The Local Effects of Industrial Complexes

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Abstract

We examine the local effects of South Koreas large-scale place-based industrial policy of constructing industrial complexes in left-behind regions. We compile a novel dataset on industrial complex designations dating back to the 1960s and link it to administrative establishment surveys. Using a stacked difference-in-differences design, we estimate the causal effects of industrial complex designation on local economic outcomes. We find that industrial complex designation increases aggregate local employment by approximately 15 percent ten years after designation and raises manufacturing output by roughly 40 percent. Employment growth occurs not only in the subsidized manufacturing sector but also in the services and construction sectors, which are not directly targeted by the policy. We find that each additional job in an industrial complex generates 1.3 to 1.9 jobs in the local economy, including itself. These additional jobs are created entirely in the services and construction sectors. In contrast, all manufacturing employment gains are attributable to activity within the industrial complexes, with nearly three quarters arising from the expansion of establishments that existed prior to the construction of the complex. We find no evidence that industrial complexes increase manufacturing establishments productivity, as measured by output or value added per worker. However, we document increases in investment, as measured by tangible assets, consistent with the policy primarily alleviating capital constraints rather than raising productivity.

Keywords: place-based policy, industrial policy, migration, South Korea, Korea

JEL Codes: R11, R58, L52, J23

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1 Introduction

Over the past four decades, regional disparities within countries have widened in the U.S., Europe, and elsewhere (e.g., Austin et al., 2018; v. Ehrlich and Overman, 2020). In response, policymakers have increasingly turned to place-based policies. In the U.S., federal and state governments jointly spend USD 60 billion annually on place-based policies (Bartik, 2020). Similarly, between 2014 and 2023, the European Union allocated nearly EUR 90 billion annually to left-behind regions via *European Structural and Investment Funds* (European Commission, 2023).

Place-based policies, however, remain controversial among economists. Critics argue that, in a spatial equilibrium, subsidies to lagging regions should be fully offset by higher prices of non-tradable goods mostly benefiting landowners (Glaeser and Gottlieb, 2008). Empirical evidence appears to confirm this prediction, at least partially, with many policies such as economic zones having at best small effects on local employment (e.g., Freedman and Neumark, 2025).[1] Simultaneously, there is strong evidence that the assumptions underlying spatial equilibria are unrealistic, such as the absence of migration frictions (e.g., Ahlfeldt et al., 2024), raising the question of whether the lack of effects are the result of policy design or wider economic forces.

We evaluate South Koreas long-standing policy of constructing industrial complexes to promote manufacturing and to revitalize regions outside the economic center of Korea, Seoul.[2] This policy differs meaningfully in both scale, as sites may employ tens of thousands of workers, and focus, with each site targeting narrow sectors, from place-based policies in other high-income countries. We find that industrial complex designations raise total local employment by roughly 15% and aggregate manufacturing output by 40% after ten years. While manufacturing, i.e., the policy target, sees employment grow, employment in the service and construction sectors, two sectors that do not receive subsidies, also grows. Each additional job in industrial complexes is associated with 0.3 to 0.9 additional local jobs. The additional jobs are created nearly entirely in the service and

[1] A growing literature has shown that, even if there are local gains, e.g., due to migration frictions, they may simply reflect the relocation of firms from more to less productive regions, without improving aggregate outcomes (e.g., Kline and Moretti, 2014b). Justifications on grounds of economic efficiency include cases where congestion costs reduce the efficiency of large cities, where cross-skill externalities support greater occupational mixing, or where the marginal benefit of additional employment is higher in subsidized regions (for detailed discussions on the welfare arguments for and against place-based policies, see Austin et al., 2018; Fajgelbaum and Gaubert, 2025). However, we explicitly focus on the local effects of this place-based policy.

[2] Henceforth, we refer to South Korea as Korea.

construction sector, suggesting that observed gains in manufacturing employment are driven by the industrial complexes themselves.

Initially introduced in the 1960s as part of a state-led national growth strategy to concentrate scarce resources, industrial complexes evolved into explicit instruments of regional development by the 1980s. By 2019, more than 1,200 sites had been developed, accounting for roughly two-thirds of Koreas manufacturing output and exports, about half of manufacturing employment, and nearly one-tenth of total national employment (Korea Research Institute for Human Settlements, 2020). In contrast to place-based policies in high-income countries (e.g., Enterprise and Opportunity Zones in the U.S.), Koreas policy develops complexes tailored to narrow manufacturing industries, ranging from heavy and chemical manufacturing to semiconductors, and complements them with sustained investments in infrastructure and business support services.

We compile a novel dataset on industrial complexes designated since the policys inception in 1962 using public listings and link it to administrative establishment surveys that report location, employment, and industry affiliation for the universe of establishments, as well as detailed balance-sheet and production information for manufacturing establishments, including sales, output, value added, wage bill, tangible assets, inventory, and production costs. To examine the policys effects on local economies, we aggregate the establishment-level data to administrative districts comparable to townships and neighborhoods.

Since Korea's government targets lagging regions, districts in which industrial complexes are built differ systematically from untreated regions, in that they are poorer, less urbanized, and less industrialized. Moreover, industrial complexes have been designated continuously since the 1960s. To identify the causal effect of constructing industrial complexes in this context, we implement a stacked difference-in-differences design (Wing et al., 2024), in which never- and not-yet-treated regions serve as controls for treated regions, preventing potential biases arising from staggered treatment timing (as discussed by, e.g., Goodman-Bacon, 2021). To address concerns from, we allow for differential trends based on a range of pretreatment characteristics capturing urbanization, industrialization and recent economic development.

We have four key findings. First, overall employment in districts surrounding industrial complexes increases by 15% ten years after designation. The gains are concentrated in manufacturing, the subsidized sector, as well as services and construction, two sectors not receiving any direct subsidies through the policy. Employment gains in manufacturing, services, and construction are nearly 30%, although, in the case of construction, the gains manifest only after four years. Manufacturing gross value added and output increase by 40% over the same time period. The gains are exclusively driven by small establishments.

Second, we find that the extensive margin, that is, new establishments entering the local market, accounts for three-quarters of the overall employment increase. This masks substantial heterogeneity across sectors; whereas we can attribute all employment growth in services to new establishments entering local markets, two-thirds of the rise in manufacturing employment is due to incumbent establishments expanding, i.e., establishments that were operating before the industrial complex was designated.

Third, we find no effect on the local average productivity of incumbent establishments, or any establishments for that matter, as measured by output per worker. Instead, investment at small incumbent establishments increases, especially driven by a growth in value of buildings and structures. These results are broadly in line with Criscuolo et al. (2019), who study place-based investment subsidies in the United Kingdom and argue that they affect local employment by alleviating capital constraints faced by small firms.

Finally, despite the large overall effects, we estimate modest job multipliers for industrial complexes ranging from 1.3 to 1.9. That is, each job at industrial complexes adds, on average, 0.3 to 0.9 additional jobs to the local economy. One explanation for our modest job multipliers is the muted effect on manufacturing: each manufacturing job at an industrial complex adds slightly less than one job in the receiving district and none in neighboring districts. Thus, all gains in manufacturing are caused by the industrial complexes themselves and a fraction would have existed in the absence of the complex designation. Nearly all additional jobs are created in the service sector, and to a lesser extent in the construction sector.

We contribute to a large literature evaluating place-based policies.[3] One strand of this literature

[3]For a comprehensive review, see Neumark and Simpson (2015). For discussions of place-based policies in the United States, Europe, and developing countries, see Freedman and Neumark (2025), v. Ehrlich and Overman (2020),

examines non-discretionary policies, e.g., the U.S.'s Enterprise Zones offering employment tax credits in designated census blocks, (e.g., Ham et al., 2011; Gobillon et al., 2012; Busso et al., 2013; Charnoz, 2018; Ehrlich and Seidel, 2018; Neumark and Young, 2019; Freedman et al., 2023) and discretionary subsidies such as the UK's Regional Selective Assistance offering investment subsidies (Criscuolo et al., 2019; Grunau et al., 2025). Non-discretionary subsidies appear to have negligible effects (e.g., Neumark and Young, 2019) or, if they do, these seem to be the result of firm relocations (e.g., Ehrlich and Seidel, 2018). In contrast, discretionary investment subsidies and business services support appear successful at increasing firms capital investment and employment although without creating any substantial spillovers (e.g., Criscuolo et al., 2019). A second line of work studies large-scale infrastructure projects such as the Tennessee Valley Authority (Glaeser and Gottlieb, 2008; Kline and Moretti, 2014a). However, our work is closest to studies examining special economic zones emerging economies such as China and India (e.g., Koster et al., 2019; Gallé et al., 2024; Heblich et al., 2022).

Compared to this literature, we study a uniquely large-scale and long-running place-based policy allowing us to make three contributions. Our analysis covers hundreds of distinct treated locations far exceeding other studies' scope ranging from one to, at best, a few dozen locations (e.g., Greenstone et al., 2010; Busso et al., 2013). Our context also permits us to estimate long-run treatment effects over a decade after complexes have been designated. Using detailed annual census data on manufacturing firms, we estimate establishment-level productivity effects and spillovers on incumbent unsubsidized establishments. Together, these features allow us to speak directly to whether place-based policies generate new economic activity or simply redistribute it across space.

We also contribute to the broader literature on local job multipliers, which studies how the creation of new jobs in a given sector affects local employment in other, often non-tradable, industries (Moretti, 2010; Moretti and Thulin, 2013; Faggio and Overman, 2014).[4] Following Moretti (2010), one strand of this literature employs Bartik instruments to exploit local shocks to tradable employment in order to estimate spillover effects on local non-tradable employment (e.g., Van Dijk, 2017, 2018; Bartik and Sotherland, 2019; Lee and Clarke, 2019; Wang and Chanda, 2018).

and Duranton and Venables (2021), respectively.

[4]For a review of the broader local multipliers literature, see Osman and Kemeny (2022).

By contrast, our analysis is closely aligned with a second strand of the literature that estimates job multipliers by exploiting policy-induced increases in local employment, such as public sector relocations (e.g., Faggio, 2019; Lee et al., 2024; Freitas, 2025a) or employment subsidies for private firms (e.g., Cerqua and Pellegrini, 2020; Osman and Kemeny, 2022; Hanson and Rohlin, 2024).[5] We adopt Faggio (2019)'s methodology to our stacked difference-in-differences approach, making use of our data's small geographic resolution.

Finally, we contribute to the growing literature on industrial policies (for a review, see Harrison and Rodríguez-Clare, 2010). Along with Japan and Taiwan, Korea has received particular attention due to its widespread adoption of industrial policy since the 1960s (in which industrial complexes were the main instrument) and its subsequent rapid economic development. Prior research on Korea has primarily focused on the *Heavy-Chemical Industry Drive*, a major policy initiative in the 1970s aimed at strengthening the countrys defense sector (e.g., Chang, 1993; Lee, 1996; Kim et al., 2021; Lane, 2024; Choi and Levchenko, 2024; Choi and Shim, 2024, 2025). By contrast, our study examines the period since the late 1990s, during which Koreas industrial policy goals shifted toward promoting balanced regional growth. Moreover, while industrial complexes and special economic zones have been central to Koreas industrial policy from the outset, existing studies have generally examined national-level outcomes.[6] In contrast, we explicitly study the local effects of Koreas industrial policy and its potential for stimulating growth in lagging regions.

Section 2 describes Korea's industrial complex policy in greater detail. Section 3 presents the data. Section 4 explains our empirical methodology for estimating the effect of industrial complex construction on local economies and presents our main results for the local effects. In Section 5, we present our methodology for estimating the job multipliers associated with industrial complexes and report the estimated multipliers. Section 7 concludes.

[5] For a review of the evidence on public job relocations, see Freitas (2025b).

[6] Choi and Levchenko (2021) exploit the regional variation for their identification strategy, but still examine industry outcomes.

2 Policy Background

Since 1962, Korea has pursued a place-based industrial policy to promote national development and reduce regional disparities.[7] Alongside infrastructure investments and trade policies, industrial complexes have been the central policy instrument. By the end of 2019, more than 1,200 industrial complex sites had been developed, employing 2.2 million workers (approximately 10% of total employment and nearly half of manufacturing employment) and accounting for roughly two-thirds of national manufacturing output and exports (Korea Research Institute for Human Settlements, 2020).

The objectives of Koreas industrial complex policy have evolved over time. In the 1960s, industrial complexes were introduced as a necessity to concentrate scarce resources in an effort to promote national economic growth. In the 1970s, rising national security concerns shifted attention toward increasing the distance between Koreas defense industrial base and North Korea. Beginning in the 1980s, industrial complexes became explicit instruments of regional development to reduce regional disparities and ease congestion in the Seoul Metropolitan Area. Our analysis therefore focuses on the post-1980 period, when the policys objectives aligned most closely with place-based economic development.[8]

At their core, industrial complexes are sites that are planned and funded by a local or the national government to provide private manufacturing firms with affordable industrial land. Tenant companies benefit from infrastructure, relaxed regulatory constraints, business support, and, in the first five years of tenancy, additional tax incentives.[9] Sites are typically developed on undeveloped land near existing transport infrastructure, such as railways or ports, and are tailored to specific manufacturing industries. For example, the Gwangju complex specializes in producing cars, and firms seeking to acquire land must meet industry-specific eligibility criteria.

Industrial complexes are further divided into three types: national complexes, which are built by the central government to support strategic industries; common complexes, which are developed

[7] For a detailed discussion of Koreas regional policy, see Korea Research Institute for Human Settlements (2020).

[8] National development objectives remain part of the policy, but only a small share of complexes explicitly pursue them. Further historical details are provided in Appendix I.1.

[9] In Appendix I.2, we describe the subsidies in greater detail. Prior to the early 1980s, when Korea had implemented tight capital controls, tenant firms in industrial complexes also received subsidized loans as part of the heavy and chemical industry drive (see, e.g., Lane, 2024).

by provincial governments to promote local economic activity; and agricultural complexes, which are also developed by provincial governments to raise income in small farming and fishing towns. Common and agricultural complexes are generally smaller than national complexes and much more numerous.[10] In this study, we focus on national and common industrial complexes, which target specific manufacturing industries and account for the majority of employment and output generated by the policy.

The planning and designation process varies across complex types. National complexes are planned by the Ministry of Construction and Transportation and approved by the Industrial Land Policy Council.[11] In contrast, common and agricultural complexes are designated by provincial governments and planned by local authorities. They require approval from the Ministry of Construction and Transportation only if they exceed size thresholds, approximately 3.3 square kilometers.

Once designated, industrial complexes are developed by private or public entities. Private development can involve specialized developers, but could also involve large tenant companies, for example, Kia may build a complex in coordination with the Korean national or a local government. Public developers are usually the Korean Industrial Complex Corporation or local housing authorities, who typically sell or rent lots to eligible businesses.[12] After construction, the complexes' infrastructure is continuously managed, either by public corporations such as the Korean Industrial Complex Corporation or by other public or private managing companies.

3 Data Description

We primarily rely on administrative establishment surveys: we use the *National Business Survey* for employment and industry affiliation for the universe of establishments from 1995 to 2020, and

[10] Common complexes are further divided into "standard" common complexes and urban high-tech complexes, specializing in knowledge-intensive industries. As of 2024, there are 14 urban high-tech complexes and over 500 standard common complexes.

[11] Usually, designation decisions are the result of lengthy discussions between policymakers and the council. A request to the Ministry of Construction and Transportation suggests that the council does not usually reject project proposals at the discussion stage.

[12] Private developers selling or renting the lots after development still face government restrictions in terms of pricing. We found no documentation to suggest that whether developers were private or public matters for firms purchasing lots.

the *Survey of Mining and Manufacturing Firms* for detailed information on employment, gross value added, output, shipments, assets, production costs, and balance sheets for manufacturing establishments over the same period. We complement these surveys with information on the universe of industrial complexes, which we scrape from Korean government websites.

3.1 Data Sources

Industrial Complex Data We collect information on industrial complexes from *Industryland*, a website operated by the Korea Research Institute for Human Settlements (KRIHS). The website provides comprehensive records on all designated and constructed industrial complexes, including each complexs unique identifier, subsidized industries, designation and construction dates, subsidy period, development method (i.e., public or private), identity of complex management, project motivation, legal basis for designation, approved construction costs, and land use plans.

We complement this data with data on each industrial complex's employment and output from quarterly status reports published by the Korea Industrial Complex Corporation (KICOX) since 2001. Because KICOX and KRIHS use different identifiers for industrial complexes, we match complexes across the two sources using each complexs name and reported location.[13]

To identify the precise geographic location of each complex, we use shapefiles for industrial complexes designated by December 31, 2019, which we obtain from the Korean open data portal. We merge these shapefiles with our original list using the KRIHS complex identifier.

Appendix II.6 provides additional details on the collection and preparation of the industrial complex data.

Establishment Data We use two administrative establishment surveys from Statistics Korea. Our first data source is the *Mining and Manufacturing Survey* for the period 1994–2020.[14] This survey covers establishments with at least 10 employees in the mining and the manufacturing sector, approximately 75,000 establishments as of 2024, and reports each establishment's location, employment, wage bill, value added, output, shipments, production cost, inventory, and tangible

[13] We successfully match 90% of the complexes in our list to KICOX reports. We rely on this matched sample only when complex-level employment or output data are required, for example when estimating job multipliers.

[14] Although the survey has been conducted since 1967, remote access is available only from 1994 onward.

assets.[15] In 2010, 2015, and 2020, the Mining and Manufacturing Survey is replaced by the mining and manufacturing segment of the *Census on Establishments* reporting the same variables but covering the universe of establishments.

We complement the Mining and Manufacturing Survey with the *National Business Survey* which provides near-universal coverage of establishments, approximately 4.4 million as of 2024.[16] The National Business Survey reports establishments' industry affiliation, founding year, business type, district, and employment for the period 1994–2020.[17]

We use remotely accessible anonymized versions of these surveys that differ in two important ways from the original surveys. First, establishment identifiers are omitted, such that the data constitute a repeated cross-section rather than a panel. For this reason, we aggregate the establishment data to a panel of administrative districts, which are roughly comparable to towns, townships, or neighborhoods in the U.S. context.[18] After ensuring that district borders are consistent over our observation period and excluding districts not located on the Korean mainland, we obtain a balanced panel of 2,844 districts. Appendix II.4 describes this procedure in detail.

When aggregating the Mining and Manufacturing Survey, we supplement the data with information on establishments below the selection threshold from the National Business Survey. This allows us to distinguish between districts with no manufacturing establishments and districts that simply lack establishments above the threshold. For the latter, we code variables that appear only in the Mining and Manufacturing Survey as missing; for the former, we code these variables as zero.

Second, values (other than location and industry) for establishments in district-industry-year cells with fewer than three observations are censored. In such cases, values are reported in bins corresponding to the number of digits of the original value. That is, values between 1 and 9 are reported as "*", 10 to 99 are reported as "**", and so on. On average, around 1.5% of establishments

[15]Until 2006, it includes manufacturing establishments with at least 5 employees. We enforce the 10 employee cutoff throughout for consistency.

[16]The National Business Survey excludes only businesses in the primary sector with one employee; the national defense industry; housekeeping services; and international and foreign organizations.

[17]During our study period, the Korean Standard Industrial Classification (KSIC) changed three times such that industry codes use the KSIC 7, 8, 9, and 10 classification. We harmonized the KSIC industry classification. For details on our harmonization, see Appendix II.2

[18]Districts are the third and lowest of Korea's sub-national administrative divisions. The other divisions are provinces (including metropolitan cities, e.g., Seoul) and municipalities. As of 2020, Korea comprises 17 metropolitan cities and provinces, 250 municipalities, and 3,501 districts.

in the Mining and Manufacturing Survey and around 0.5% of establishments in the National Business Survey are censored. We replace censored values with the average value of observations from districts with more than three establishments in the same industryyearbin combinations. Appendix Table 6 reports the average censoring rate by year.

Appendix II.1 provides additional details on accessing and cleaning the establishment surveys.

3.2 Summary Statistics

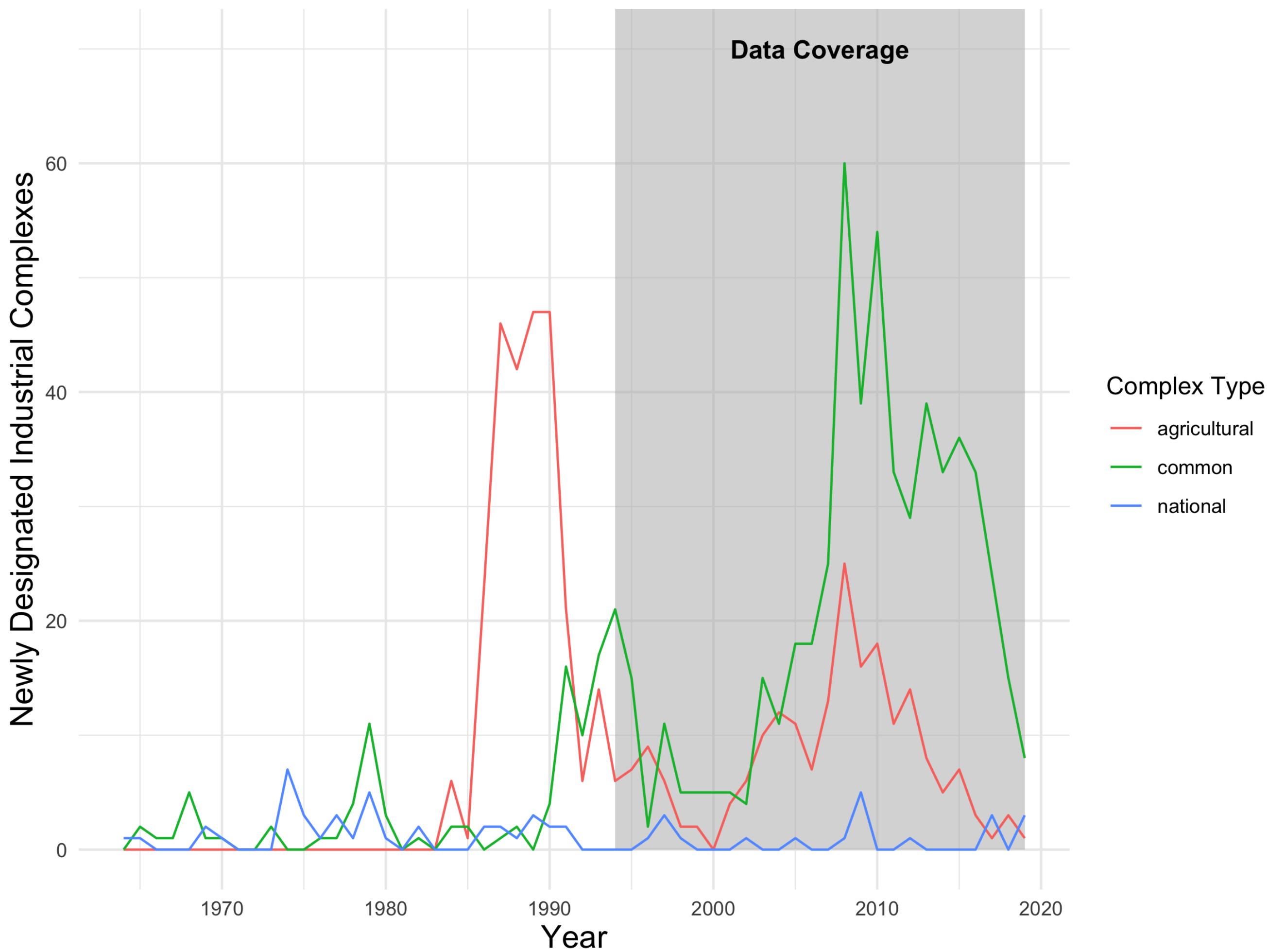
Industrial Complex Designation Dates Figure 1 plots the number of newly designated industrial complexes over time, disaggregated by complex type. The shaded areas indicate the periods covered by the Mining and Manufacturing Survey and the National Business Survey. Appendix Figure 16 shows the corresponding geographic distribution of complexes.

