and Census region of the corporate HQ.

Details: computing corporate distance to policy regions

Main deck

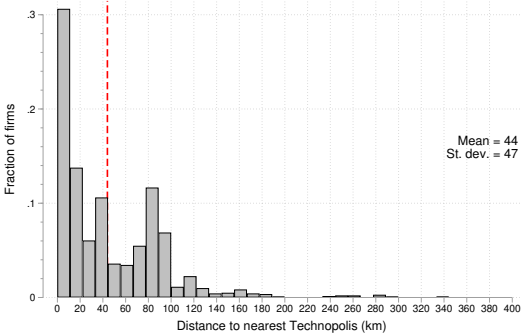
- Extend baseline DD to include triple interaction with distance measure:

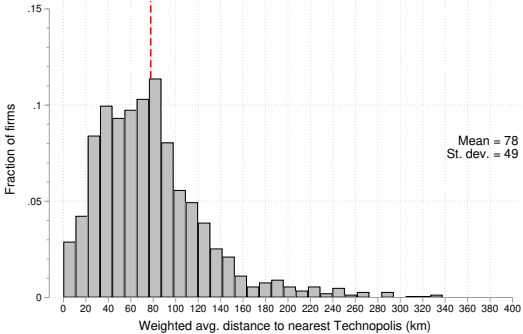
$$y_{j,k,t} = \gamma_j + \delta_t + Distance_j \times Post_t + Treated_k \times Post_t \tag{8}$$
$$+ Distance_j \times Treated_k \times Post_t + \eta' \cdot \mathbf{X_{j,k,t}} + \varepsilon_{j,k,t}$$

- Since we are looking at extensive margin of policy take-up, $Post_t$ does not vary at the firm j level (unstaggered)
- Same results if define $Post_{j,t}$ based on activation of nearest Technopolis (staggered)
- $Distance_j$ is a function of all pairwise truck driving distances between a plant location within j and a Technopolis area

Comparing transport distance measures

Main deck





- 43% of firms already operate within a Technopolis border
- Typical corporate plant is 100 km from nearest Technopolis
- Alternatives: driving time or Haversine distance, employment-weighted averages

Structural approach to recover capital input shares

Main deck

- Firms benefit more from bonuses if assets they use have longer depreciation lives
  - Example with tax breaks from investing in computers vs. real estate
- We compute the production input shares and focus on firms which rely on buildings
  - Six categories in our data: buildings, land, machines, structures, tools, vehicles
  - Depreciation lives vary by asset use but are much longer (up to 65 years) for buildings
- Approach is based on Q-theory and relies on two assumptions:
  1. Profit function is homogeneous of degree one in k_i inputs
  2. Cobb-Douglas capital aggregator for firm j:

$$f(K_j) = \prod_{i=1}^{6} k_i^{\omega_{i,j}} \quad \text{s.t.} \sum_{i=1}^{6} \omega_{i,j} = 1, \forall j$$

- **Basic idea: aggregate capital stock can be recovered as function of user costs of inputs $c_{i,t}$ and real inputs $k_{i,t}$ themselves**

- For CRS capital aggregate and profit-maximizing firms:

$$\frac{\partial f(K_t)/\partial k_{i,t}}{\partial f(K_t)/\partial k_{j,t}} = \frac{\omega_{i,t} \cdot k_{j,t}}{\omega_{j,t} \cdot k_{i,t}} = \frac{c_{i,t}}{c_{j,t}}$$

$$c_{i,t} = \left[1 - (1 - \delta_i) \cdot \mathbb{E}_t\left(\beta^R_{i,t,t+1}\right)\right] \cdot \frac{(1 - z_{i,t}) \cdot Pk_{i,t}}{(1 - \tau_t) \cdot P_t}$$

- User costs depend on depreciation rates δ_i, the discount rate β^R (WACC), PDV of claimed tax breaks $z_{i,t}$ and tax rates τ_t