Three main patterns emerge. First, designations of agricultural complexes surged between 1984 and 1991. Faced with severe economic difficulties and stark regional disparitiesbetween Seoul and Busan on the one hand and rural areas on the otherthe governments of Chun Doo-hwan (1980-1988) and Roh Tae-woo (1988-1993) expanded Koreas place-based policies to stimulate rural development, establishing nearly 200 agricultural industrial complexes. Second, following a major reform of the designation process in 1991 which standardized and simplified the designation process, the number of common industrial complex designations surged until 1998. These complexes were mainly located in Seouls hinterland, in an attempt to alleviate congestion in the capital, and in lagging regions, to reduce regional disparities. Finally, a second major reform of Koreas place-based policy under Lee Myung-baks government substantially simplified the designation process giving politicians more leeway in designations triggering a sharp increase in new industrial park establishments after 2008.[19]

We restrict our focus to 1995 onwards, because the Mining and Manufacturing Survey uses its own district identifiers between 1992 and 1994.

[19] Among other changes, councils that previously deliberated on designations and were composed exclusively of career bureaucrats and experts are now headed by political appointees.

Figure 1: Newly Designated Industrial Complexes By Year and Type



Notes: Number of newly designated industrial complexes by complex type over time. Shaded areas indicate years covered by the Mining and Manufacturing Survey and the National Business Survey. Data on designations taken from Industrial Land Information System.

Table 1: Summary Statistics

Variable	Always Treated	Eventually Treated	Never Treated
Panel A: National Business Survey			
Total District Employment	7882.10	3824.78	1191.81
	(13671.07)	(9321.53)	(1861.56)
Avg. Establishment Employment	509	432	378
	(413)	(204)	(162)
No. of Establishments	5.06	4.14	3.42
	(4.23)	(2.03)	(1.61)
Manufacturing Employment Share	0.20	0.20	0.13
	(0.22)	(0.18)	(0.12)
Agricultural Employment Share	0.01	0.01	0.02
	(0.02)	(0.03)	(0.05)
Observations (district×year)	41503	16928	10126
Panel B: Mining and Manufacturing Survey			
Total District Employment	1511.59	637.27	115.71
	(4573.36)	(2880.42)	(209.01)
Avg. Establishment Employment	32.45	26.46	26.46
	(165.38)	(33.80)	(102.81)
No. of Establishments	49.28	24.67	6.23
	(144.49)	(67.20)	(10.13)
Output (million KRW)	550929.01	178137.33	21659.94
	(2934792.02)	(1577311.96)	(80996.71)
Output per Worker (million KRW)	183.05	187.88	179.39
	(285.82)	(299.99)	(303.17)
Tangible Assets	225317.28	92761.96	11117.01
	(1029826)	(879495)	(47498)
Tangible Assets per Worker	80.20	80.18	93.55
	(215.44)	(117.84)	(157.05)
Observations (district×year)	33563	12989	6277
Panel C: Regional Characteristics			
Population in 1990	11202040	6287213	623981
	(14608844)	(13098744)	(3074294)
Land Area (square km)	21.38	43.37	87.69
	(29.53)	(38.77)	(67.28)
Flat Land Area (square km)	11.46	18.15	24.00
	(15.42)	(15.38)	(14.69)
Observations (districts)	1739	681	424

Notes: This table reports means for selected variables from the National Business Survey (NBS), the Mining and Manufacturing Survey (MMS), and the 1990 Population Census. NBS and MMS are aggregated at the district level. Capital intensity is defined as assets used in production divided by the number of workers. Per-worker values for wages, output, value added, and capital intensity are weighted by establishment employment. 1 million Korean Won (KWON) are approximately 600 Euros in 2025. Population density is population per square kilometer. District area is computed from district shapefiles (Data Korea) after harmonizing boundaries over time. Flat land area is area (sqkm) with slope below 20 degrees. Slope data: *Steepness Earthexplorer* (`https://earth.explorer.usgs.gov/`). All figures rounded to two decimals. Standard deviations in parentheses.

Summary Statistics Table 1 reports summary statistics for establishment-level outcomes and district characteristics by treatment group: always treated (treated before 1995), eventually treated, and never treated districts. Panels A and B present the mean and standard deviation of key variables from the National Business Survey and the Mining and Manufacturing Survey, respectively, while Panel C reports district-level characteristics, including population, population density, and flat land area.

4 The Effects on Local Economic Activity

4.1 Empirical Strategy

Empirical Challenges We begin by examining how the construction of industrial complexes affects local economic activity, measured by employment, number of establishments, and, for manufacturing, by output and value added. Our empirical analysis faces three key challenges, the first two of which are common to the literature on place-based policies (see, e.g., Neumark and Simpson, 2015). First, industrial complexes are not randomly placed: policymakers typically prioritize disadvantaged regions or areas where the policy is expected to have the largest impact. Second, although industrial complexes represent narrowly defined locations, they may generate spillover effects across complex and administrative boundaries, violating the Stable Unit Treatment Value Assumption and potentially distorting our estimates. Lastly, industrial complexes are designated sequentially. In the presence of heterogeneous treatment effects, such staggered adoption can bias conventional difference-in-differences estimators (see, e.g., Goodman-Bacon, 2021).

To address the challenges posed by staggered treatment adoption, we estimate a stacked difference-in-differences specification, as in Cengiz et al. (2019). We organize the data into event-time cohorts, where each cohort corresponds to a treatment year in which industrial complexes were designated. Within each cohort, treated districts, i.e., those districts that are treatment in the corresponding year, are paired with a control group consisting of districts that remain untreated throughout a fixed event window covering pre- and post-treatment years. As shown by Wing et al. (2024), the stacked difference-in-differences approach estimates treatment effects by comparing treated districts with control districts belonging to the same cohort, thereby avoiding the biases that can arise in conventional two-way fixed effects regressions under staggered adoption. Our choice of the stacked difference-in-differences framework over alternative estimators, e.g., Callaway and SantAnna (2021)'s doubly-robust estimator, is motivated by its ability to accommodate treatment effect heterogeneity.

We define the event window as spanning from five years before to ten years after industrial complex designation and restrict our analysis to cohorts in 1999–2007. This restriction ensures that we observe all 16 years of each cohorts event window in our data (our data covers the period from 1994 onward) and that the examined designations occurred before a major legislative reform changing the designation process in 2008.

The stacked difference-in-differences design also helps address non-random treatment assignment by allowing not-yet-treated districts to serve as controls, which are plausibly more comparable to treated districts than never-treated units. In addition, district fixed effects absorb time-invariant unobserved heterogeneity across districts. To further account for systematic differences between treated and control districts, we allow for differential trends across districts by interacting pre-treatment, time-constant controls with time effects. Motivated by the summary statistics showing that later-treated districts are less urbanized, we use log population density in 1990. We also include controls for average overall and sector-specific employment growth in the five years preceding treatment, to account for differences in economic development and structural change.

Lastly, to guard against violations of the Stable Unit Treatment Value Assumption, we classify districts as treated, if they are sufficiently close to a newly designated industrial complex, even if no complex is located within the district itself. To determine the appropriate distance cutoff, we estimate a spatial difference-in-differences specification using five-kilometer distance bins for districts whose geographic centroids lie within 50 kilometers of a newly designated complex (see Appendix II.7 for details). We find that, relative to districts located at least 50 kilometers away, employment increases following designation in districts that host a complex as well as in nearby districts whose centroids lie within 10 kilometers of the complex. Beyond this distance, we find no statistically significant effects. Based on this evidence, we classify all districts whose centroids lie within a 15.5-kilometer radius of an industrial complex as treated. This is more conservative than the spatial difference-in-differences suggests we have to be. As a result, our estimates should be interpreted as lower bounds of any potential span of effects. We adopt a cutoff of 15.5 kilometers, rather than 15 kilometers, to ensure that all districts hosting a complex are classified as treated.

Figure 2 plots the treatment status and timing for Korean districts. Note that once a district is treated, its treatment status remains unchanged, and we therefore ignore cases of multiple complex constructions within the same district. This also means that we drop always treated districts from our estimation sample.

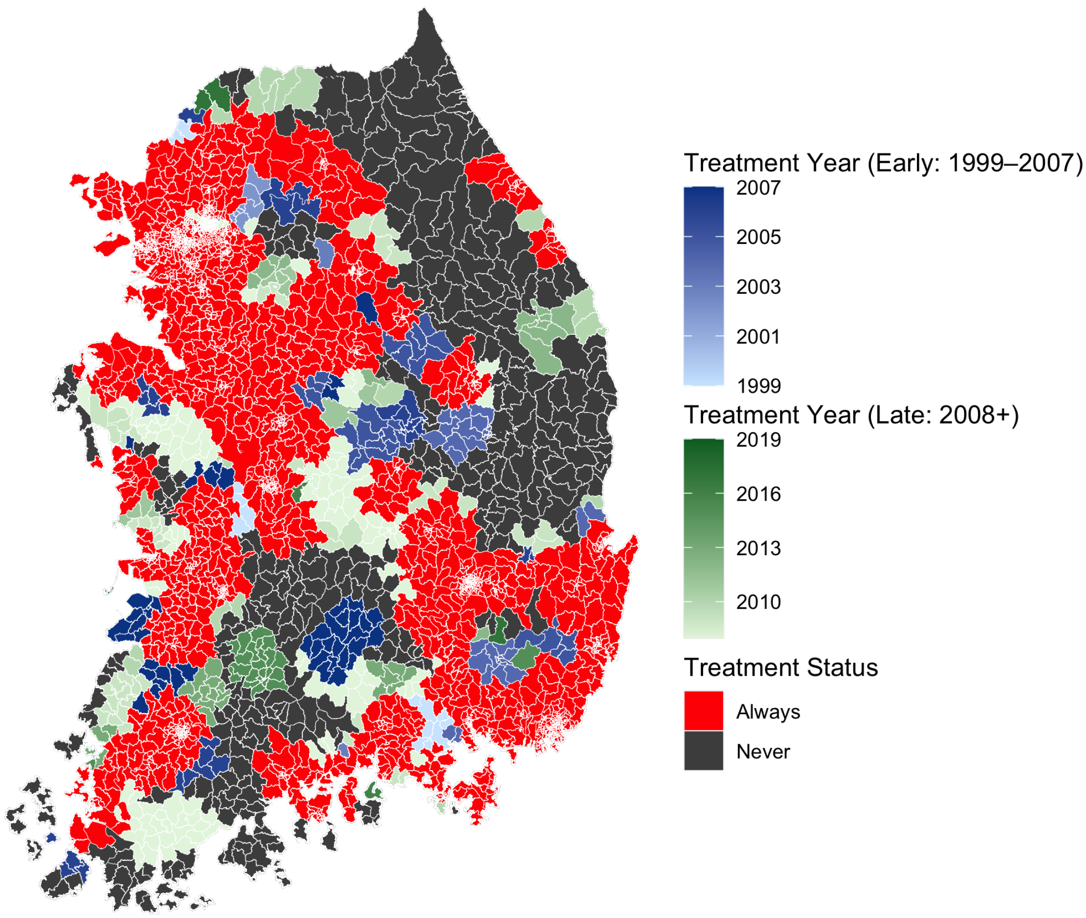
Empirical Methodology Our main specification takes the following form:

$$Y_{rtc} = \lambda_{rc} + \gamma_{tc} + \sum_{k=-5}^{10} \beta^k \, \mathrm{T}_{rc} + \gamma_{tc} \times X_r' \delta + \varepsilon_{rtc}, \tag{1}$$

where the dependent variable, Y_{rtc}, represents log counts plus one, e.g., of district employment or manufacturing output. The sub-indices denote the district r, year t, and treatment cohort c. λ_{rc} and μ_{tc} denote district-cohort and time-cohort fixed effects, and ε_{rtc} denotes time-varying unobservable factors impacting our outcomes. X_r refers to pre-treatment time-constant control variables which we interact with the cohort-by-year fixed effects. Our pre-treatment covariates control for a region's urbanization (log of population density in 1990), industrial structure (average share of agricultural and manufacturing employment) and its recent economic trend (average employment growth across all sectors and for manufacturing sector in the last five pre-treatment years). Variables controlling for the industrial structure and recent economic trends are averages of the five years preceding designation.

In the specification above, the estimands of interests are the β_ks for all $k > 0$. Since we use a log-like transformation for our dependent variables, i.e., $\log(y + 1)$ for some outcome y, we interpret them as semi-elasticities. We address concerns regarding the interpretation as highlighted by Roth (2022) in our robustness checks. The estimands are identified from changes in outcomes of treated districts around the time of treatment, relative to changes in outcomes of not-yet- and never-treated district from the same cohort. District-by-cohort fixed effects (λ_{rc}) absorb all permanent unobserved

Figure 2: Treatment Status and Timing of Administrative Districts



Notes: Treatment status of administrative districts (i.e., eup, meyong, and dong). Treatment year refers to the first year in which a district's geographic centroid lay within a 15.5 kilometer radius of a newly designated industrial complex. For our analysis, we define districts as always treated, if treatment occurs prior to 1997. Early treated districts are affected by a designation between 1999 and 2007. Later treated are those affected by a designation between 2008 and 2019. Never treated includes all districts, treated after our study period (post 2019) or those never treated. Borders of administrative districts have been harmonized over time (see Appendix II.4 for details).

differences in outcomes across districts. Year-by-cohort fixed effects (μ_{tc}) capture common shocks that differentially affect cohorts in a given year.

The key identification assumption is that, absent treatment, counties *within the same cohort* would have followed parallel trends in outcomes over event time, conditional on our pre-treatment covariates. In other words, after accounting for district-by-cohort fixed effects (which capture time-invariant differences), year-by-cohort fixed effects (which capture common shocks within cohorts), and different trends in outcomes explainable by observables, the only remaining systematic differences in outcome dynamics between treated and not-yet-treated counties in a cohort are those attributable to treatment. If satisfied, this assumption ensures that the estimated β^k coefficients can be interpreted as causal effects of treatment relative to the pre-treatment baseline of the treated districts.

4.2 The Effects on Economic Activity

We now turn to the effects of industrial complex designation on local economies, initially focusing on the targeted sector, manufacturing. Our primary outcomes of interest are manufacturing employment and the number of manufacturing establishments measured using the National Business Survey as well as total shipments and gross value added measured with the Mining and Manufacturing Survey. As noted before, the Mining and Manufacturing Survey only includes establishments with 10 or more employees. This limits the estimation sample for the last two outcomes to 20% of manufacturing establishments and 75% of manufacturing employees. Figure 3 plots the estimates from model (1) along with their 95% confidence intervals. The point estimates for the pre-treatment periods are statistically indistinguishable from zero, providing preliminary support for the parallel trends assumption. Following designation, manufacturing employment in treated districts increases by approximately 25% over the subsequent ten years, while the number of manufacturing establishments rises by nearly 20%. For both outcomes, effects are close to zero in the designation year and the first two post-designation years, before increasing steadily over time.

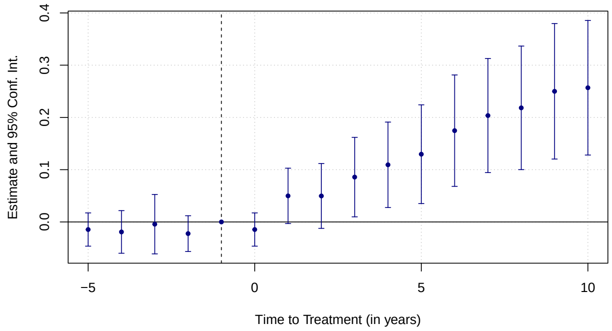
The effects on manufacturing output are substantially larger. Total shipments and gross value added increase by roughly 40% and 50%, respectively. Unlike employment and establishment counts, these gains materialize quickly: estimated effects rise sharply within the first four years after designation and stabilize thereafter. Because these outcomes are measured using the Mining and Manufacturing Survey–and because the corresponding employment effect in that survey is also somewhat larger (see Appendix Figure 17)–differences in the estimates may be due to sample selection. In particular, these results raise the question whether industrial complexes affect establishments of different sizes differentially. We return to this issue below.

Appendix Figure 17 reports the results for additional outcomes from the Mining and Manufacturing Survey: total employment, total wage bill, total output, total operating cost, total shipments, and total tangible assets. The estimates for these additional outcomes are in line with the effects on manufacturing gross value added and total shipments, suggesting an effect of around 40% on manufacturing output for establishments with more than 10 employees. Finally, Appendix Figure 18 examines which type of product sales drive are behind the growth in manufacturing output, showing that the growth is nearly exclusively driven by tollprocessing. Tollprocessing refers to production done as a subcontractor on goods owned by the contracting firm.

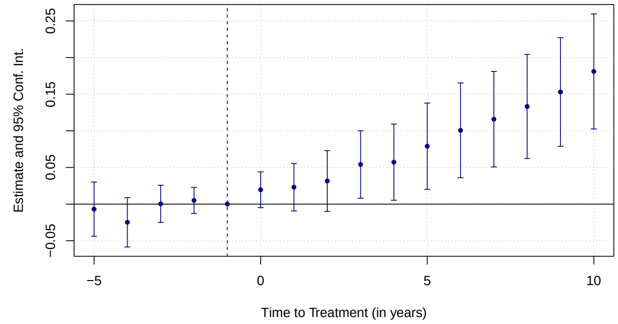
Next, we examine the broader effects of industrial complexes on local economic activity across all sectors. Figure 4 reports event-study estimates for total employment and the total number of establishments. Total employment increases by approximately 14%, and the number of establishments rises by around 12%. Although these magnitudes are smaller than those observed for manufacturing, manufacturing establishments account for only about 7% of establishments and 12% of employment in our sample. This suggests that the employment gains following industrial complex designation are not confined to the manufacturing sector, but extend to sectors not directly targeted by the policy.

Sectoral Effects Given that manufacturing accounts for only 12% of employment in our estimation sample, the large employment effects suggest spillover effects to unsubsidized sectors. We examine this possibility by estimating model (1) using the log of sectoral employment counts as dependent variable. In addition to manufacturing, we consider agriculture (including fishing and forestry), mining, construction, the public sector (government and public administration), and services, which encompass the remaining industries and account for the majority of employment.

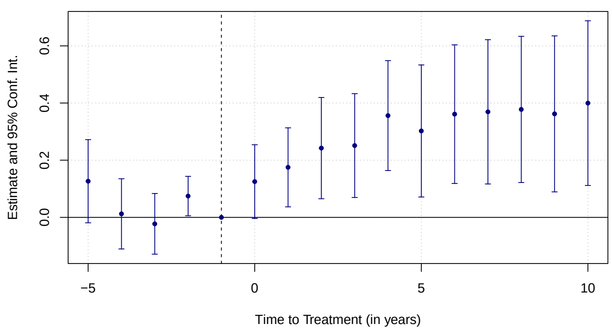
Figure 3: Effect of Industrial Complex Designation on Manufacturing



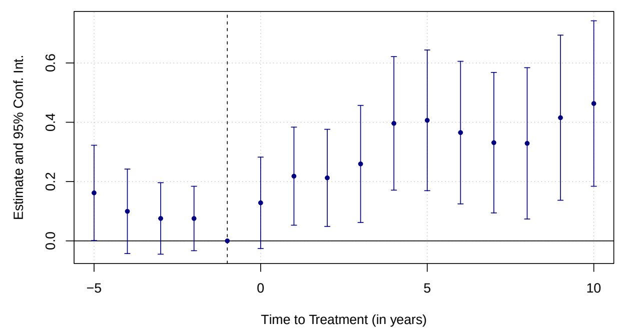
(a) Manufacturing Employment



(b) Number of Manufacturing Firms



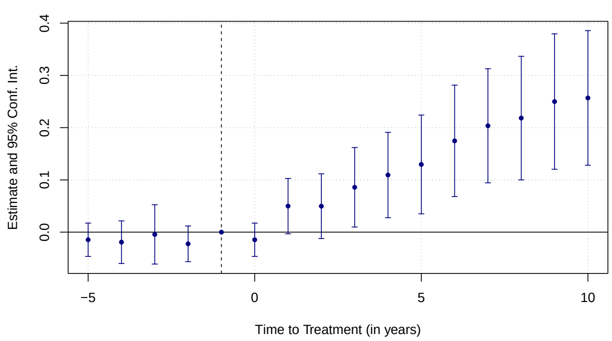
(c) Manufacturing Shipments



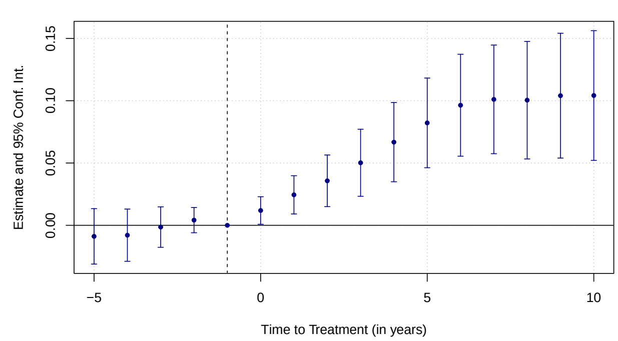
(d) Manufacturing Value Added

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are log transformed manufacturing employment (a) and firm-numbers (b), as well as total shipments (c) and value added (d). Employment and firm numbers are taken from the NBS, with shipments and value added from the MMS.

Figure 4: Effect of Industrial Complex Designation on Total Employment



(a) Total Employment



(b) Total Number of Firms

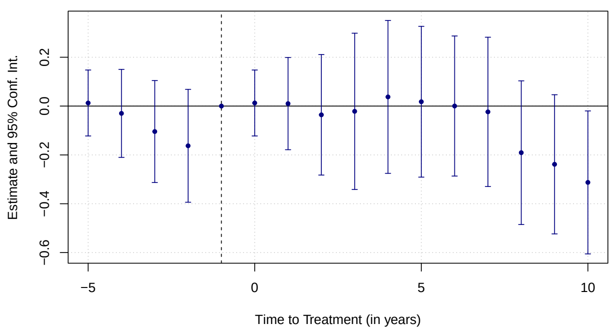
Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are log transformed total employment (a) and firm-numbers (b). Data is taken from the NBS.

Figure 5 reports the corresponding event-study estimates along with their 95% confidence intervals. We cannot reject the hypothesis that point estimates in pre-treatment periods are jointly statistically significantly different from zero, again providing preliminary support for the parallel trends assumption. Examining the post-treatment periods, we find strong differences across sectors: we find no statistically significant effects on employment in agriculture or the public sector. Mining employment declines following designation by up to 50% relative to control regions. This effect should be interpreted cautiously: mining accounts for only 1% of total employment in Korea and is concentrated in a small number of districts, resulting in a high uncertainty regarding the estimates. Nevertheless, industrial complexes may displace economic activity in mining. By contrast, the post-treatment effects on service and construction employment are statistically significant and large. Construction employment increases by roughly 30%, which is of similar magnitude to the effect on manufacturing, while service-sector employment rises by a little over 10%.

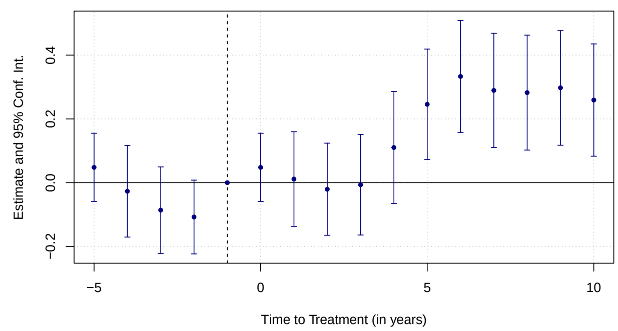
Notably, the effects manifest at different times relative to treatment: service employment rises immediately following the designation but plateaus after approximately five years. Similarly, manufacturing employment takes off shortly after designation, although it continues to rise throughout the event window. In contrast, construction employment remains flat for the first three years after designation before rising sharply over the subsequent two years and stabilizing at its long-run effect of around 30%. The delayed response of construction employment is somewhat notable, as one might expect industrial complex construction to generate immediate local demand for construction labor. One possible explanation is that initial construction activity is carried out by external firms or specialized contractors located outside the treated districts, limiting early increases in local construction employment. The subsequent expansion of the construction sector may instead reflect broader local economic growth following industrial complex establishment.

Establishment Size The differences in patterns between estimates based on the National Business Survey versus the Mining and Manufacturing Survey suggest that the effect of industrial complexes depends on establishment size. To answer this question, we classify establishments by contemporaneous employment: establishments with 50 or more employees are defined as large, and all others as small. Due to limitations of the remotely accessed data, establishments cannot be

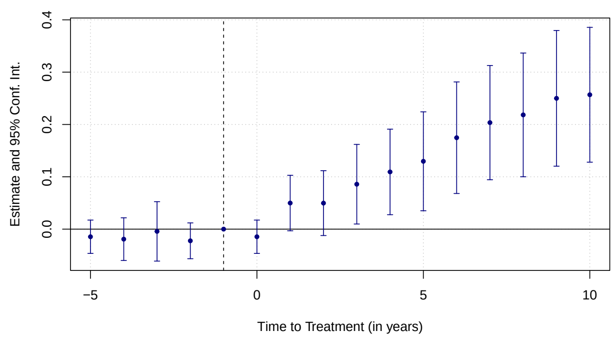
Figure 5: Effect of Industrial Complex Designation on Sectoral Employment



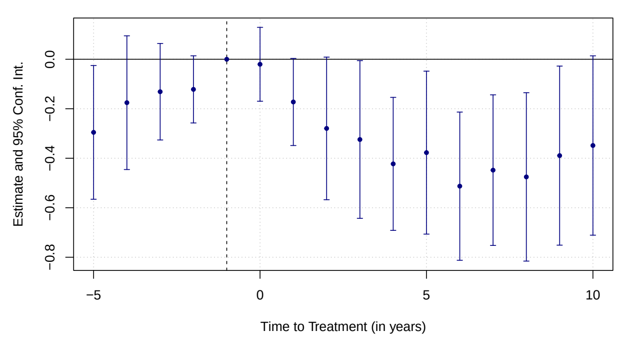
(a) Agricultural Employment



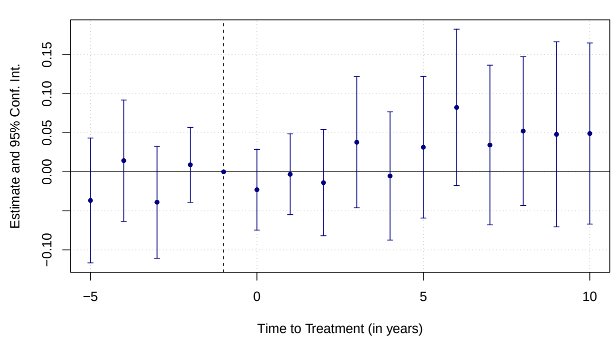
(b) Construction Employment



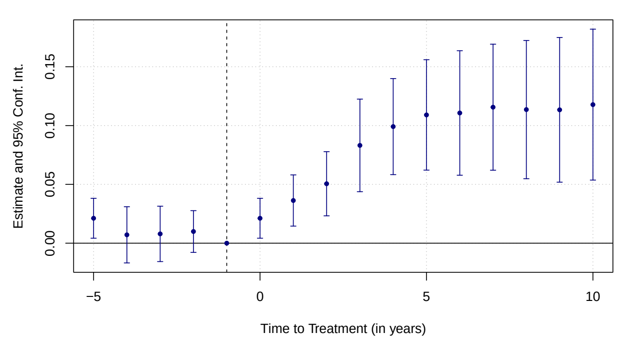
(c) Manufacturing Employment



(d) Mining Employment



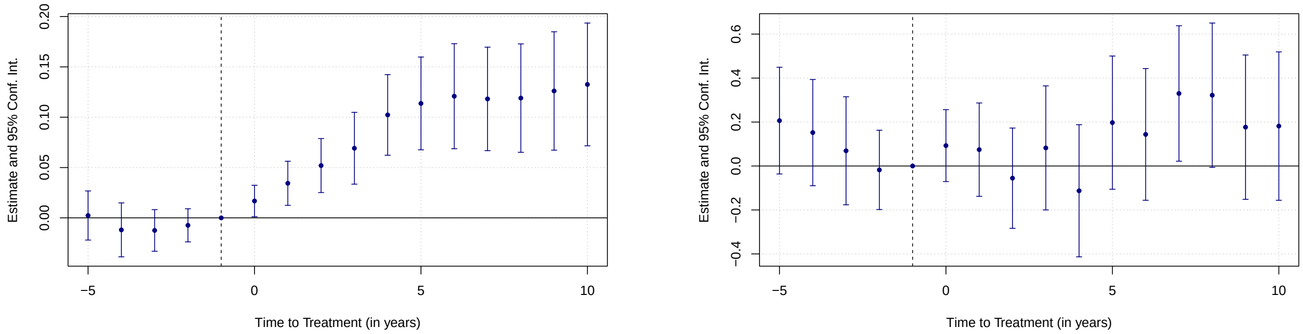
(e) Public Employment



(f) Services Employment

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variable is logged employment, with numbers for each of the six industries (a)–(e). Data is taken from the NBS .

Figure 6: Effect of Industrial Complex Designation By Establishment Size



(a) Small Firm Employment

(b) Large Firm Employment

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are log transformed total employment for large establishments (a) and small establishments (b). Large establishments are defined as those with 50 or more employees. Data is taken from the NBS.

permanently assigned to a size category; instead, size is determined in each year based on current employment. Based on this classification, we construct total local employment separately for small and large establishments and estimate our main specification in equation (1).

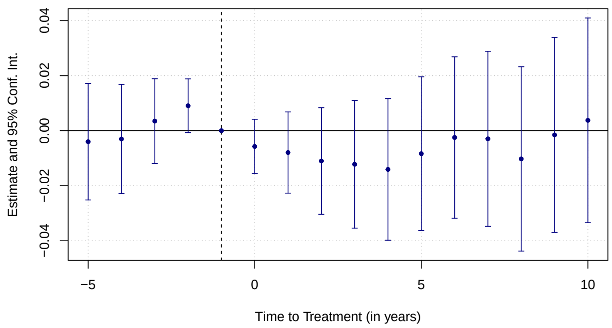
Figure 6 plots the corresponding event-study estimates with 95% confidence intervals. We find large and precisely estimated employment gains among small establishments, but no statistically significant effects for large establishments. Estimates using alternative outcomes, such as output and gross value added, display the same pattern (see Appendix Figures 19, 22, 21, 23 and 20), indicating that the employment gains associated with industrial complex designation accrue almost exclusively to small establishments.

This result is in line with recent findings from the literature on place-based policies, e.g., Criscuolo et al. (2019) find that place-based investment subsidies in the UK primarily help small firms. However, it does not explain, why we find larger effects for outcomes from the Mining and Manufacturing Survey. We return to the issue in the section below.

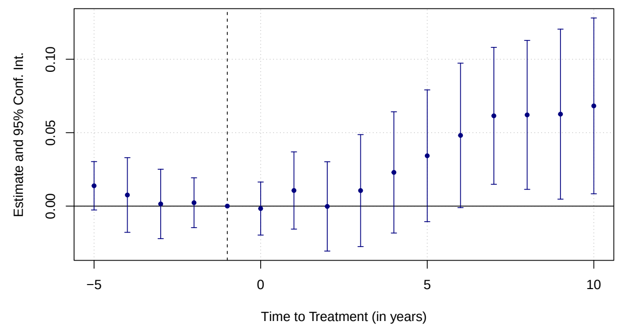
4.3 Margin of Adjustment: Establishment Expansion or Entry?

We have shown that the employment response to industrial complex designation is driven almost entirely by small establishments. The role of small establishments raises the question of whether

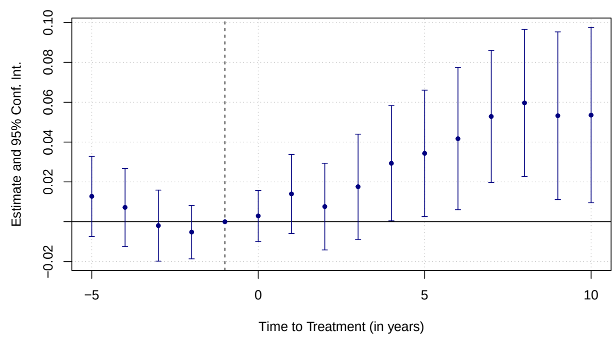
Figure 7: Effect of Industrial Complex Designation on Incumbent Establishments



(a) Number of Incumbent Firms



(b) Total Incumbent Employees



(c) Average Incumbent Employment

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variable are log transformed number of establishments (a), number of employees (b) and average establishment employment (c). All estimates only consider incumbent establishments, those opened any year prior to treatment. Data is taken from the NBS.

industrial complexes primarily encourage the entry of new establishments, which are smaller, or the expansion of small incumbent establishments. To shed light on the margin of adjustment, we split establishments into incumbents and new entrants. We here again used stacked datasets with distinct cohorts. For each cohort, we define incumbent establishments in both treated and control districts as establishments that were founded at least one year before the cohort's treatment year. Using total employment at incumbent establishment, number of incumbent establishments, and average employment per establishment as outcome, estimate equation (1). Figure 7 presents the corresponding event-study estimates with 95% confidence intervals.

The results show no significant change in the number of incumbent establishments. Given that we do not have establishment identifiers, we can not account for establishments relocation, but since we observe null effects, relocation does not appear to affect the outcomes. Total employment per establishment rises by approximately 6% after ten years, while average employment among incumbent establishments increases by about 5%. These effects are notably smaller than the aggregate employment effects reported earlier and estimated imprecisely and therefore not statistically significant in the first half of our observation period. Despite these concerns, we can gather from our results, that the gains in total employment are not only by new entrants, but that the local incumbents account for some of the observed positive effects.[20]

Our results indicate that the employment effects of industrial complex designation reflect both the expansion of incumbent establishments and the entry of new establishments. We can go a step further by quantifying the relative contribution of each margin. To do so, we estimate a simplified version of model (1) that collapses post-treatment dynamics into a single average effect:

$$Y_{rtc} = \lambda_{rc} + \gamma_{tc} + \beta\,\mathrm{T}_{rtc} + \gamma_{tc} \times X_r'\delta + \varepsilon_{rtc}, \tag{2}$$

where T_{rtc} indicates treatment status for district r in year t, and all other notation follows equation (1). We estimate this specification separately for outcomes defined over all establishments and for outcomes defined over incumbent establishments only. Combined with pre-treatment outcome levels in treated districts, the estimated coefficient β allows us to compute treatment effects in levels. This, in turn, permits a decomposition of the total employment effect into the share attributable to incumbent expansion (the intensive margin) and the share attributable to entry of new establishments (the extensive margin).

Table 2 reports the results of this decomposition for outcomes from the National Business Survey. In manufacturing, the sector directly targeted by industrial complex policy, approximately two-thirds of the employment gains accrue to incumbent establishments. This suggests that industrial complex designation generates substantial spillovers to existing manufacturers outside the complex itself, a point we return to when examining manufacturing-specific mechanisms.

In the construction sector, the distribution is even more skewed toward incumbents: employment gains are entirely driven by existing establishments, while new entrants employ fewer workers

[20] Appendix Figures 24 to 26 show additional results for incumbents.

Table 2: Contribution of the Intensive Margin to Employment Effects by Sector

	Overall Employment		Construction Employment		Manufacturing Employment		Services Employment	
	Total	Incumbents	Total	Incumbents	Total	Incumbents	Total	Incumbents
Complex Designation	0.100	0.027	0.157	0.182	0.167	0.111	0.086	-0.002
	(0.022)	(0.020)	(0.063)	(0.069)	(0.042)	(0.048)	(0.022)	(0.020)
Contribution Incumbents	0.268		1.155		0.664		-0.023	
Contribution Entrants	0.732		-0.155		0.336		1.023	
R^2	0.990	0.990	0.890	0.880	0.953	0.957	0.990	0.990
Adj. R^2	0.989	0.989	0.880	0.870	0.949	0.954	0.989	0.989
Observations	38,592	38,592	38,592	38,592	38,592	38,592	38,592	38,592

Notes: This table presents the contribution to the overall effects of industrial complex designation to the local economy due to incumbent establishments expanding and new establishments entering. The first row presents the estimates of the effect of industrial complex designation on employment from estimating model 2. For each outcome, we estimate the effect on district totals and incumbents. The table presents results for total employment, as well as construction, manufacturing and service employment. Contribution of incumbents gives the share of the total effect explained by the incumbents. Data is taken from NBS.

than their counterparts in untreated regions, consistent with entry deterrence due to incumbent expansion. By contrast, employment gains in the service sector are driven entirely by new entrants, with no detectable change in incumbent employment.

Appendix Table 7 reports for the agricultural, mining, and public sector. In agriculture, the modest negative employment effect reflects a decline in entry rather than contraction among incumbents, which exhibit small positive effects. The employment losses in the mining sector are entirely attributable to the incumbents declining in size. Finally, the modest increase in public-sector employment is overwhelmingly driven by incumbents, with roughly 85% of the gain attributable to existing establishments. Aggregating across sectors, and driven largely by the size of the service sector, approximately three-quarters of total employment growth arises from new entrants, with the remainder attributable to incumbent expansion.

These results may also explain why effects on outcomes reported by Mining and Manufacturing Survey are larger: since new establishments are less likely to cross the employment threshold to be included in the survey, estimates based on the Mining and Manufacturing Survey give a larger weight to the intensive margin effect.

4.4 Treatment Effect Heterogeneity

We next examine treatment effect heterogeneity along three dimensions: whether the treated district itself hosts an industrial complex or is merely located near one, the size of the industrial complex, and whether the complex was developed by a private or public entity. To do so, we extend our baseline specification (1) as follows:

$$Y_{rt} = \lambda_{rc} + \gamma_{tc} + \sum_{l \in L} \sum_{k=-5}^{10} \beta_l^k \, T_{rc} \, D_{rc}^l + \gamma_{tc} \times X_r' \delta + \varepsilon_{rtc}, \tag{3}$$

where D_{rc}^l is a binary indicator classifying treated districts (or their complexes) into category l, and all remaining notation follows equation (1). For each dimension of heterogeneity, we use two mutually exclusive classes: complexes above versus below the median size (measured by total area), privately versus publicly developed complexes, and districts that directly host a complex versus districts that are only located nearby.

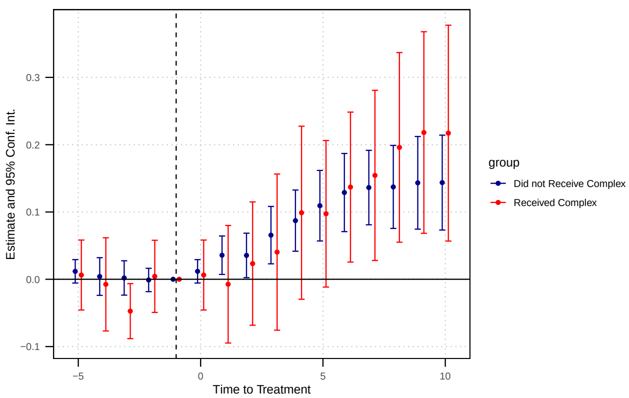
Figure 8 reports the event-study estimates distinguishing between districts that directly receive an industrial complex and districts located within a 15.5-kilometer radius of a newly designated complex but do not host one themselves. Panel (a) shows that districts directly receiving industrial complexes experience larger gains in overall employment than nearby districts, with employment increasing by roughly 20% and 15% after ten years, respectively. Panels (b) and (c) demonstrate that this pattern also holds for manufacturing and service employment. While spillovers in services are expected, given that workers employed in industrial complexes may reside and consume in neighboring districts, the presence of spillovers in manufacturing suggests a role for some agglomeration economies. For construction employment, we find no statistically significant effects in districts directly receiving complexes, though standard errors are large, reflecting the small number of districts that host industrial complexes.

Figure 9 plots the corresponding event study estimates for the model differentiating between districts that are near below and above median-sized complexes. Panel (a) highlights that districts that are treated by larger complexes experience somewhat lower effects. Examining the heterogeneous effects across sectors, we find larger effects of larger complexes on manufacturing employment, but smaller and largely statistically insignificant effects on service and construction employment. There are three potential explanations for this finding; first, larger complexes are located near districts with higher ex-ante employment levels, e.g., because they are more populated and more urbanized. Our estimates measure semi-elasticities, such that industrial complex employment would have to grow proportional with local employment to have effects of similar sizes, assuming spillovers across sectors are constant across complex sizes. Second, spillovers may simply be smaller for larger complexes.[21]

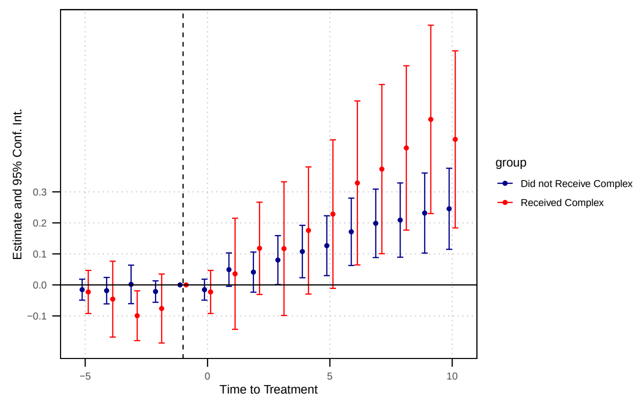
Finally, Figure 10 presents heterogeneity by development method, distinguishing between complexes developed by private entities and those developed by public entities, most commonly the Korean Industrial Complex Corporation or local housing authorities. Across all sectors, we find that

[21]Alternatively, larger industrial complexes have a lower employment density, e.g., because they primarily host capital-intensive industries such as oil refineries. However, since we observe larger effects on manufacturing employment for larger industrial complexes and we find that the employment density is not meaningfully smaller, we consider this explanation unlikely.