- Impose Cobb-Douglas production and then solve for the ω_i shares for each firm

Nearest neighbor imputation for input shares

Main deck

- Problem: approach requires many balance sheet items to be non-missing in all years
  - Real capital inputs $k_{i,t}$ come from iterating on investment law of motion:

$$Pk_{i,t} \cdot k_{i,t+1} = (1 - \delta_i) \cdot Pk_{i,t}k_{i,t} + NOMI_{i,t}$$

- For roughly half of the sample we cannot fill in the index $f(K_t)$ due to missing variables (i.e. local tax bills), so nearest-neighbor match using logit model
  - Covariates: dummies for eight broad industrial sectors, total assets, and a quadratic in age
  - Take fitted prob. of having non-missing ω_i as propensity score and then match each firm to nearest (squared difference) donor firm

- Similar results if we apply a corporate tax calculator to directly impute τ_t, $z_{i,t}$ based on national + local tax code provisions

Propensity score model estimates for missing input shares

Main deck

	(1)	(2)	(3)	(4)	(5)
Assets	0.080	0.079	0.073	0.057	0.179
	(0.190)	(0.193)	(0.193)	(0.212)	(0.214)
Age	0.001	0.001	0.002	0.010	0.011
	(0.014)	(0.014)	(0.014)	(0.016)	(0.016)
Age^2	0.000	0.000	0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mfg dummy	0.499***	0.501***	0.478***	0.324**	0.318**
	(0.122)	(0.134)	(0.134)	(0.141)	(0.143)
Services dummy		0.045	0.027	−0.489	−0.677*
		(0.295)	(0.296)	(0.382)	(0.369)
Retail dummy		−0.016	−0.058	0.317	0.078
		(0.224)	(0.225)	(0.244)	(0.254)
DB method dummy			0.669**	0.487	0.326
			(0.289)	(0.318)	(0.325)
Tobin's Q				−0.176	−0.258**
				(0.117)	(0.124)
EBITDA				7.659***	8.807***
				(1.626)	(1.737)
RE/PPE ratio					0.762***
					(0.246)
HQ prefecture FEs	✓	✓	✓	✓	✓
N	1,477	1,477	1,473	1,376	1,376
Pseudo-R^2	0.026	0.026	0.030	0.073	0.078

Notes: Assets measured as average pre-Technopolis total assets in millions of yen. Age measured from the TSE listing date. DB method dummy is equal to unity if the firm uses declining balance depreciation accounting methods.

- Collect donor firms j for which we can estimate all ω_i and set $T_j = 1$ for them to estimate logit:

$$P\Big(T_j = 1|X_j\Big) = \frac{\exp\Big(h(X_j\Big)}{1 + \exp\Big(h(X_j)\Big)}$$

- Higher-income mfg. firms more likely to have non-missing input shares
- But no clear relationship between size/age and balance sheet completeness

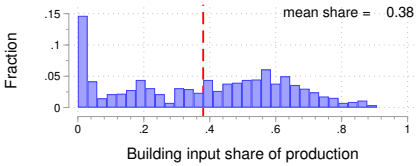
Phys. capital input shares by type + sector

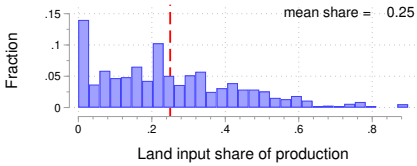
Main deck

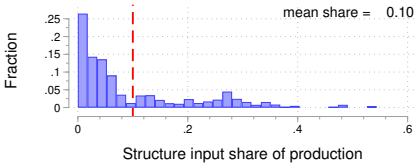
	N	ω_{build}	$\omega_{machine}$	ω_{land}	$\omega_{structure}$	ω_{tools}	$\omega_{vehicle}$
Light manufacturing	211	0.357	0.212	0.273	0.110	0.037	0.009
		(0.247)	(0.222)	(0.205)	(0.115)	(0.067)	(0.020)
Heavy manufacturing	492	0.399	0.199	0.249	0.094	0.037	0.020
		(0.262)	(0.229)	(0.197)	(0.105)	(0.069)	(0.102)
Real estate	28	0.346	0.254	0.231	0.116	0.040	0.009
		(0.284)	(0.265)	(0.186)	(0.127)	(0.067)	(0.015)
Construction	106	0.332	0.202	0.240	0.124	0.065	0.036
		(0.277)	(0.236)	(0.191)	(0.134)	(0.149)	(0.138)
Transportation	81	0.301	0.204	0.299	0.103	0.036	0.053
		(0.248)	(0.250)	(0.260)	(0.109)	(0.065)	(0.170)
Electronics	245	0.434	0.156	0.277	0.079	0.042	0.011
		(0.235)	(0.186)	(0.185)	(0.092)	(0.064)	(0.048)
Non-transportation services	79	0.379	0.181	0.262	0.127	0.038	0.009
		(0.272)	(0.194)	(0.272)	(0.131)	(0.092)	(0.015)
Tradables	125	0.326	0.198	0.295	0.107	0.042	0.030
		(0.249)	(0.258)	(0.215)	(0.123)	(0.072)	(0.128)
Agriculture	9	0.500	0.099	0.290	0.059	0.036	0.012
		(0.346)	(0.075)	(0.327)	(0.074)	(0.078)	(0.024)
Overall	1,376	0.380	0.193	0.265	0.100	0.041	0.020
		(0.259)	(0.224)	(0.203)	(0.111)	(0.079)	(0.095)