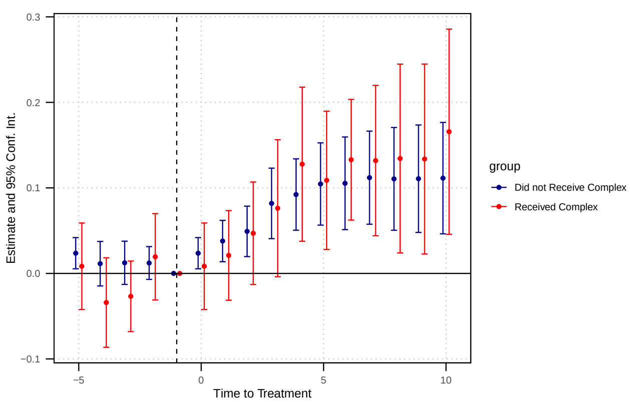
Figure 8: Heterogeneous Effects of Industrial Complex Designation By Containment



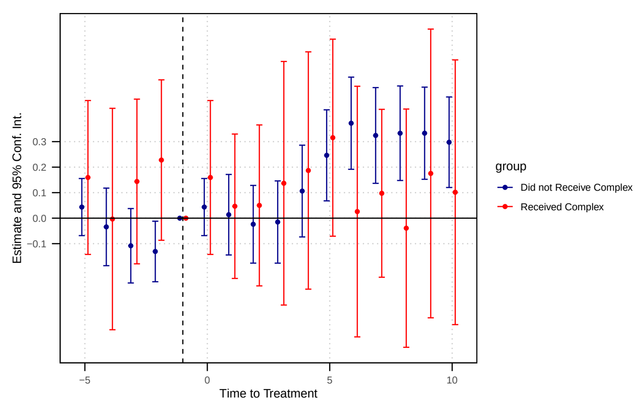
(a) Overall Employment



(b) Manufacturing Employment



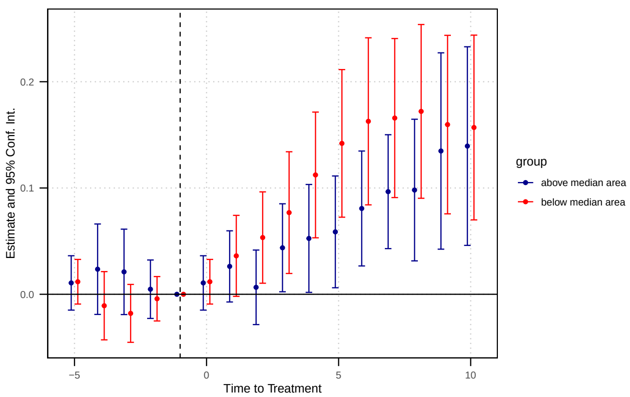
(c) Service Employment



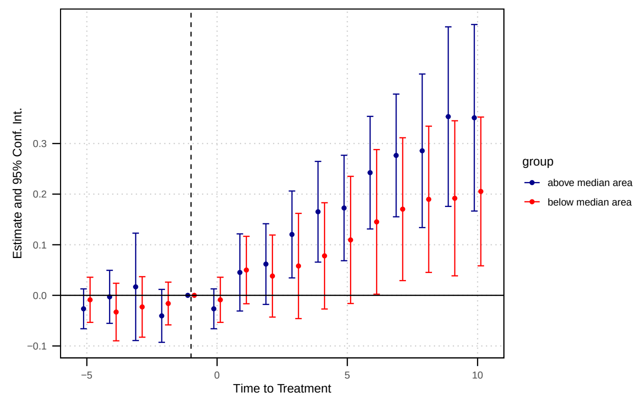
(d) Construction Employment

Notes: Event study estimates of model (3) with 95% confidence interval, where the dummies D_r^l classify treated districts into those actually housing the industrial complexes (red) and those only located near newly designated complexes without actually receiving them (blue). The dependent variables are log transformed total employment (a), as well as manufacturing (b), services (c) and construction (d) employment. Data is taken from the NBS.

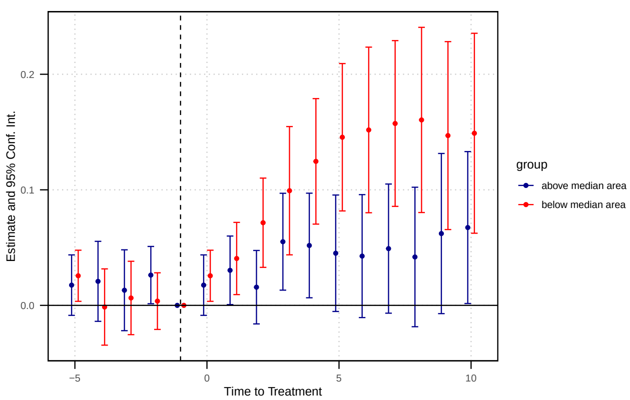
Figure 9: Heterogeneous Effects of Industrial Complex Designation By Complex Size



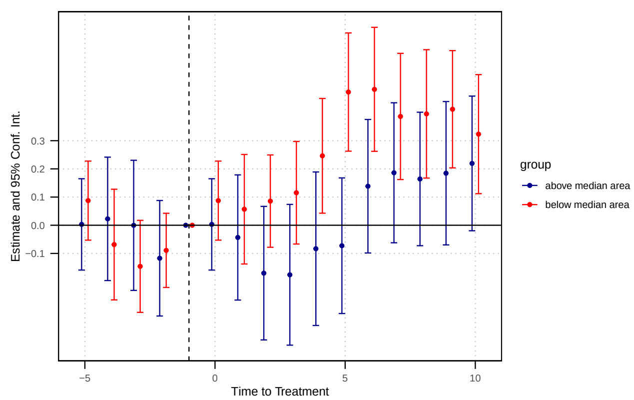
(a) Overall Employment



(b) Manufacturing Employment



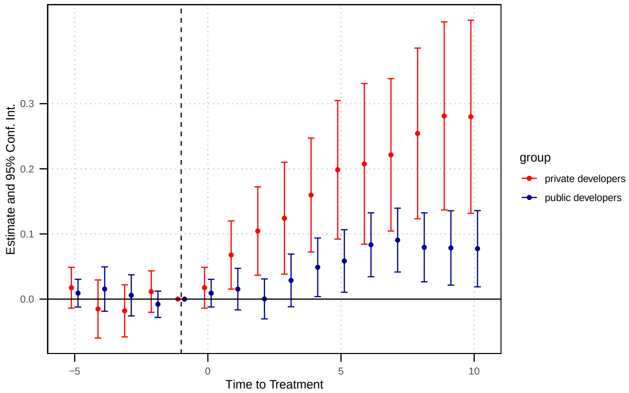
(c) Service Employment



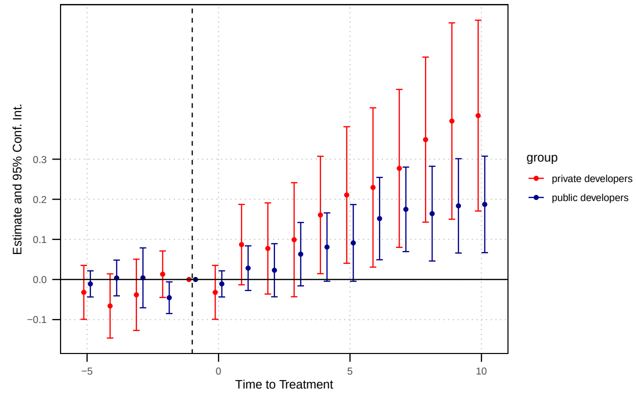
(d) Construction Employment

Notes: Event study estimates of model (3) with 95% confidence interval, where the dummies D_r^l classify treated districts based on the land area of the locally designated complex. Those above median size are defined as large (red) and those below as small (blue). The dependent variables are log transformed total employment (a), as well as manufacturing (b), services (c) and construction (d) employment. Complex size data is taken from the Industrial Land Information System. Employment data is taken from the NBS.

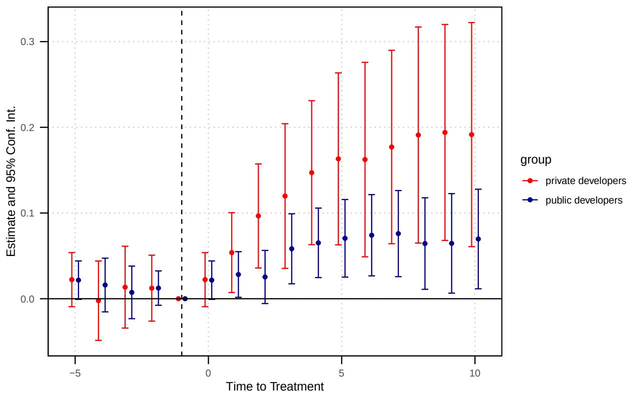
Figure 10: Heterogeneous Effects of Industrial Complex Designation By Developer Type



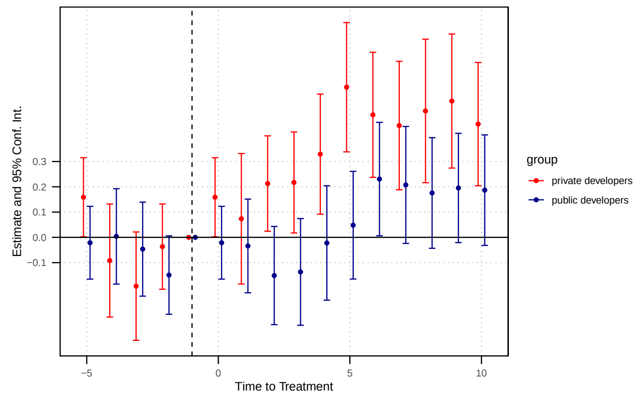
(a) Overall Employment



(b) Manufacturing Employment



(c) Service Employment



(d) Construction Employment

Notes: Event study estimates of model (3) with 95% confidence interval, where the dummies D_r^l classify treated districts based on the development type designated complex. Complexes are either developed privately (red) or publicly (blue). The dependent variables are log transformed total employment (a), as well as manufacturing (b), services (c) and construction (d) employment. Complex development type data is taken from the Industrial Land Information System. Employment data is taken from the NBS.

industrial complexes developed by private entities generate effects that are more than twice as large as those developed by public entities. One interpretation is that private developers possess superior information about local conditions and thus select more favorable locations. Alternatively, private developers may strategically target regions with higher probabilities of success to mitigate risk, whereas public developers may deliberately target lagging regions for equity or regional development reasons, even when expected economic returns are lower.

4.5 Robustness

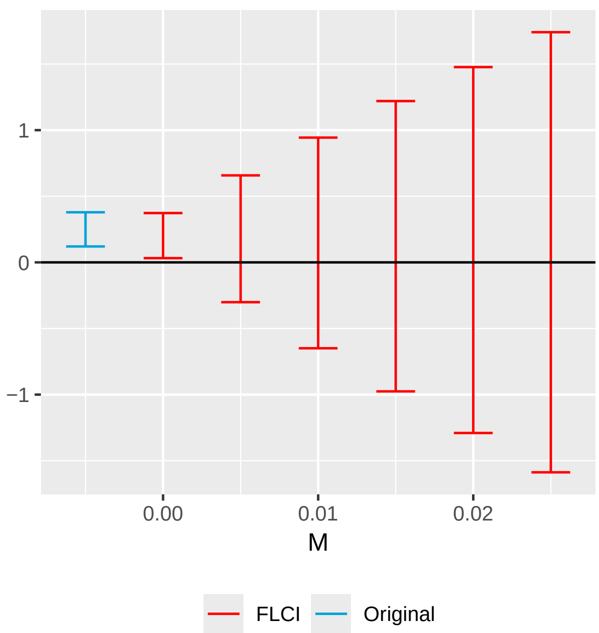
Next, we conduct key robustness checks. First, we examine the sensitivity of our main results to violations of parallel trends by implementing robust pre-trend tests from Rambachan and Roth (2023). Second, we investigate whether our estimates are interpretable as semi-elasticities. As shown by Chen and Roth (2023), if a treatment affects the extensive margin and the outcome is a log-like transformation, the estimands need not be a semi-elasticity. We show that alternative specifications with estimands robust to the existence of effects along the intensive margin result in broadly similar conclusions.

Pre-trend Testing While our pre-treatment estimates fail canonical statistical significance tests, low statistical power means that we cannot conclude that there are no pre-trends (Roth, 2022). Therefore, we implement Rambachan and Roth (2023)'s pre-trend test for our initial results of Figure 3. Because the most likely threat to our parallel trends assumption is a continuous divergence and not singular outliers from the trend, we implement a smoothness restriction. We calculate confidence intervals for our last post-treatment period that are robust to different levels of violations from parallel trends. Figure 11 reports the result from this exercise. We find that, while there are no pre-trends detectable, small violations from parallel trends in the post-treatment period between the treatment and control group would result in statistically insignificant estimates. Nearly any violation of parallel trends would result in statistically insifignificant effects on manufacturing employment (Panel (a)) or firm numbers (Panel (b)) and, for manufacturing shipments (Panel (c)) or value added (Panel (d)), our estimates are only robust to a divergence in parallel trends by 0.5%. We attribute our low range of potential deviations to the large standard errors we observe throughout most of our results.

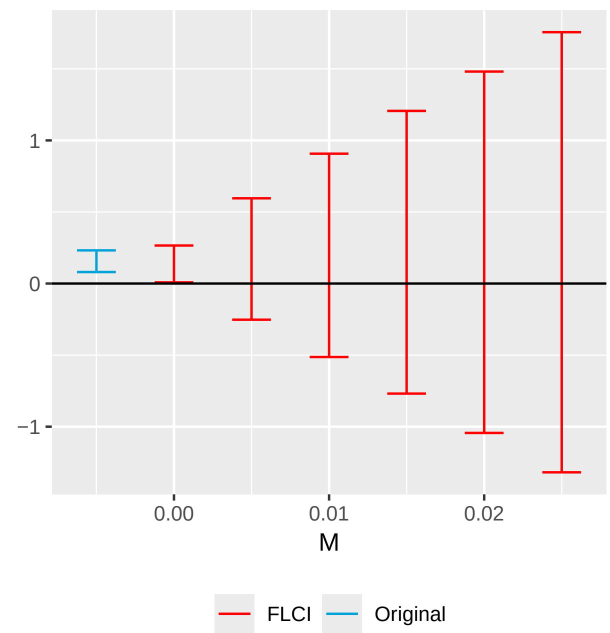
Log-like Transformations Our main specification uses a log-like transformation of the dependent variables. That is, for some variable of interest, y, we use $log(y + 1)$ as the dependent variable, allows us to interpret our estimates as semi-elasticities. However, as Chen and Roth (2023) show, this is true only if the treatment effects along the extensive margin are zero.

This is not a concern for our estimates for aggregate employment. However, because a significant

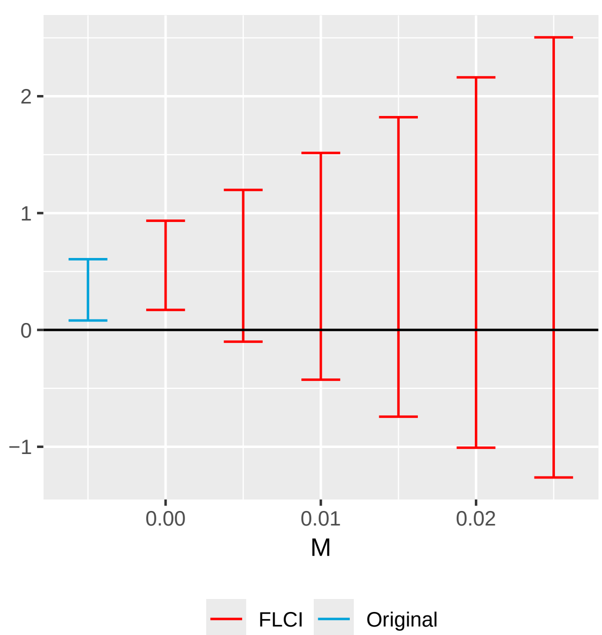
Figure 11: Effect with Robust Confidence Intervals



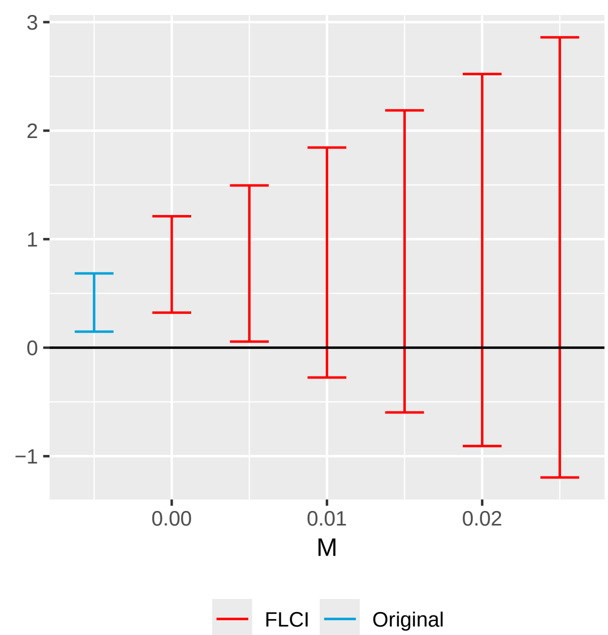
(a) Manufacturing Employment



(b) Manufacturing Firm Number



(c) Manufacturing Shipments



(d) Manufacturing Value Added

Notes: 95 % Confidence intervals of final period in Figure 3, with increasing deviation from parallel trends. Blue bracket shows baseline effects, while red brackets give increasing confidence intervals of increasing deviation. Data on employment and firm numbers is taken from the NBS. Data on Shipments and Value added is taken from the MMS.

number of our outcomes are zero-valued, e.g., because there is no manufacturing employment in about one-third of all districts. Thus, we reestimate our model via Poisson Pseudo Maximum Likelihood Regression under which our estimand turns into the percentage change in the average outcome among units, if they switched to treated status (Wooldridge, 2010, chapter 18.2). Appendix Figure 27 reports the estimates from this exercise for four outcomes: total employment (as a baseline) and manufacturing employment from the National Business Survey and manufacturing value added and output from the Mining and Manufacturing survey. The estimates are of similar magnitudes as from our baseline estimation fixed effects ordinary least squares regression.[22]

5 Job Multipliers

Our analysis has thus far established that the introduction of new industrial complexes leads to substantial increases in local manufacturing employment, along with positive spillovers to unsubsidized sectors. While these patterns point to broader local economic benefits, a meaningful evaluation of the policy requires quantifying their size. In particular, we seek to measure how many additional jobs are generated per subsidized manufacturing job, i.e., the local job multiplier, and to assess whether the observed expansion reflects net new economic activity rather than reallocation. In this section, we focus on the first of these questions by estimating the magnitude of spillovers.

To do so, we adopt Faggio (2019)'s methodology for estimating job multipliers to our stacked difference-in-differences model in long differences,

$$\Delta Y_r = \phi_c + \varphi^D \Delta CE_r^D + \varphi^I \Delta CE_r^I + \phi_c \times X_r' \delta + \epsilon_r, \tag{4}$$

where ΔY_r denotes the long-difference in district r's employment between the year before and 10 years after construction begins. We use total employment, total employment minus directly received complex employment, and sectoral employment. Similarly, ΔCE_r^D captures employment growth in industrial complexes within district r and, correspondingly, ΔCE_r^I represents the growth in employment in industrial complexes whose centroid lies within 15.5 kilometers of the district r's

[22]Other outcomes are omitted for sake of brevity. They are available upon request from the authors.

centroid.

Three points are worth highlighting. First, because we exclude districts treated prior to 1999, both ΔCE_r^D and ΔCE_r^I correspond to employment levels ten years after construction begins. As a result, although our employment data start in 2001, we are able to estimate job multipliers for industrial complex openings dating back to 1991. However, we restrict our attention to complexes designated between 1999 and 2007, consistent with the sample used in the preceding sections.

Second, since accurately measuring treatment intensity is crucial for estimating job multipliers we aggregate complex employment across multiple treatments. That is, if a district is treated twice within 10 years, we sum employment across both complexes.

Third, while a quarter of all industrial complex extend across district boundaries, none in our estimation sample do. Thus, there is only one receiving district and, on average, 4.6 neighboring complexes.[23]

Lastly, we include cohort fixed effects, ϕ_c, and a set of control variables, X_r, interacted with these cohort fixed effects. The inclusion of cohort fixed effects ensures that job multipliers are identified from comparisons within cohorts and eliminates the need to include year fixed effects. The control variables mirror those used in our main specification in the preceding section and include both geographic and economic characteristics. Specifically, we control for log population density in 1990 and the average employment shares of the manufacturing and agriculture sector in the five years prior to designation. In addition, we include average growth in total and manufacturing employment over the five years preceding construction.

Table 3 reports the estimated job multipliers. Columns (1)–(3) present estimates for total employment, including employment within industrial complexes, from alternative specifications. Columns (4)–(6) use total employment minus complex employment as the outcome, such that the represent the additional jobs brought on top complex employment. For each outcome variable, the third specification is our preferred variant, because it includes the most control variables. The estimated multipliers for receiving districts range from 1.1 to 1.3, implying that each job created within an industrial complex increases aggregate resident district employment by 1.1 to 1.3 jobs (see columns (1)–(3)) or, put differently, adds 0.1 to 0.3 (see columns (6)–(9)) additional jobs. Job

[23]The median is three.

Table 3: Impact Complex Employment on Local Employment

	Total Employment			Excluding Complex Employment			Excluding Manufacturing		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Receiving areas									
0 km	1.041	1.029	1.225	0.041	0.029	0.225	0.271	0.249	0.261
	(0.165)	(0.158)	(0.176)	(0.165)	(0.158)	(0.176)	(0.153)	(0.143)	(0.161)
Spillovers									
0–15 km	0.103	0.064	0.156	0.103	0.064	0.156	0.166	0.116	0.136
	(0.064)	(0.062)	(0.069)	(0.064)	(0.062)	(0.069)	(0.059)	(0.056)	(0.063)
District controls		✓	✓		✓	✓		✓	✓
Pre-trends			✓			✓			✓
Observations	554	554	554	554	554	554	554	554	554

Notes: Robust Standard errors are reported in parenthesis. All columns show long difference changes in employment for districts receiving an industrial complex, as well as changes in surrounding districts, following model (3.4). Columns (1)–(3), give change in total employment, columns (4)–(6) change in employment excluding complex employment and columns (7)–(9) change in employment excluding the manufacturing sector. Columns (1),(4) and (7) include neither district controls nor pre-trends, Columns (2),(5) and (8) include only district controls and Columns (3),(6) and (9) include both district controls and pre-trends. Data on district employment is taken from NBS. Data on complex employment is taken from KICOX.

multipliers for neighboring districts are substantially smaller, ranging from 0.06 to 0.15. Given that each complex treats on average four neighboring districts, a single job in a complex adds another 0.2 to 0.6 jobs in the surrounding districts. The overall effect lies between 0.3 and 0.9 additional jobs, which is well in line with the literature. For example, using Bartik instruments, Van Dijk (2017) estimates that adding one tradable job adds 0.17-0.93 additional jobs.

Columns (7) through (9) use total employment minus manufacturing employment as outcome variable. Thus, these estimates examine the strength of spillovers to sectors other than employment. Using the same logic as before, these estimates suggest job multipliers in the range of 0.8 to 0.9. This suggests that, on net, nearly additional jobs created by industrial complexes accrue sectors other to manufacturing. If anything, because these estimates are much larger than those from columns (1) through (6), this suggests that a fraction of the employment at industrial complexes may simply be the result of relocation from within treated districts.

To investigate these possibilities, we estimate sector-specific job multipliers for manufacturing, services, and construction, i.e., the only sectors exhibiting a detectable employment response at the regional level. Table 4 reports the estimates.[24] One additional job in an industrial complex increases employment in the receiving district by approximately 0.03 jobs in construction, 0.2 jobs in services, and 0.77 to 0.96 jobs in manufacturing, including itself. The corresponding estimates for the neighboring districts are 0.01, 0.12, and effectively zero, respectively. These estimates imply total job multipliers of 0.07 for construction, 0.68 for services, and 0.77 to 0.96 for manufacturing, again including the added manufacturing job in industrial complexes.