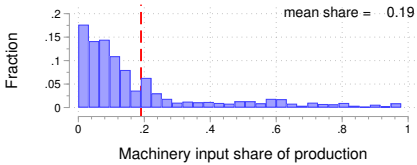
Main deck

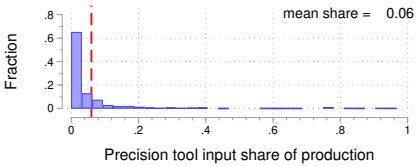
Distribution of physical capital input shares

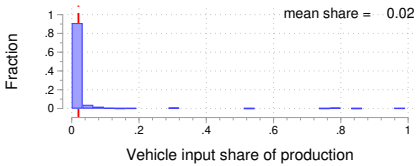












Pooled OLS results by long-lived asset share

Main deck

$$y_{j,t} = \gamma_j + \delta_t + \beta_1 \cdot Treatment_{j,t} \times LL - Firm_j + \beta_2 \cdot Treatment_{j,t} \times SL - Firm_j + \eta' \cdot \mathbf{X}_{j,t} + \varepsilon_{j,t}$$

	Bonus claim		Construction		Non-RE purchases		Employment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treatment \times LL - Firm$	0.096***	0.089***	0.166**	0.170**	0.180***	0.171***	0.077**	0.076**
	(0.029)	(0.028)	(0.074)	(0.074)	(0.048)	(0.049)	(0.031)	(0.031)
$Treatment \times SL - Firm$	−0.011	0.028	0.169	0.160	0.245**	0.265***	−0.037	−0.004
	(0.104)	(0.109)	(0.261)	(0.273)	(0.097)	(0.094)	(0.111)	(0.106)
p-value on difference	0.319	0.586	0.991	0.971	0.542	0.367	0.323	0.465
Firm FEs	✓	✓	✓	✓	✓	✓	✓	✓
Controls × year FEs		✓		✓		✓		✓
N	38,374	38,360	26,996	26,985	36,396	36,383	38,340	38,326
# Firms	1,508	1,507	1,416	1,415	1,499	1,498	1,508	1,507
Adj. R^2	0.535	0.551	0.702	0.702	0.948	0.949	0.954	0.955

Notes: Sample time period: 1975 – 2000. We include a one-year lead to account for potential anticipation effects from the announcement of Technopolis sites. Controls × year FEs includes size/age quintiles and Census region of the corporate HQ. We use the pre-Technopolis share of buildings in the firm's constant returns to scale production function as the basis for classifying firms as using primarily long-lived or short-lived assets.