Two issues are worth pointing out. First, the finding that there are no spillovers in the manufacturing sector is at odds with the finding in Section 4.4, that manufacturing employment in districts that are only nearby new industrial complexes increases by 15%. This can be explained by the level of pretreatment manufacturing employment in districts that are treated but do not receive industrial complexes, which is very low (139 employees). A semi-elasticity of 15% after ten years thus represents 20.7 additional employees. If we consider the estimated (albeit statistically insignificant) job multiplier of 0.02 and that the average industrial complex employment is just

[24] Results for the remaining sectors are shown in Appendix Table 8. However, the effects are close to zero and insignificant across the board. This is somewhat expected as our main results are that complex do not substantially affect employment in these sectors.

Table 4: Impact Complex Employment on Local Employment

	Construction			Services			Manufacturing		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Receiving areas									
0 km	0.050	0.044	0.033	0.200	0.185	0.209	0.770	0.780	0.964
	(0.026)	(0.024)	(0.028)	(0.138)	(0.131)	(0.148)	(0.058)	(0.056)	(0.062)
Spillovers									
0–15 km	0.017	0.010	0.014	0.141	0.100	0.117	−0.063	−0.052	0.020
	(0.010)	(0.009)	(0.011)	(0.053)	(0.051)	(0.058)	(0.022)	(0.022)	(0.024)
Area controls		✓	✓		✓	✓		✓	✓
Pre-trends			✓			✓			✓
Observations	554	554	554	554	554	554	554	554	554

Notes: Robust Standard errors are reported in parenthesis. All columns show long difference changes in employment for districts receiving an industrial complex, as well as changes in surrounding districts, following model 4. Columns (1)–(3), give change in construction employment, columns (4)–(6) change in service employment and columns (7)–(9) change in manufacturing employment. Columns (1),(4) and (7) include neither district controls nor pre-trends,Columns (2),(5) and (8) include only district controls and Columns (3),(6) and (9) include both district controls and pre-trends. Data on district employment is taken from NBS. Data on complex employment is taken from KICOX.

over 1,000 employees, we get an average effect of just over 20 employees for neighboring districts. Thus, this results are in fact very much in line with each other.

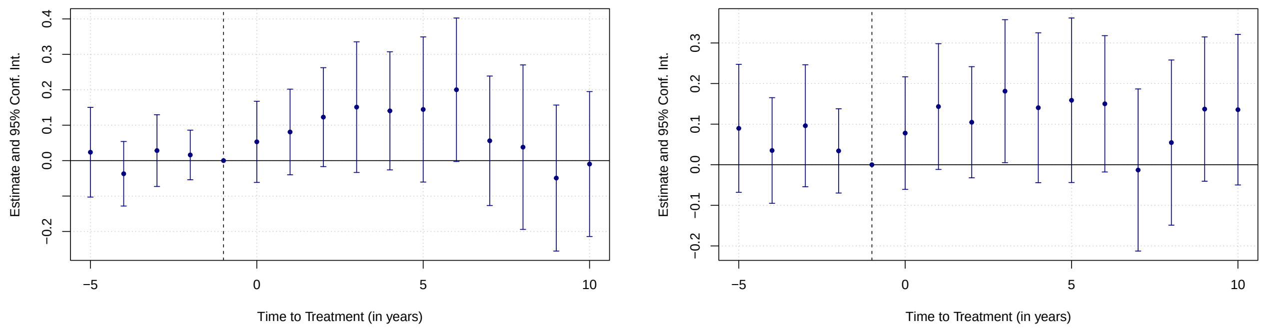
Second, across all specifications the job multiplier for manufacturing is smaller than one, although the job multiplier is not statistically different from 1 in our preferred specification in colum (9). This raises concerns, because roughly two thirds of the observed employment gains are due to incumbent establishments expanding. This suggests that incumbent establishments either relocate into industrial complexes or that industrial complexes crowd out existing manufacturing employment. Unfortunately, our data does not allow us to test these potential explanations.

6 Potential Channels of Incumbent Manufacturing Expansion

Our results have thus far shown that industrial complexes raise local employment and do so by more than the number of workers they employ, although gains in manufacturing beyond the industrial complexes are so small that they are statistically insignificant. Moreover, the majority of gains in manufacturing are the result of incumbent establishments expanding. We now explore one potential channel that could help explain why complexes induce incumbent establishments' expansion: productivity gains due to agglomeration and localisation economies (see, e.g., **?**) or business service support (see, e.g., Bartik, 2020). For this, we reestimate model 1 with measures of productivity, e.g., output per worker. We restrict our attention to incumbent establishments, because we are interested in their expansion.

Figure 12 reports the effects of industrial complex designation on alternative measures of productivity. Panel (a) presents the effects on output per worker and Panel (b) on value added per worker. Appendix Figures 29 and 30 report the same outcomes for different sets of establishments: all establishments including new entrants, small establishments, and large establishments. Both pre- and post-treatment point estimates are statistically insignificant, suggesting the absence of pre-trends as well as the absence of any productivity effect on incumbent establishments. This finding is concerning insofar exploiting agglomeration economies is an explicit goal of this policy is to raise

Figure 12: Effect on Productivity of Manufacturing Establishments



(a) Log Output per Worker of Incumbent Establishments

(b) Log Value Added per Worker of Incumbent Establishments

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are (a) log transformed output per worker and (b) valueadded per worker for incumbent establishments. Data is taken from the MMS.

the productivity of local manufacturing through agglomeration economies (Korea Research Institute for Human Settlements, 2020).[25] These results are also consistent with the lack of any significant job multiplier in the manufacturing sector, since it is unlikely that agglomeration spillovers would be confined to the boundaries of the industrial complexes.

However, our results should not be interpreted as conclusive evidence against productivity effects. Since the data lacks establishment identifiers, the dependent variable is the average output per worker in a district-year observation. Thus, our results might mask substantial heterogeneity across establishments. Moreover, if industrial complex designation affects establishments likelihood of exiting the sample, for example by falling below the employment threshold for the Mining and Manufacturing Survey or by ceasing operations altogether, the estimated effects may be confounded.

This null result raises the question which other channel could potentially explain the expansion of incumbent manufacturing establishments. In their analysis of the United Kingdom's investment subsidies targeting left-behind areas, Criscuolo et al. (2019) find that the policy raises employment and investment by small firms, but has no effect on productivity measures or on large firms receiving these subsidies. They argue that this is consistent with the United Kingdom's policy alleviating capital constraints facing smaller firms. Indeed, Appendix Figure 28 shows that the value of tangible

[25]The source refers to this as clustering effects.

assets among incumbent establishment increases after an industrial complex was designated nearby. This is primarily driven by the value of building and structures and not by growth in the value of machines. Appendix Figure 21 confirms that he effect exists only for small establishments.

7 Conclusion

We evaluate the local effects of South Koreas industrial complex policy, one of the largest and longest-running place-based interventions. Linking administrative establishment data to detailed information on industrial complex designations, we document large and persistent increases in local employment and manufacturing activity following designation: ten years after designation, total local employment is approximately 15 percent higher. Estimating job multipliers associated with industrial complexes, we find that employment and output growth in manufacturing is largely driven by activity within the complexes themselves. At the same time, we observe spillovers to the local non-manufacturing economy: each additional job in an industrial complex raises employment in the services and construction sectors by 0.3 to 0.9 jobs.

Our findings suggest that industrial complexes are successful in expanding incumbent firms, albeit without generating significant spillovers within the manufacturing sector, while generating substantial spillovers beyond manufacturing. In particular, total employment increases by 1.3 to 1.9 times the number of subsidized jobs. However, this does not necessarily imply that the policy is efficient at the national scale. Since gains in manufacturing are driven predominantly by increased toll processing, industrial complexes may simply relocate supply chains and thus economic activity across space.[26]

Taken together, our findings suggest that while industrial complexes generate sizable local employment gains, much of the manufacturing response reflects activity within the complexes themselves, with broader benefits accruing primarily through non-manufacturing spillovers.

[26]Even if the policy merely relocates economic activity, it may still be efficient, for example, if the positive externalities of raising employment in lagging regions exceed those of raising employment elsewhere (Austin et al., 2018).

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I Additional Institutional Background

I.1 Historical Backdrop of Korea's Place-based Industrial Policy

Following the Korean War and the 1961 coup led by Park Chung-hee, the Korean government launched an industrialization strategy through a series of Five-Year Economic Development Plans (for a detailed discussion, see, e.g., **?**).

Recognizing the countrys limited resources, Parks administration concentrated subsidies geographically, constructing twelve industrial complexes and initiating major infrastructure projects in Seoul and across Koreas southeast between 1962 and 1971. Under the First Five-Year Economic Development Plan (1962–66), the government pursued export-led growth, investing heavily in infrastructure such as roads, railways, and schools, and promoting labor-intensive and light industries–such as plywood, shoe manufacturing, and textiles, particularly in Seoul and the southeast, where labor was abundant. During the Second Five-Year Economic Development Plan (1967–71), the focus shifted toward capital accumulation through import substitution, leading to the development of petrochemical complexes along Koreas southern coast (e.g., Ulsan and Yeochun) to support fertilizer production and oil refining.

In response to the Nixon Doctrine of 1969, which stated that U.S. allies would be primarily responsible for their own defense, Koreas government restricted its subsidies to heavy and chemical industries during the 1970s. The heavy and chemical industry drive concentrated government subsidies on six key industries: steel, petrochemicals, nonferrous metals, shipbuilding, machinery, and electronics (for an evaluation, see, e.g., Lane, 2024). Nevertheless, industrial complexes remained the main vehicle through which these industrial policies were implemented (Kim et al., 2021).

The assassination of Park Chung-hee in 1979, the subsequent political turmoil, and South Koreas democratization in 1987 led to another shift in industrial policy. In order to reduce severe economic disparities between Seoul, Busan, and rural regions, Koreas government built nearly 200 *agricultural complexes*, which promote manufacturing industries in rural towns, between 1985 and 1989. Furthermore, to alleviate congestion in Seoul, another 128 *common complexes* were built, mostly on the southern outskirts of the capital, to relocate firms from Seoul. Figure 1, which plots the number of newly designated industrial complexes by type and year, highlights this shift in industrial policy, displaying spikes in the designation of agricultural and common complexes between 1985 and 1990 and between 1990 and 2000, respectively.

Although the policys overarching goal remained balanced economic growth and the promotion of new growth engines, Koreas industrial complex policy has been refined multiple times since. As the key industries behind Koreas rapid economic development matured, the policys scope expanded to include non-manufacturing industries, culminating in the introduction of *urban high-tech complexes* in 2001. Following the 2008 financial crisis, the policy shifted toward protecting manufacturing jobs. Since the mid-2010s, the focus has been on sharpening the competitiveness of existing industrial complexes and upgrading infrastructure rather than constructing new complexes.

I.2 Detailed Description of Subsidies

In this appendix, we provide a more detailed overview of the subsidies available to tenant factories in industrial complexes. Our description draws on the laws that establish the legal framework for industrial complexes (Republic of Korea, 2025a,b).

Across all complexes, tenant companies receive four forms of support: financial, regulatory, managerial and infrastructural. The principal financial assistance consists of reductions in the land acquisition and property taxes. These provisions are codified in Article 276 of the Local Tax Act (Republic of Korea, 2023b) and, since 2011, in Article 78 of the Local Tax Special Exceptions and Limitations Act (Republic of Korea, 2023a). Prior to 2015, tenants of industrial complexes were fully exempt of land acquisition taxes and, for the first five years of tenancy, were exempted of property taxes. For industrial complexes located in the Seoul Metropolitan Area, the tax reductions were capped at 50% to alleviate congestion in the capital.[27] In 2015 the benefits were reduced: the land acquisition tax reduction was capped at 50 percent, while the property tax exemption was replaced by a 75 percent reduction (35 percent in the metropolitan area). In industrial complexes where land is leased rather than sold, the maximum rent is capped at 3% percent of the land development cost.

Industrial complex also provide infrastructure tailored to the targeted industry, including water treatment facilities, transport infrastructure, residences for workers, and research institutes. Integrated Guidelines for the Development of Industrial Sites outlines the infrastructure projects that governments may provide with industrial complexes, as well as government funding contributions from the national and local level.

Furthermore, finalizing a tenancy agreement with an industrial park also grants all relevant permits, to the company, reducing administrative burden (Industrial Cluster Activation and Factory Establishment Act Article 13(2)-2)

Lastly, the Korea Industrial Complex Cooperation (KICOX), the government agency tasked with managing and supporting industrial complexes, provides managerial support, such as help for moving into complexes, connecting companies within complexes or supporting establishments in loan acquisition. Additional support is also provided by the local public or private managers of the respective industrial complexes.

[27] Higher tax rates in the Seoul Metropolitan Area relative to the rest of Korea are a common feature of Korea's tax code.

II Data Appendix

II.1 Administrative Establishment Data

We access all establishment data through the Korean Microdata Integrated Service's download portal https://mdis.kostat.go.kr/. We download the National Business Survey (NBS) for the period 1994-2020, the Mining and Manufacturing Survey (MMS) for the years 19922019 (excluding 2010 and 2015), and the mining and manufacturing segment of the Economic Census for 2010, 2015, and 2020, replacing the Mining and Manufacturing survey and covering the universe of establishments. Because we access the data remotely, the data sets are anonymized such that values of observations in year-industry-region cells with fewer than three establishments are represented by bins indicating the number of digits. We download all data with the highest spatial resolution, i.e., dong/myeon/eup, and the least disaggregated industry classification, i.e., with 20 industries for the NBS and 2 for the MMS.

II.2 Industry Code Harmonization

The Korean Standard Industrial Classification (KSIC) changes multiple times during our study period. It changes from version 7 to 8 in 2000, then to version 9 in 2006 and finally to version 10 in 2017. Since our data is aggregated at the highest industry classification and we additionally combine multiple KSIC classifications into one broad industry classification, we avoid nearly all switching of subindustries between our categories. Our categories are agriculture (consisting of agriculture, forestry and fishing), construction, mining, manufacturing, public sector (consisting of the public sector and extraterritorial organizations and bodies) and services, which contains of all other sectors. While the change between KSIC 8 and 9 is quite severe, changing the labeling of some top level industries, our grouping keeps all these changes within our categories. One notable exception here is the manufacturing subindustry "industrial machinery & equipment repair" which switches, from services to manufacturing from KSIC 9 to 10. Given that this industry is very small, accounting for less than 1% of manufacturing employment, we do not expect this change to have any effect on our results.

II.3 Crosswalks for District Codes

We rely on different Korean government agency for our data using alternative district codes. We adopt the administrative district codes defined by the Korean Statistical Office used in our establishment data. We match district codes in other data sources, e.g., the population census uses codes as defined by Ministry of Public Administration and Security, using a crosswalk provided by the Korean Statistical Office.

II.4 District Boundaries and Geography

II.4.1 Data Access

District Shapefiles We use district shape files from the Korean Statistical Geographic Information Service (SGIS), accessible at https://sgis.kostat.go.kr. The shape files are available annually since 2000 and five-yearly for the period 1980–2000. Maps are available for the first, second and third layer of administrative division in South Korea.

Land Slope We use elevation data provided by the United States Geographical Service (USGS), which is accessible at https://earthexplorer.usgs.gov/. We combine our elevation data with our district shape-files in ArcGis and calculate the share of flat land, i.e., land with a slope below 20 degrees, for each district.

II.4.2 Harmonizing District Boundaries

We harmonize district boundaries by aggregating districts that ever exchanged territories during the period 1990–2023.

We proceed as follows; we match geometries of districts in year t to geometries of districts in year t+1, if their territories overlap by at least 15%. We choose the 15% overlap threshold to balance accuracy in identifying true administrative continuities against the risk of spurious matches driven by minor boundary adjustments. This many-to-many matching results/ in a panel of supersets of districts that are consistent over time. We aggregate districts within each sets and assign each aggregation a new harmonized identifying number. These unions of districts represent our harmonized districts.

For years in which there are no shape files, we assign the harmonized identifying number to districts by matching based on the next closest year with available shape files and confirming accuracy by cross-validating based of district names using the list of districts available in each NBS survey. Our approach leaves us with 2844 districts, down from the total of 3501 districts in 2020.

II.5 Population Data

Our population data comes from the 1990 *Korean Population Census*, which is available every five years since 1970 and available annually since 2000. We download the census from the website of the Korean statistical office (KOSTAT) https://kosis.kr/. The census reports the number of residents by age and gender for each district, i.e., dong/myeon/eup.

II.6 Data on Industrial Complexes

***Industryland* Database** For information on industrial complexes, we rely on data published by the Korea Research Institute for Human Settlements (KRIHS) on its *Industryland* website.[28] The website provides information on Korea's industrial land policy, of which industrial complexes are the primary tool, including a list of all designated and existing complexes with detailed characteristics on each complex and partial information on establishments operating within them. Data on the *Industryland* website is based on the *Industrial Land Information System* and the *FactoryOn* database.

We scrape the public listings of industrial complexes, covering all complexes that had been designated or were already constructed as of October 31, 2025.[29] Appendix Figure 15 provides an example of a listing for the *Export National Industrial Complex* in Seoul. Each listing contains a table with basic information (complex name, complex id, location, construction dates, whether the complex was developed publicly or privately, and the reason for construction), the developer and the manager of the complex, a table on land use and construction status, a table on project costs, and a list of the targeted sub-industries. We focus on variables relevant to our analysis, which we report in Appendix Table 5. We translate Korean text using the google translate API.

[28]The website can be accessed at industryland.or.kr.

[29]The listings can be accessed at industryland.or.kr/il/ie/list.

Quarterly Reports on Industrial Complexes We supplement our webscraped data with status reports by the *Korean Industrial Complex Corporation*, which are available quarterly since 2001.[30] The status reports include information on new and canceled designations as well as employment, output (in KWON), and exports (in USD), land use, number of tenant factories and number of operating tenant factories for each designated industrial complex.

Industrial Complex Shapefiles We download the shapefiles of industrial complexes designated by the 31st December of 2019 via Korea's open data portal.[31]

II.7 Treatment Definition

Our empirical strategy relies on the Stable Unit Treatment Value Assumption (SUTVA), which requires that each district's outcomes depend only on its own treatment status. In the context of place-based policies, this assumption is particularly restrictive, as it rules out spatial spillovers from treated to untreated districts. Such spillovers are plausible in our setting, for example, if firms or workers relocate from nearby untreated districts into treated districts, implying that SUTVA may be violated.

To address this concern, we implement a robustness check that broadens the definition of treatment to explicitly capture potential geographic spillovers. While this approach changes the interpretation of the estimand, it allows us to recover an unbiased estimate under spatial interference and yields an estimand that we view as more economically meaningful in a spatial context.

The key challenge is to determine the geographic reach of potential spillovers. We do so by estimating a spatial difference-in-differences model that flexibly allows treatment effects to vary with distance from the treated location. Specifically, we construct a dataset of district–complex pairs whose geographic centroids lie within 50 kilometers of each other and restrict attention to industrial complexes designated after 1995 to ensure sufficient pre- and post-treatment outcome data.

Using these district–complex pairs as the unit of observation, we estimate the following specification:

$$\ln(Y_{rt}+1) = \gamma_{rp} + \eta_{tp} + \sum_{b=1}^{10} \beta_b \mathbf{1}\{\text{distance}_r \in \mathcal{B}_b\} \times T_{rtp} + \eta_{tp} \times X_r'\delta + \varepsilon_{rt}, \tag{5}$$

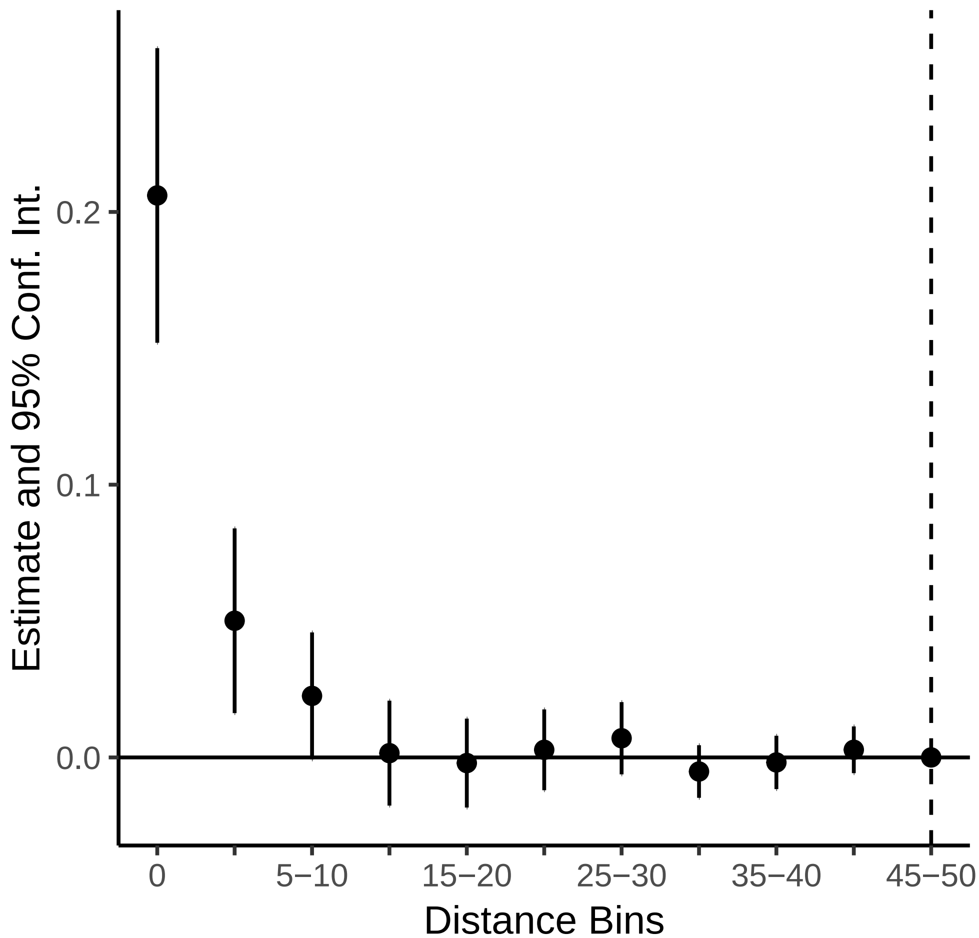
where γ_{rp} and η_{tp} denote district-by-complex and year-by-complex effects respectively. The outcome variable $\ln(Y_{rt}+1)$ represents log total employment in district r at time t. For simplicity, we use only one outcome: overall employment from the National Business Survey, because this captures geographic spillovers across multiple sectors. T_{rtp} indicates whether industrial complex p is designated as treated at time t.

The indicators $\mathbf{1}\{\text{distance}_r \in \mathcal{B}_b\}$ correspond to distance bins defined over the distance between district centroids and industrial complex locations. The first bin captures districts that directly receive employment from the complex, while bins two through ten represent untreated districts located at increasing distances from the complex in five-kilometer intervals, up to a maximum distance of 50 kilometers.

Lastly, we allow for differential trends across catchment areas by interacting a vector of time-invariant district characteristics, X_r, (log population density) with year-by-complex effects. The

[30] The reports can be downloaded at https://www.kicox.or.kr/.
[31] Korea's open data portal can be accessed at https://www.data.go.kr/.

Figure 13: Spatial Difference-in-Differences



Notes: The figure plots estimates of the spatial difference-in-differences specification in equation (5). Points show estimated treatment effects by distance bin relative to untreated districts located more than 50 kilometers from any treated industrial complex. Vertical bars indicate 95% confidence intervals based on heteroskedasticity-robust standard errors.

error term ε_{rt} captures unobserved determinants of employment.

As in a standard difference-in-differences framework, identification relies on comparing changes in outcomes over time. However, the year-by-complex and district-by-complex effects ensure that we compare outcomes of districts which are located within the 50 kilometer radius but at different distances to the same industrial complex. The estimated coefficients β_b therefore trace out how the treatment effect varies with geographic distance, allowing us to assess the presence and spatial extent of spillovers.

Figure 13 presents the corresponding point estimates. The estimates clearly show that there are geographic spillovers beyond districts that do not receive any employment from an industrial park, but that these spillovers dissipate quickly after 10 or so kilometers.

III Additional Figures and Tables

Figure 14: Aerial Photograph of the Gumi National Industrial Complex

Notes: Aerial photograph of the Gumi National Industrial Complex built in 1969 and expanded multiple times since its initial construction. The complex employs roughly 70,000 workers and specializes in semi-conductor and related industries. Source: `https://www.investkorea.org/ik-en/bbs/i-5045/detail.do?ntt_sn=490770`. Accessed on the 17th December, 2025.

Figure 15: Example of an Industrial Complex Listing

한국수출국가산업단지

목록

단지기본정보	시설용지별 세부내역	기반시설현황	유치업종	추진현황
입주기업				

1. 단지정보 | 2. 사업시행자 및 관리기관 | 3. 시설용지 현황 | 4. 토지이용현황 | 5. 사업비 | 6. 보고서

1. 단지정보

단지명(111010)	한국수출국가산업단지	소재지	서울	구로구	
단지유형	국가	조성상태	조성완료		
임대단지구분		분양상태	분양완료		
위치	서울특별시 구로구 구로동, 금천구 가산동 일원, 인천광역시 부평구 청천동, 서구 가좌동, 남구 주안동, 부평구 십정동 일원				
조성목적 및 특징	수출 진흥과 균형있는 국민 경제의 발전에 기여				
사업기간(년월)	1964-04 ~ 1974-11				
개발방법	공영개발	사업주체	공사		
지정일	1964-04-15	지정면적(주1)	3,708,451㎡	조성공정율(주1)	100%
기본고시일		실시계획승인일(최초)	1965-03-12	준공인가일	1974-11-05
착공일자	1965-03-12	계획변경일(최종)	2025-06-05		
지정근거법	수출산업공업단지개발조성법				
유치업종	한국표준산업분류상전제조업(*입주제한 업종 고시문 참조)				
분양연락처					
해당사이트					

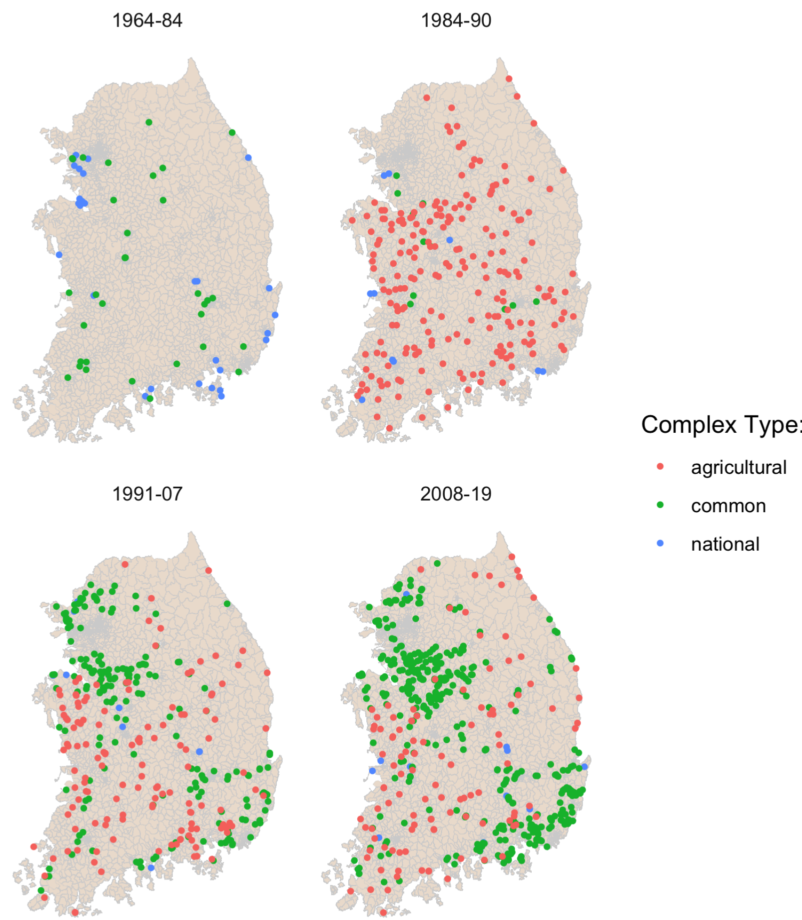
※ 소재지, 단지유형 및 지정일자는 산업입지정보센터에서만 수정이 가능합니다.(수정 필요 시 센터연락)
주1) 지정면적 및 조성공정율은 아래 '시설용지별 지정.개발.분양 현황' 면적 변경시 자동 반영됩니다.

2. 사업시행자 및 관리기관

사업시행자명	한국산업단지공단
관리기관명	한국산업단지공단

Notes: Screenshot of a listing for the Korea Export National Industrial Complex in Seoul. For details on the public listings, see the Data Appendix II.6.

Figure 16: Location of Newly Designated Industrial Complexes By Year and Type



Notes: The figure plots the location of newly designated industrial complexes for five periods on a map of South Korean provinces–the first-level administrative division. The shapefiles for the administrative regions come from Statistical Geographic Information Service (SGIS) and the shapefiles for each (sub-)complex come from the Industrial Land Information System. Each dot represents a newly designated complex which may consist of a set of contiguous sub complexes. In cases where subcomplexes are not contiguous, we plot each subcomplex separately with the designation date of that subcomplex. Complexes that were designated, developed, or managed separately but are contiguous are shown separately. Each dot's color represents the type of the complex as of December 2024. The map omits Jeju island and islands which are smaller than 75 square kilometers. The map also does not show the location of six industrial complexes built since the 1980s on Jeju island.

Table 5: Description of Scraped Variables

Variable	Variable Description
complex_id_official	official six digit complex id
complex_name	complex name
complex_type	complex type (national, common, urban high-tech, agricultural)
development_method	development method (e.g., private, public, joint, private by tenant companies)
location_1	name of highest administrative division (province, special city, or self-governing city)
location_2	name of second highest administrative level (city or county)
location_3	name of lowest regional administrative division (township, villages, or towns); we call this district
date_designation	date at which an industrial complex was designated by the responsible entity
date_notification	date at which public was notified of designation
date_approval	date at which designation was approved by land policy council (if required)
business_period	period between construction start and
legal_basis	law which was the basis for the designation
purpose	paragraph explaining the purpose of the industrial park
business_operator	name of entity developing park
management_agency	name of agency managing park after development
Shipments_status	(Shipments plan, lots for sale, sale completed)
construction_status	land use plan, under construction, construction completed
construction_date_end	date (mm-yyyy) at which construction is completed
construction_date_start	date (mm-yyyy) at which construction commences
land_use_total	total area designated for complex
land_use_residential	area designated for residential use
land_use_commercial	area designated for commercial use
land_use_industrial	area designated for industrial use
land_use_green	area designated for green space
land_use_other	area designated for other uses
cost_total	total cost
cost_research	cost for research facilities
cost_construction	cost for construction
cost_compensation	cost for compensation (e.g., for appropriation)
cost_environment	cost for environmental projects
cost_maintenance	cost for maintenance
cost_reserve	cost for reserve funds

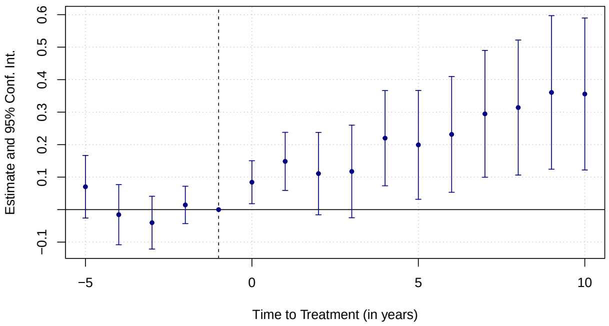
Notes: This table lists all variables scraped from public listings on *industryland.or.kr*. Variable names correspond to cleaned identifiers used in the empirical analysis. Monetary values are reported in Korean Won.

Table 6: Censoring Rates of Establishment Information by Year

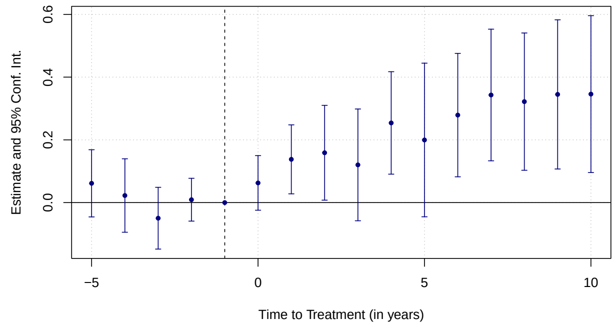
Year	**NBS**	**Supplemented MMS**	**MMS**
1994	0.60%	0.31%	0.91%
1995	0.54%	0.29%	0.85%
1996	0.53%	0.29%	0.85%
1997	0.51%	0.30%	0.92%
1998	0.49%	0.29%	0.96%
1999	0.47%	0.29%	0.88%
2000	0.45%	0.27%	0.82%
2001	0.45%	0.25%	0.74%
2002	0.43%	0.26%	0.74%
2003	0.42%	0.28%	0.74%
2004	0.41%	0.28%	0.73%
2005	0.41%	0.27%	0.72%
2006	0.47%	0.27%	0.71%
2007	0.46%	0.39%	2.00%
2008	0.45%	0.38%	1.98%
2009	0.44%	0.39%	2.03%
2010	0.43%	0.02%	0.02%
2011	0.41%	0.38%	1.94%
2012	0.39%	0.36%	1.92%
2013	0.38%	0.34%	1.82%
2014	0.37%	0.33%	1.83%
2015	0.37%	0.31%	1.78%
2016	0.35%	0.30%	1.84%
2017	0.34%	0.29%	1.78%
2018	0.34%	0.28%	1.75%
2019	0.33%	0.29%	1.81%
2020	0.20%	0.22%	1.74%

Notes: This table reports the share of observations (i.e., establishments) whose data is censored, as a percentage of total establishments surveyed. Censoring rates are calculated separately for the National Business Survey (NBS) and the Mining and Manufacturing Survey (MMS) after cleaning the respective data sets. Supplemented MMS refers to a data set in which we append the MMS with NBS observations from manufacturing establishments below the employment cutoff. The mining and manufacturing section of the Economics Census replaces the MMS for the years 2010, 2015, and 2020. The jump in the censoring rates in the MMS from 2006 to 2007 is due to an increase in the employment cutoff from 5 to 10 employees.

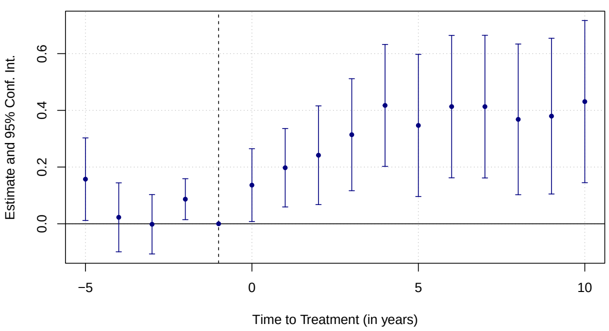
Figure 17: Effects of Industrial Complex Designation on Additional Manufacturing Outcomes



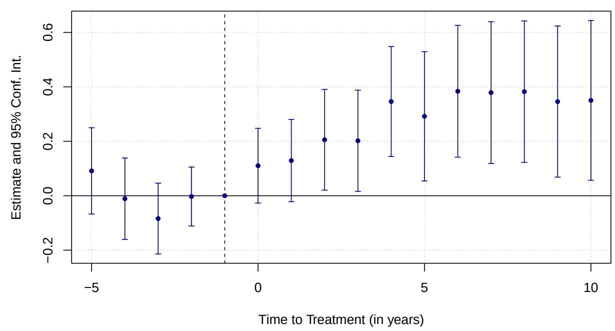
(a) Log Manufacturing Employment



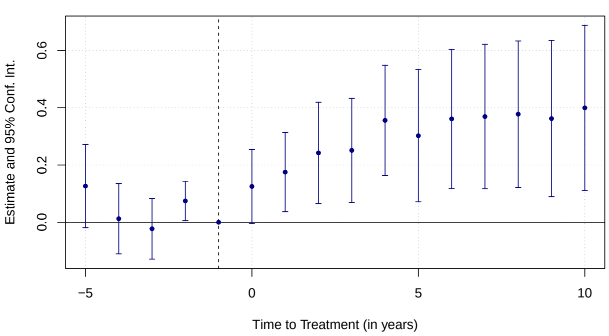
(b) Log Manfacturing Wagebill



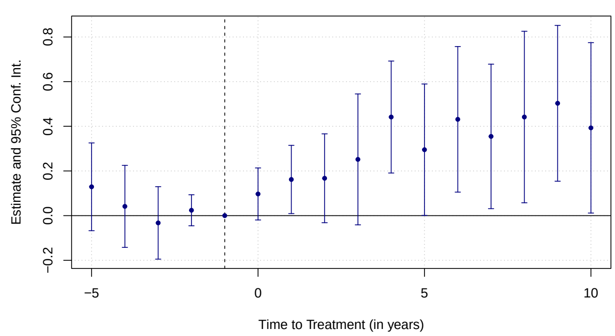
(c) Log Manufacturing Output



(d) Log Operating Cost



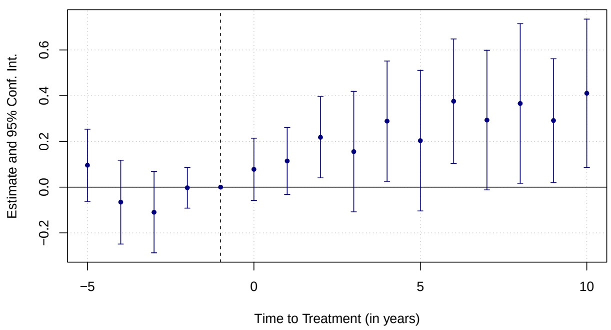
(e) Log Total Shipments



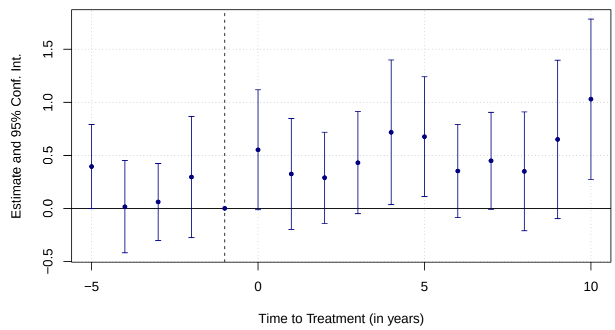
(f) Log Total Assets

Notes: Event study estimates of model (1) with 95% confidence intervals using dependent variables from the Mining and Manufacturing Survey. The dependent variables are log transformed (a) manufacturing employment, (b) wage bill, (c) output, (d) operation cost, (e) total shipments, and (f) total assets. All outcome variables are from the MMS.

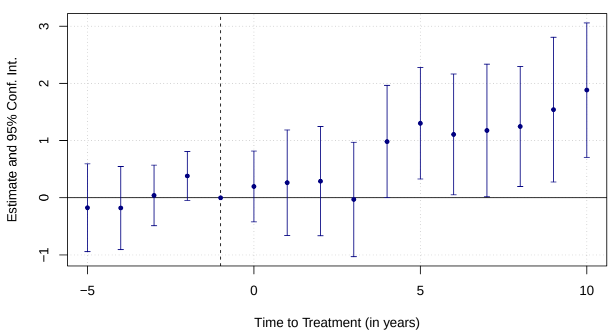
Figure 18: Effects of Industrial Complex Designation on Manufacturing Shipments



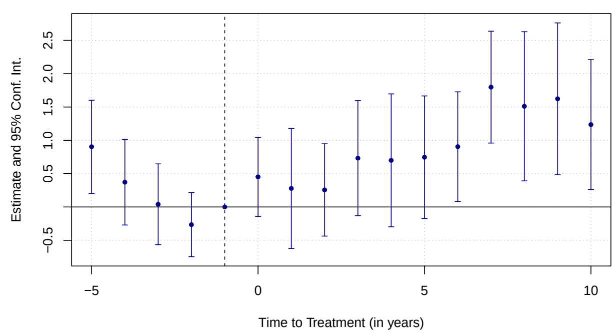
(a) Log Products Shipments



(b) Log Repair Shipments



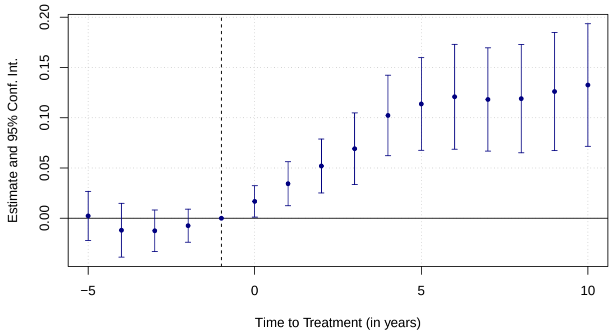
(c) Log Tollprocessing Shipments



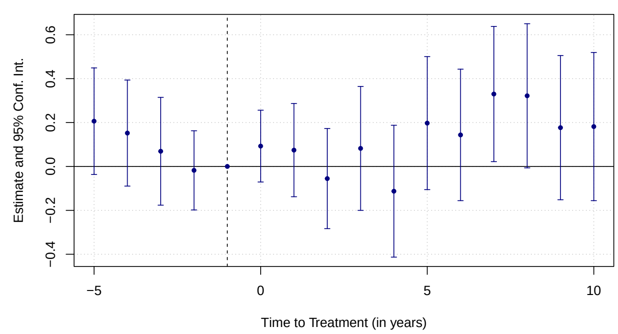
(d) Log byproducts Shipments

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are log transformed (a) product shipments, (b) repair shipments, (c) toll processing shipments, and (d) byproduct shipments. Data is taken from the MMS.

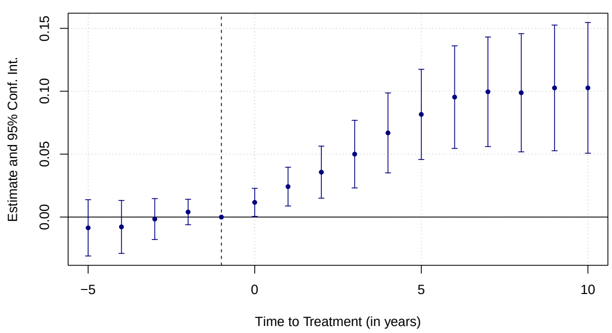
Figure 19: Effects of Industrial Complex Designation on Additional Outcomes by Establishment Size



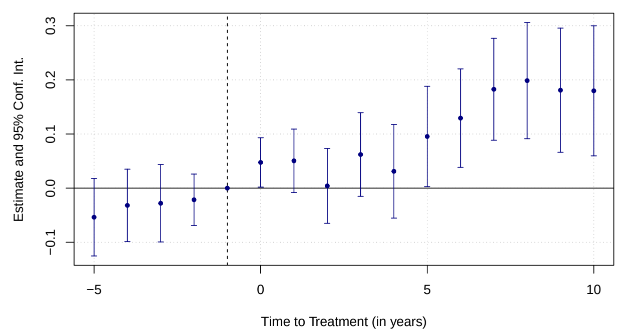
(a) Employment at Small Establishments



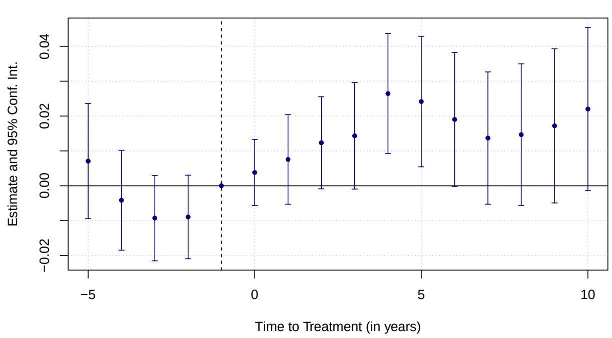
(b) Employment at Large Establishments



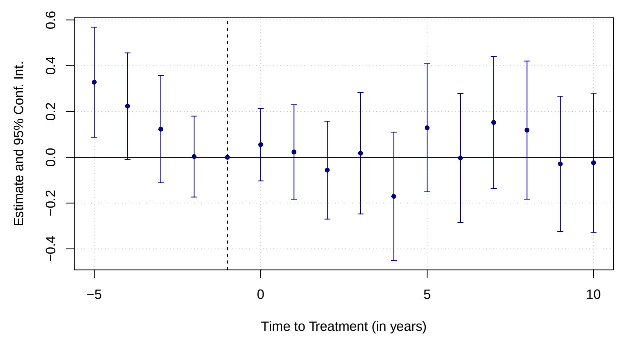
(c) Log No. of Small Establishments



(d) Log No. of Large Establishments



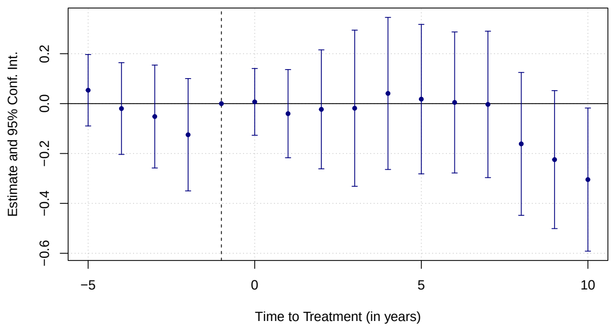
(e) Log Average Employment at Small Establishments



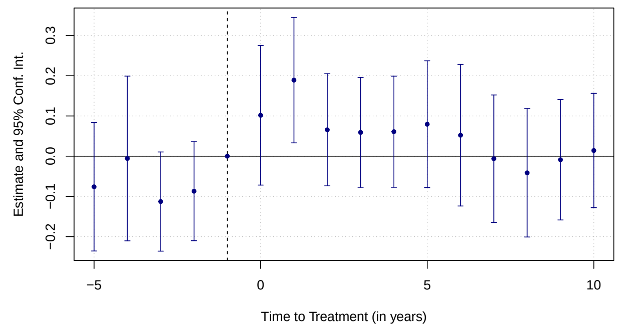
(f) Log Average Employment at Large Establishments

Notes: Event study estimates of model (1) with 95% confidence interval for both small and large establishments. Small establishments are defined as those with less than 50 employees, all others are defined as large. Results for small establishments are shown on the left and for large establishments on the right The dependent variables are log transformed total employment (a)–(b), number of establishments (c)–(d) and average employment (e)–(f). Data is taken from the NBS.