No pos. spillovers to untreated firms in treated areas

Main deck

$$y_{j,c,k,t} = \gamma_j + \delta_t + \beta_1 \cdot Treatment_{j,k,t} + \beta_2 \cdot TreatedCity_{j,c,t} + \eta' \cdot \mathbf{X}_{j,k,t} + \varepsilon_{j,c,k,t} \quad (9)$$

	Bonus claim		Construction		Non-RE purchases		Employment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treatment$	0.100^{***}	0.084^{***}	0.139^{*}	0.145^{*}	0.151^{***}	0.136^{***}	0.080^{**}	0.076^{**}
	(0.028)	(0.028)	(0.074)	(0.074)	(0.047)	(0.047)	(0.031)	(0.030)
$TreatedCity$	0.029	-0.004	-0.087	-0.083	-0.105^{***}	-0.129^{***}	0.029	0.014
	(0.016)	(0.017)	(0.065)	(0.068)	(0.033)	(0.036)	(0.021)	(0.022)
Firm FEs	✓	✓	✓	✓	✓	✓	✓	✓
Controls × year FEs		✓		✓		✓		✓
N	38,374	38,360	26,996	26,985	36,396	36,383	38,340	38,326
# Firms	1,508	1,507	1,416	1,415	1,499	1,498	1,508	1,507
Adj. R^2	0.535	0.551	0.702	0.702	0.948	0.949	0.954	0.955

Notes: Sample time period: 1975 – 2000. We include a one-year lead to account for potential anticipation effects from the announcement of Technopolis sites. Controls × year FEs includes size/age quintiles and Census region of the corporate HQ.

- Some evidence of cannibalization on the non-RE CAPX margin (pre-trend)

- Consider augmented regression which captures sectoral exposure to trade flows:

$$y_{j,k,t} = \gamma_j + \delta_t + \beta_1 \cdot Treatment_{j,k,t} + \beta_2 \cdot TradeExposure_{j,k,t} + \varepsilon_{j,k,t} \tag{10}$$

$$TradeExposure_{j,k,t} = \sum_{p \in \mathcal{J}} \omega^{j}_{p,1980} \cdot TradeExposure^{k}_{p,t} \quad \text{for } \mathcal{J} = \{j_1, j_2, \ldots, j_n\}$$

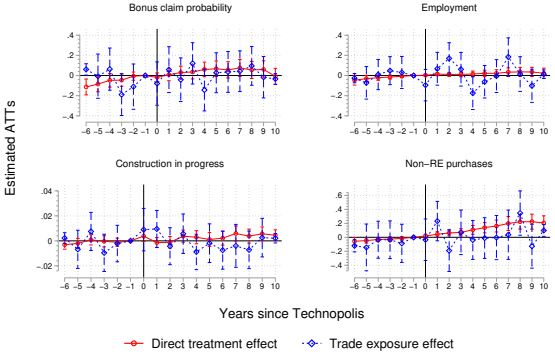
where $\omega^{j}_{p,1980} = \dfrac{PPE^{j}_{p,1980}}{\sum_{p \in \mathcal{J}} PPE^{j}_{p,1980}}$ (each location's net PPE share)

and $\text{TradeExposure}^{k}_{p,t} = \underbrace{\sum_{q \neq p} \frac{Imports^{k}_{p,q}}{TotalImports^{k}_{p}} \times Treatment_{q,t}}_{\text{supply}} + \underbrace{\sum_{q \neq p} \frac{Exports^{k}_{p,q}}{TotalExports^{k}_{p}} \times Treatment_{q,t}}_{\text{demand}}$

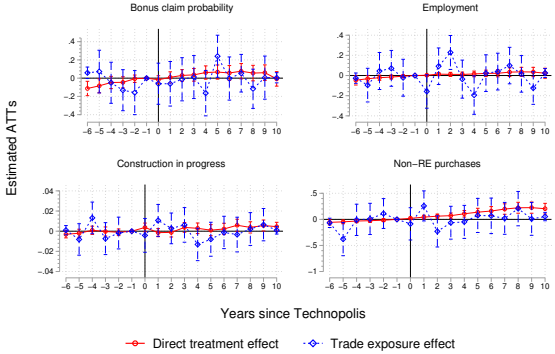
No trade exposure through demand or supply

Main deck

Import exposure (supply)



Export exposure (demand)



Null results for hiring/firing in the HQ city

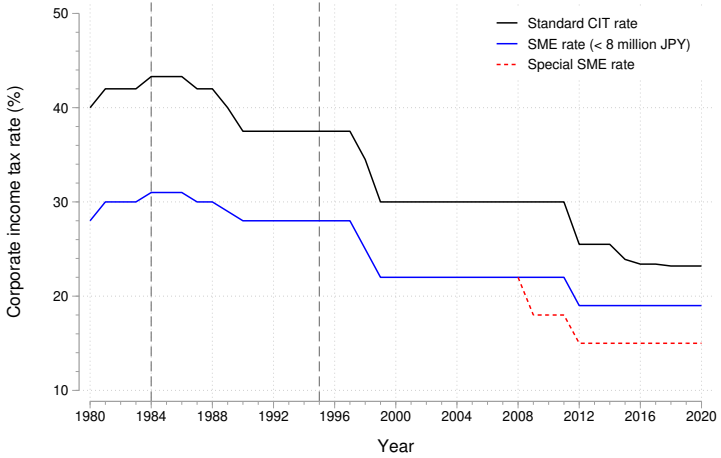
Main deck

	Hiring $\mathbb{1}\{\Delta L^{HQ} > 0\}$				Firing $\mathbb{1}\{\Delta L^{HQ} < 0\}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treatment$	−0.019	−0.040	−0.033	−0.032	0.025	0.044	0.028	0.027
	(0.039)	(0.040)	(0.039)	(0.042)	(0.049)	(0.050)	(0.050)	(0.054)
$Takeup$	0.050	0.052	0.017	−0.032	−0.009	−0.011	−0.042	−0.010
	(0.042)	(0.042)	(0.044)	(0.045)	(0.050)	(0.050)	(0.054)	(0.059)
$Treatment \times Takeup$	0.043	0.035	0.041	0.079	−0.021	−0.016	0.007	0.008
	(0.063)	(0.062)	(0.062)	(0.065)	(0.075)	(0.075)	(0.076)	(0.082)
1-digit sector FEs		✓	✓	✓		✓	✓	✓
Size & age bins			✓	✓			✓	✓
Financial controls			✓	✓			✓	✓
Exclude if $\omega_{build} = 0$				✓				✓
# Firms	740	740	729	627	740	740	729	627
Adj. R^2	0.003	0.010	0.056	0.053	−0.003	−0.001	0.026	0.020

- Suggests labor reallocation is not from mfg. plants to office/administrative workforce

Historical corporate income tax rates

Main deck



- National corporate income tax rates (CIT) are flat
- SME rate applies for firms with annual earnings $<$ 8 million JPY ($\approx$ 80k USD)
- Rates were relatively high during our sample period, and increasing right before spatial bonus policies

Calculating qualifying CAPX and jobs numbers

Main deck

- **Qualifying CAPX:** scale down total CAPX by share of eligible investment among manufacturing firms' plants:

$$\frac{\sum_{t=0}^{T}\sum_{i}\Delta PPE_{i,t}\times Treatment_{i,k,t}}{\sum_{t=0}^{T}\sum_{i}\Delta PPE_{i,t}}$$

  - $Treatment_{i,k,t}$: industry eligibility of plant i
  - $\Delta PPE_{i,t}$: YOY change in net book value of non-land physical assets, plus accounting depreciation (i.e. investment in non-land assets)
  - $\Longrightarrow$ 6.6% eligibility rate, or $93.65 billion in corporate CAPX

- **Jobs created:** avg. employment during the pre-reform period $\times$ $(1+\widehat{\beta}^{emp})$
  - $\Longrightarrow$ between 68,342 $[\widehat{\beta}^{emp}=5\%]$ and 96,650 $[\widehat{\beta}^{emp}=7\%]$ new corporate jobs

1. Feed in observed corporate cash flows
   - Version A (baseline): compare D_t^{total}/I_t of bonus claiming to non-claiming firms
   - Version B: compute $\overline{D_t^{gap}/I_t} - D_{pre}^{gap}/I_{pre}$ accruing only to the eligible firms [1st differences]
   - Version C: $\left(\overline{D_t^{gap}/I_t} - D_{pre}^{gap}/I_{pre}|\text{ eligible}\right) - \left(\overline{D_t^{gap}/I_t} - D_{pre}^{gap}/I_{pre}|\text{ ineligible}\right)$ [diff-in-diff]
   - **Version D: residualized diff-in-diff** where feed in $\widehat{\beta}_t$ from regression:

$$D_{j,k,t}^{gap}/I_{j,k,t} = \gamma_j + \sum_{t=1975}^{1995} \left(\beta_t \cdot Treated_{j,k,t} \times Post_t + \textbf{Controls} \times \delta_t\right) + \varepsilon_{j,k,t}$$