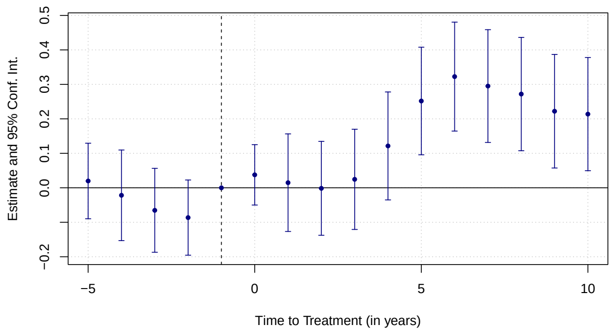
Figure 20: Effects of Industrial Complex Designation on Sectoral Employment by Establishment Size



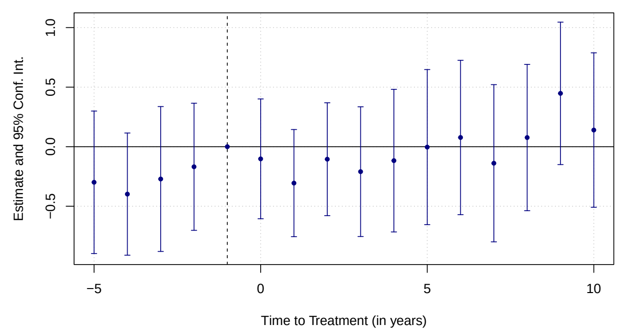
(a) Log Agriculture Employment of Small Establishments



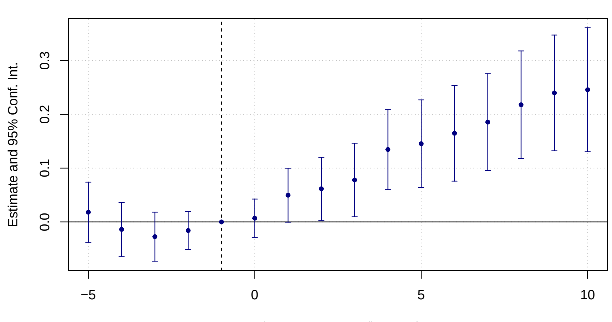
(b) Log Agriculture Employment of Large Establishments



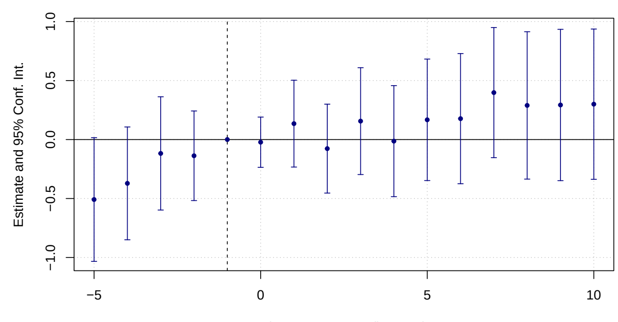
(c) Log Construction Employment of Small Establishments



(d) Log Construction Employment of Large Establishments

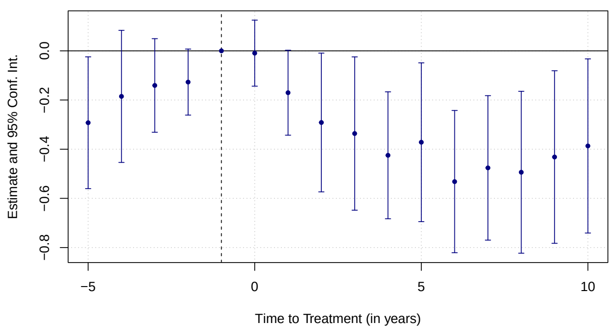


(e) Log Manufacturing Employment of Small Establishments

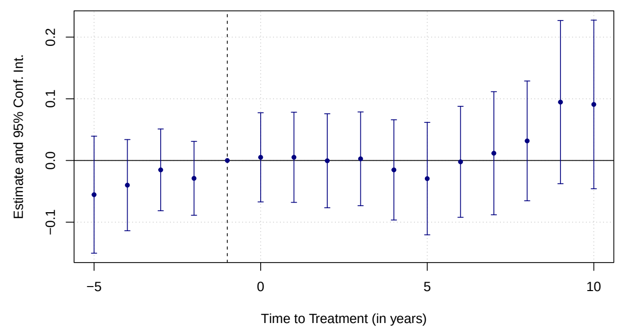


(f) Log Manufacturing Employment of Large Establishments

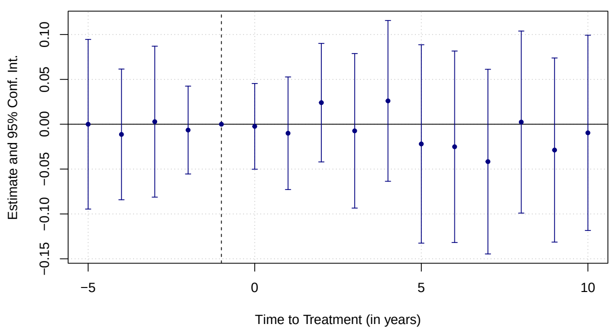
Figure 20: Effects of Industrial Complex Designation on Sectoral Employment by Establishment Size (continued)



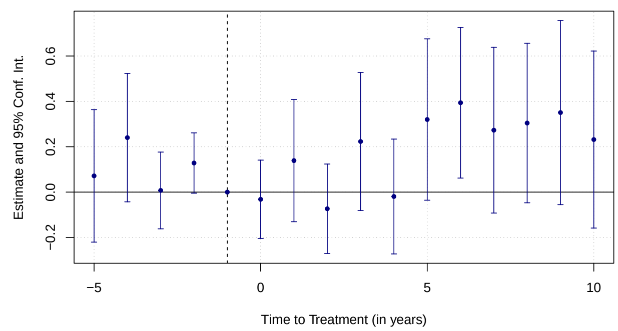
(g) Log Mining Employment of Small Establishments



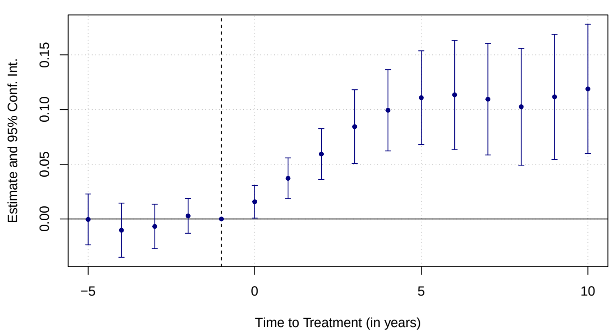
(h) Log Mining Employment of Large Establishments



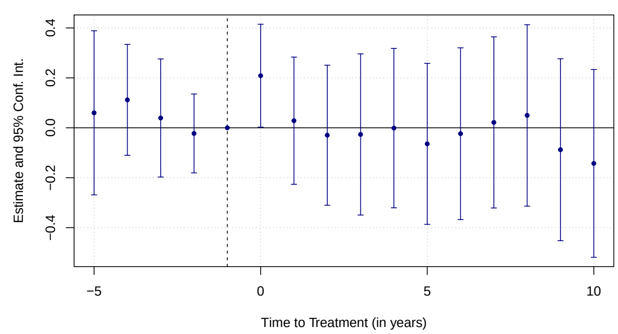
(i) Log Public Employment of Small Establishments



(j) Log Public Employment of Large Establishments



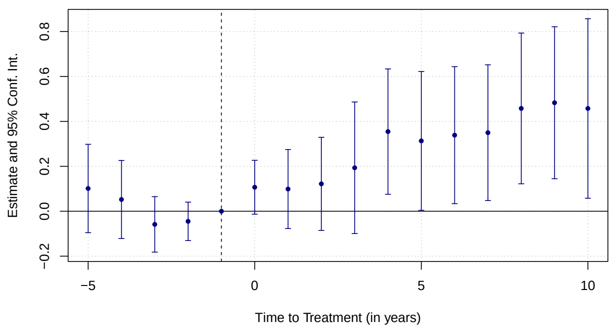
(k) Log Services Employment of Small Establishments



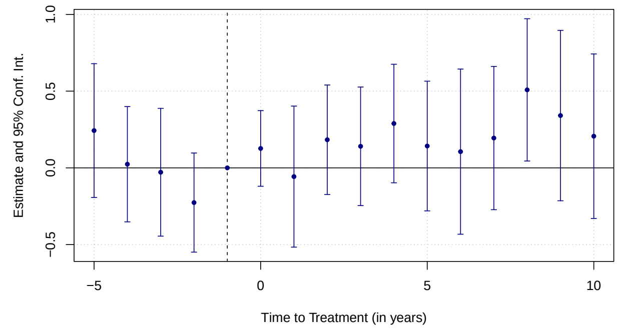
(l) Log Services Employment of Large Establishments

Notes: Event study estimates of model (1) with 95% confidence interval for both small and large establishments. Small establishments are defined as those with less than 50 employees, all others are defined as large. results/ for small establishments are shown on the left and for large establishments on the right The dependent variables are log agricultural (a)–(b), construction (c)–(d), manufacturing (e)–(f), mining (g)–(h), public (i)–(j) and service employment (k)–(l). Data is taken from the NBS.

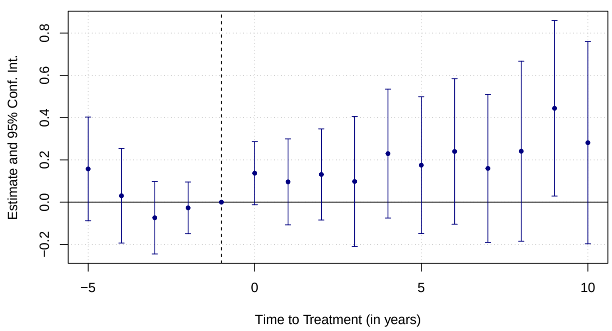
Figure 21: Effects of Industrial Complex Designation on Manufacturing Establishments' Assets by Establishment Size



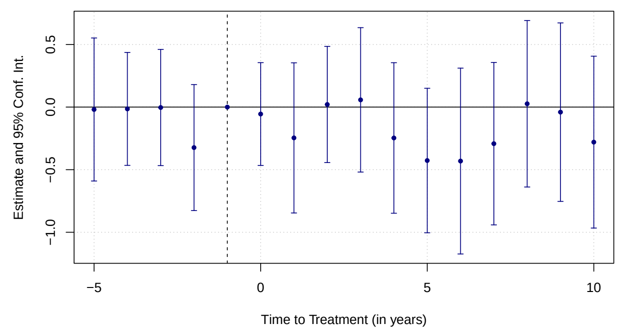
(a) Log Total Assets of Small Establishments



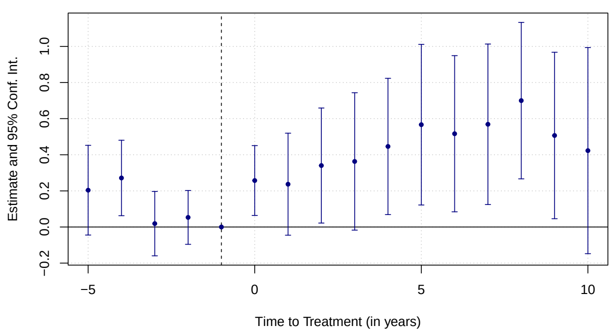
(b) Log Total Assets of Large Establishments



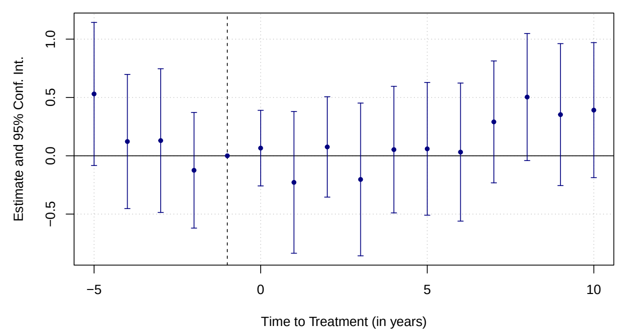
(c) Log Machine Assets of Small Establishments



(d) Log Machine Assets of Large Establishments



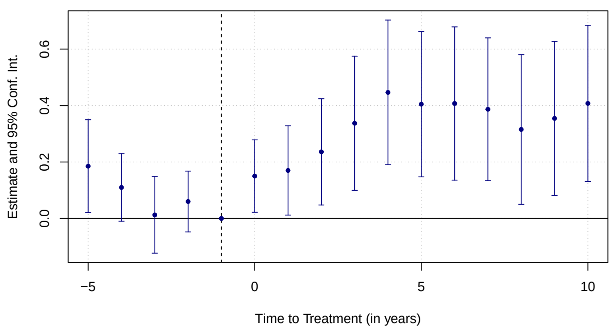
(e) Log Asset Value of Buildings and Structures of Small Establishments



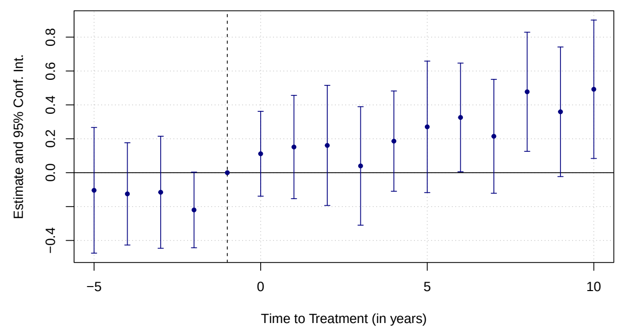
(f) Log Asset Value of Buildings and Structures of Large Establishments

Notes: Event study estimates of model (1) with 95% confidence interval for both small and large establishments. Small establishments are defined as those with less than 50 employees, all others are defined as large. Results for small establishments are shown on the left and for large establishments on the right The dependent variables are log transformed total assets (a)–(b), machinery (c)–(d) and buildings and structures (e)–(f). Data is taken from the MMS.

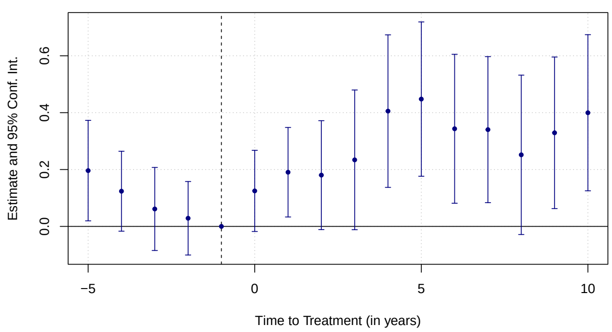
Figure 22: Effects of Industrial Complex Designation on Manufacturing Establishments by Establishment Size



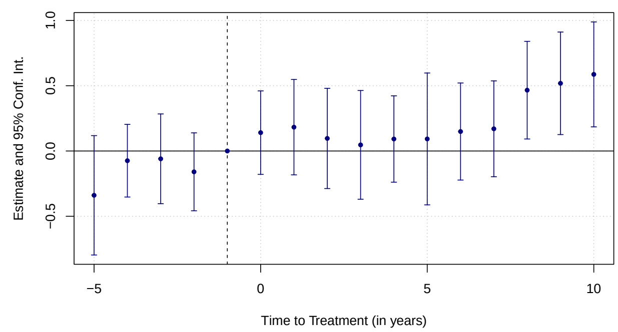
(a) Log Output of Small Establishments



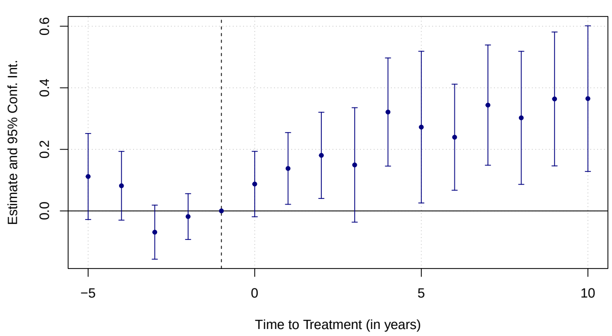
(b) Log Output of Large Establishments



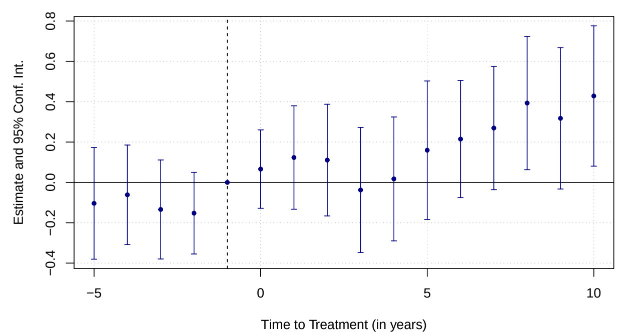
(c) Log Value Added of Small Establishments



(d) Log Value Added of Large Establishments



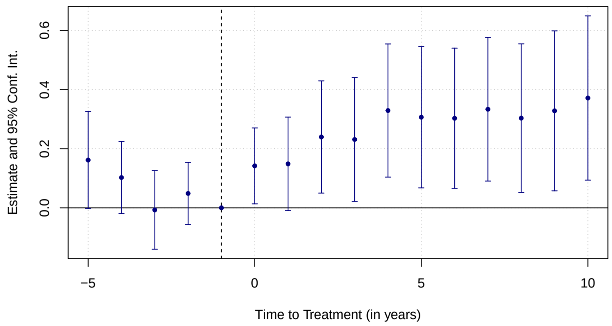
(e) Log Wagebill Of Small Establishments



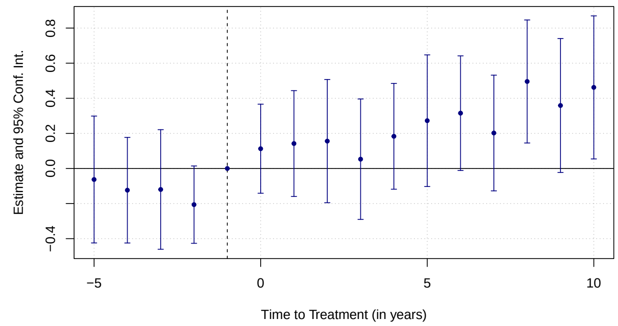
(f) Log Wagebill Of Large Establishments

Notes: Event study estimates of model (1) with 95% confidence interval for both small and large establishments. Small establishments are defined as those with less than 50 employees, all others are defined as large. Results for small establishments are shown on the left and for large establishments on the right The dependent variables are log transformed manufacturing output (a)–(b), Value added (c)–(d) and wage bill (e)–(f). Data is taken from the MMS.