2. Simulate expected benefits for firms based on capital stock composition
3. Apply expected benefits to CAPX of all eligible firms from public-use files of mfg. Census

Sensitivity analysis of cost-per-job estimates

Main deck

	A: Baseline	B: 1st diff in means	C: DD in means	**D: Residualized DD**
$r = 5\%;\ \widehat{\beta}^{emp} = 5\%$	\$55,430 [3.69%]	\$52,672 [3.50%]	\$37,011 [2.46%]	\$26,659 [1.77%]
$r = 7\%;\ \widehat{\beta}^{emp} = 5\%$	\$43,556 [2.90%]	\$45,439 [3.02%]	\$30,525 [2.03%]	\$22,222 [1.48%]
$r = 5\%;\ \widehat{\beta}^{emp} = 7\%$	\$39,135 [3.69%]	\$33,931 [3.50%]	\$21,584 [2.46%]	\$16,781 [1.77%]
$r = 7\%;\ \widehat{\beta}^{emp} = 7\%$	\$30,799 [2.90%]	\$32,130 [3.02%]	\$18,818 [2.03%]	**\$15,714** **[1.48%]**

Notes: The table shows cost-per-job estimates (real 2010 USD) for different parameter estimates using the accounting identity for lost cash flows from offering bonus depreciation. Brackets indicate the fiscal cost as a percentage of a dollar of capital investment that qualifies for bonuses. In each method we compute the denominator of D_t / I_t using the YOY change in the net book value of PPE excluding land, plus accounting depreciation.

- Simulation-based measures also result in fiscal cost of $\approx$ 2-3% once we take into account capital input shares ω_i

Technopolis increased compensation, profits, and tax base

Main deck

	Wage bill	Corporate profits	Taxable income
$Treatment$	0.061^{**}	0.025^{***}	0.124^{*}
	(0.028)	(0.008)	(0.070)
Firm FEs	✓	✓	✓
Controls × year FEs	✓	✓	✓
N	27,567	28,941	27,462
# Firms	1,374	1,406	1,506
Adj. R^2	0.952	0.613	0.585

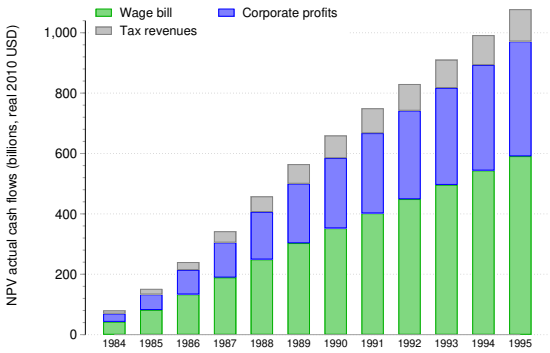
Notes: The wage bill is the log of the sum of wage and non-wage compensation which includes employer retirement contributions and pensions. Corporate profits is net income before depreciation after taxes, deflated by its firm value at beginning of the panel. Taxable income is the sum total of all gains less allowable losses, left-censored at zero and transformed using the IHS function to accommodate firm-years with no taxable income.

- Tax base **grows** (big CIs) as many firms transition from years of negative taxable income

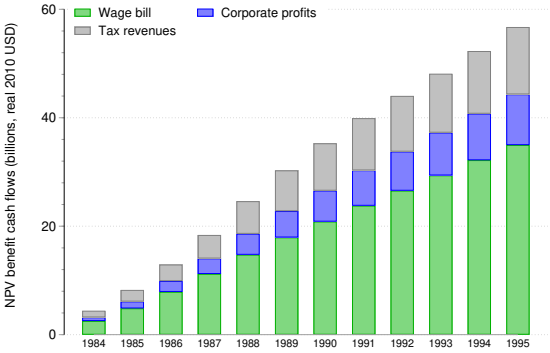
NPV cash flows over the Technopolis regime

Main deck

Actual cash flows



Benefits = actual − counterfactual



- After-tax corporate profits grow dramatically in early policy years, but only account for ≈ 15% of overall welfare gain