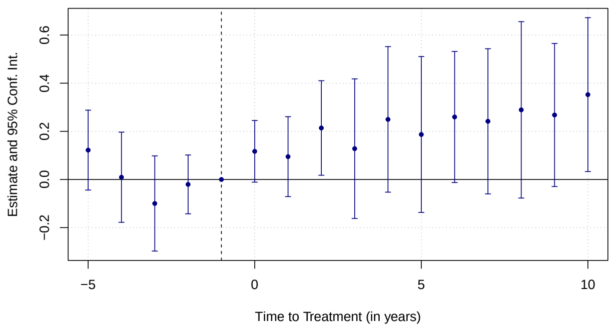
Figure 23: Effects of Industrial Complex Designation on Manufacturing Establishments' Shipments by Establishment Size



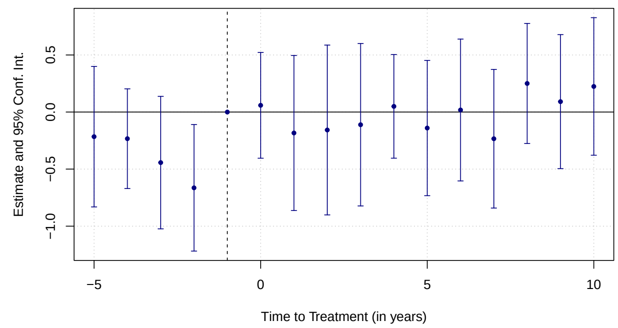
(a) Log Total Shipments of Small Establishments



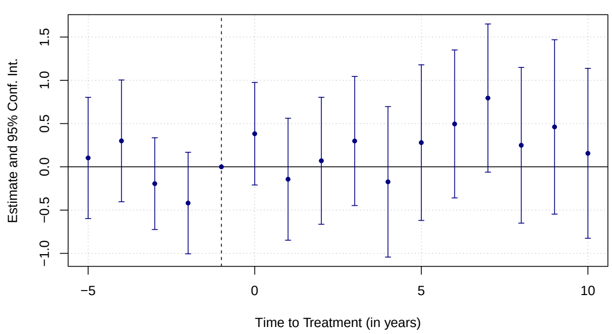
(b) Log Total Shipments of Large Establishments



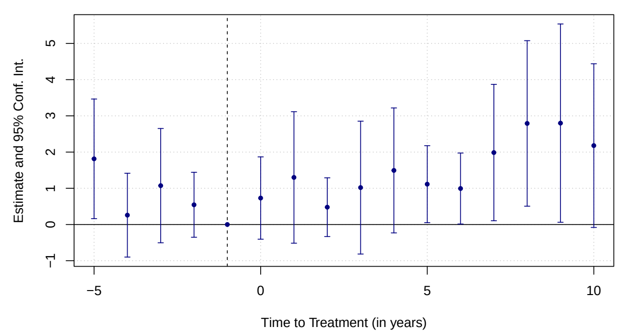
(c) Log Product Shipments of Small Establishments



(d) Log Product Shipments of Large Establishments

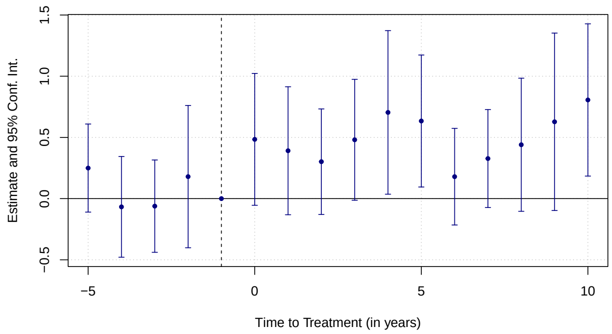


(e) Log Byproduct Shipments of Small Establishments

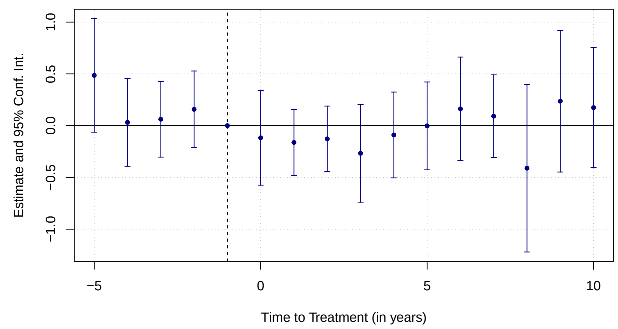


(f) Log Byproduct Shipments of Large Establishments

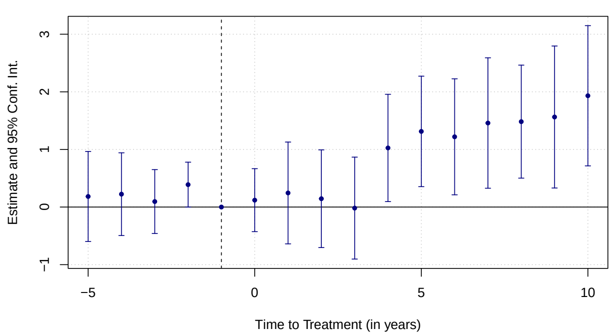
Figure 23: Effects of Industrial Complex Designation on Manufacturing Establishments' Shipments by Establishment Size (continued)



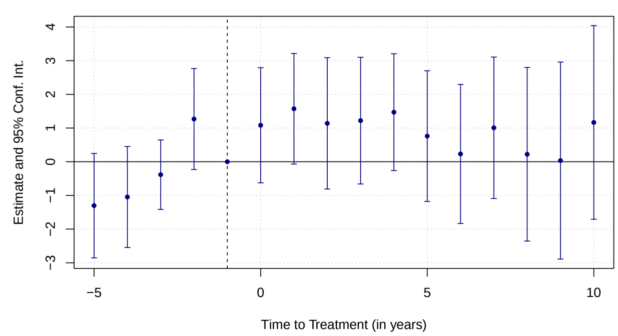
(g) Log Repair Shipments of Small Establishments



(h) Log Repair Shipments of Large Establishments



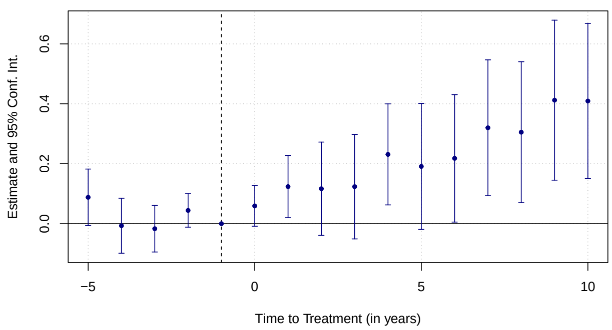
(i) Log Toll Processing Shipments of Small Establishments



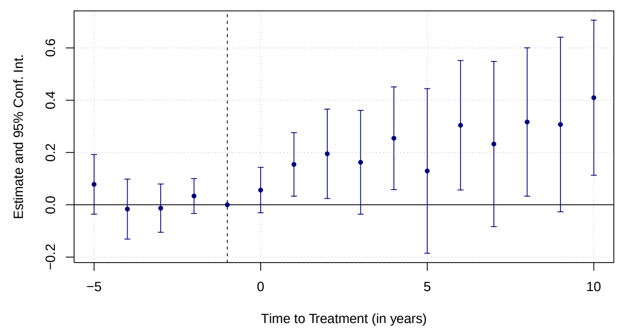
(j) Log Toll Processing Shipments of Large Establishments

Notes: Event study estimates of model (1) with 95% confidence interval for both small and large establishments. Small establishments are defined as those with less than 50 employees, all others are defined as large. results/ for small establishments are shown on the left and for large establishments on the right. The dependent variables are log transformed total shipments (a)–(b), product shipments (c)–(d), byproduct shipments (e)–(f), repair product shipments (g)–(h) and toll processing shipments (i)–(j). Data is taken from the MMS.

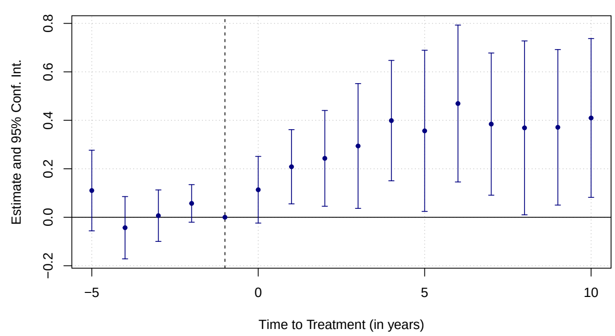
Figure 24: Effects of Industrial Complex Designation on Incumbent Manufacturing Establishment



(a) Log Manufacturing Employment



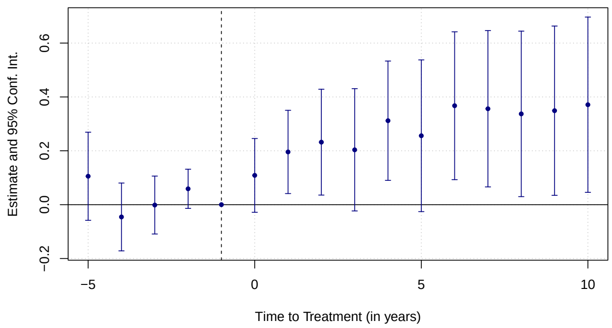
(b) Log Manufacturing Wage Bill



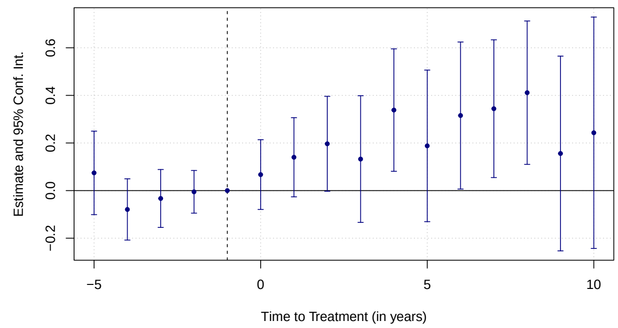
(c) Log Manufacturing Output

Notes: Event study estimates of model (1) with 95% confidence interval, replicating the results/ of figure 17 for incumbents. The dependent variables are log transformed manufacturing employment (a), wage bill (b) and output (c). Data is taken from the MMS.

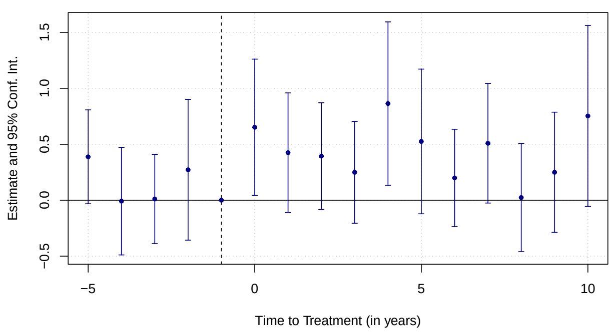
Figure 25: Effects of Industrial Complex Designation on Incumbent Manufacturing Establishments' Shipments



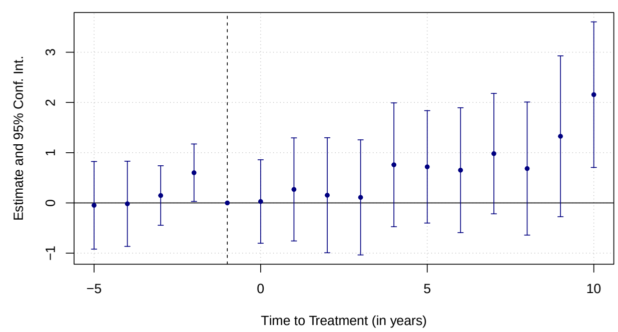
(a) Log Total Shipments



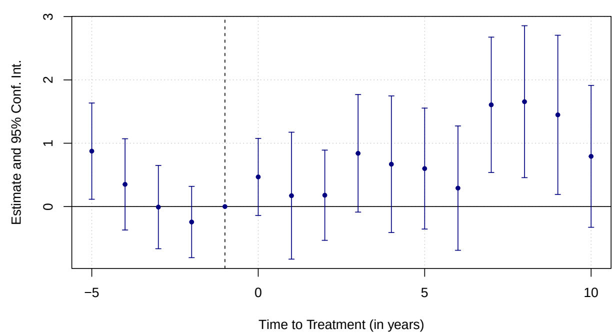
(b) Log Products Shipments



(c) Log Repair Shipments



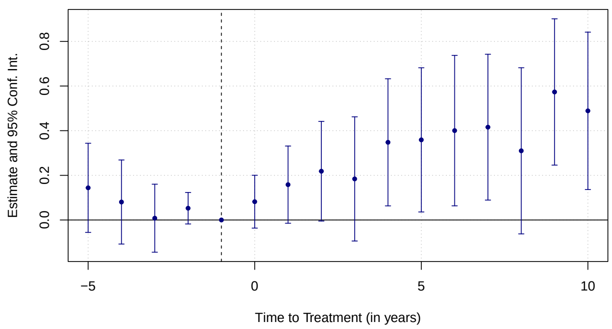
(d) Log Toll Processing Shipments



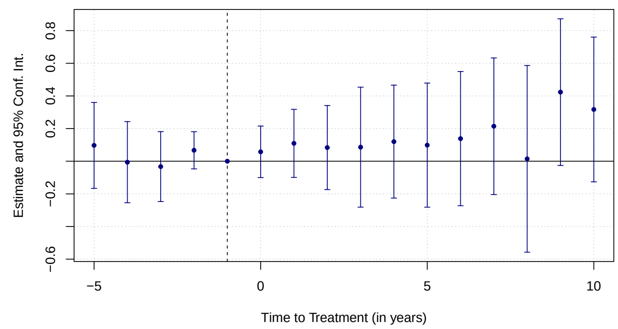
(e) Log Byproducts Shipments

Notes: Event study estimates of model (1) with 95% confidence interval, replicating the results of figure 18 for incumbents. The dependent variables are log transformed total shipments(a), product shipments (b), repair shipments (c), toll processing shipments (d) and byproduct shipments (e). Data is taken from the MMS.

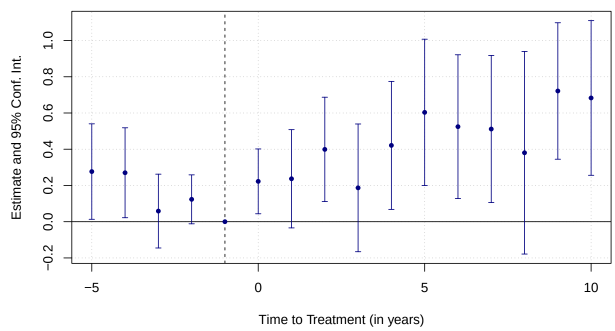
Figure 26: Effects of Industrial Complex Designation on Incumbent Manufacturing Establishments' Assets



(a) Log Total Assets



(b) Log Machines Assets



(c) Log Asset Value of Buildings and Structures

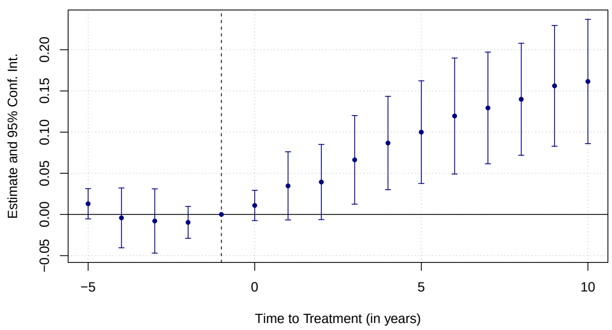
Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are log transformed year end asset values for the total asset stock(a), machinery (b)and building and structures (c). Data is taken from the MMS.

Table 7: Contribution of the Intensive Margin to Employment Effects by Sector (continued)

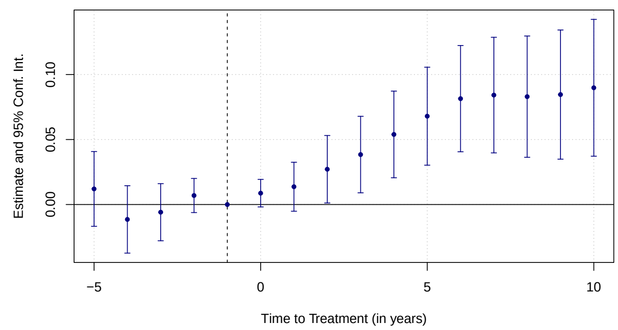
Panel A: National Business Survey	Agricultural Employment		Mining Employment		Public Employment	
	Total	Incumbents	Total	Incumbents	Total	Incumbents
Complex Designation	-0.025	0.033	-0.232	-0.237	0.045	0.039
	(0.117)	(0.117)	(0.130)	(0.130)	(0.038)	(0.038)
Contribution Incumbents	-1.298		1.019		0.856	
Contribution Entrants	2.298		-0.019		0.144	
R^2	0.724	0.701	0.848	0.848	0.963	0.962
Adj. R^2	0.701	0.675	0.836	0.835	0.960	0.959
Observations	38,592	38,592	38,592	38,592	38,592	38,592

Notes: This table presents the contribution to the overall effects of industrial complex designation to the local economy due to incumbent establishments expanding and new establishments entering. The first row presents the estimates of the effect of industrial complex designation on employment from estimating model 2. For each outcome, we estimate the effect on district totals and incumbents. The table presents results/ for total employment, as well as construction, manufacturing and service employment. Contribution of incumbents gives the share of the total effect explained by the incumbents. Data is taken from NBS.

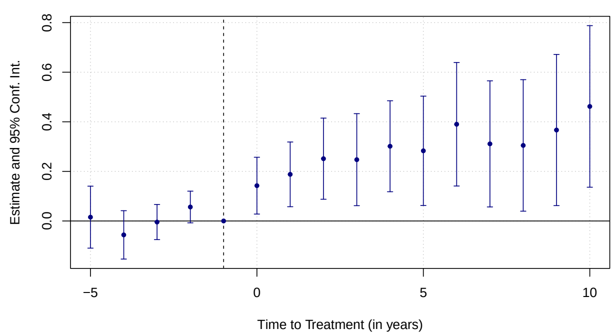
Figure 27: Effect of Industrial Complex – PPML Estimator



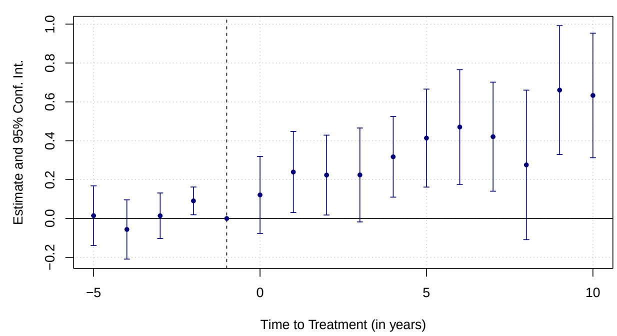
(a) Manufacturing Employment



(b) Manufacturing Firmnumber



(c) Manufacturing Shipments



(d) Manufacturing Value Added

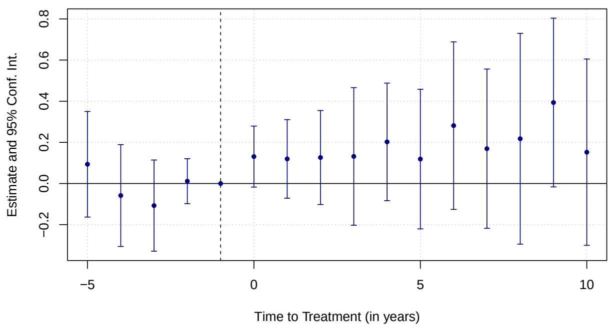
Notes: Event study estimates of model (1) utilizing a PPML estimator, replicating the results/ in Figure 3. Results are shown with 95% confidence interval. The dependent variables are (a) manufacturing employment, (b) firm-numbers, (c) total shipments (c) and (d) value added. Employment and firm numbers are taken from the NBS, with shipments and value added from the MMS.

Table 8: Job Multipliers By Sectors (continued)

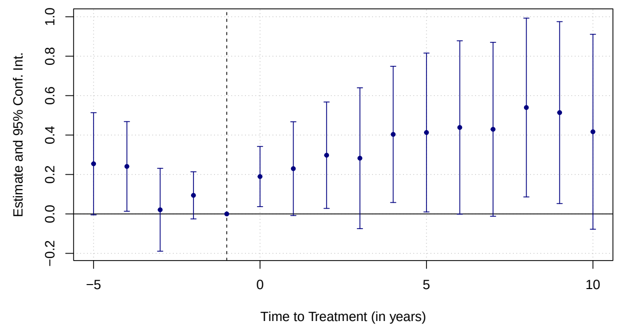
	Public Employment			Mining Employment			Agricultural Employment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Receiving areas									
0 km	0.028	0.027	0.025	0.004	0.004	0.000	−0.011	−0.011	−0.006
	(0.016)	(0.016)	(0.019)	(0.008)	(0.008)	(0.009)	(0.005)	(0.005)	(0.006)
Spillovers									
0–15 km	0.006	0.004	0.007	0.002	0.001	−0.003	0.001	0.001	0.001
	(0.006)	(0.006)	(0.007)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Area controls		✓	✓		✓	✓		✓	✓
Pre-trends			✓			✓			✓
Observations	554	554	554	554	554	554	554	554	554

Notes: Robust Standard errors are reported in parenthesis. All columns show long difference changes in employment for districts receving an industrial complex, as well as changes in surrounding districts, following eq.4. Columns (1)–(3), give change in public employment, columns (4)–(6) change in mining employment and columns (7)–(9) change in agricultural employment. Columns (1),(4) and (7) include neither district controls nor pre-trends,Columns (2),(5) and (8) include only district controls and Columns (3),(6) and (9) include both district controls and pre-trends. Data on district employment is taken from NBS. Data on complex employment is taken from KICOX.

Figure 28: Effects of Industrial Complex Designation on Incumbent Manufacturing Establishments' on Assets By Asset Type



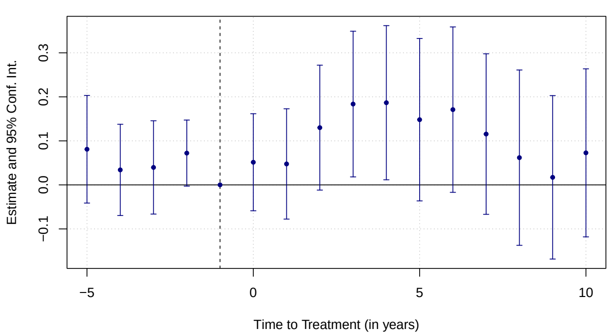
(a) Log Machines



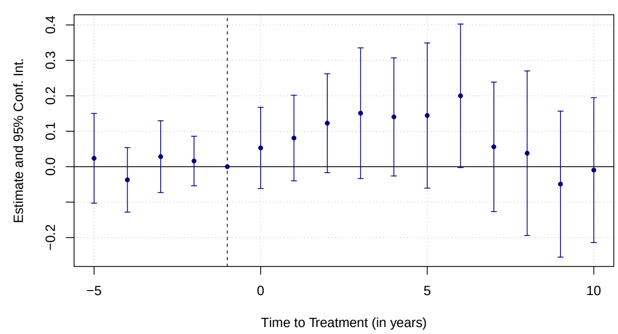
(b) Log Buildings and Structures

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are log transformed year end asset values for the (a) machinery and (b) building and structures. Data is taken from the MMS.

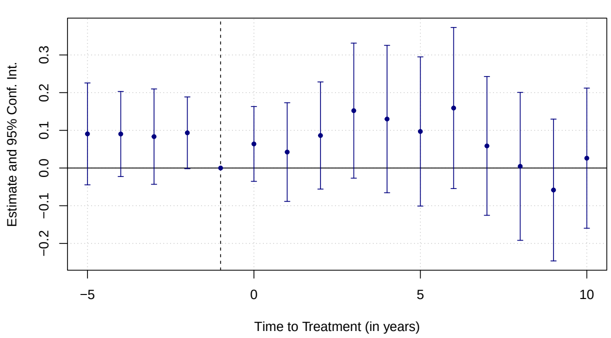
Figure 29: Effects of Industrial Complex Designation on Manufacturing Establishments' Output per Worker



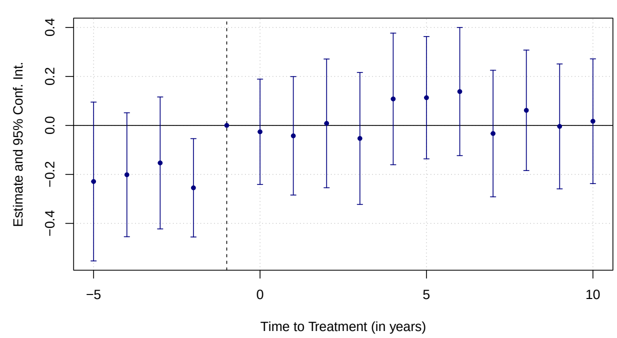
(a) Log Output per Worker



(b) Log Output per Worker of Incumbent Establishments



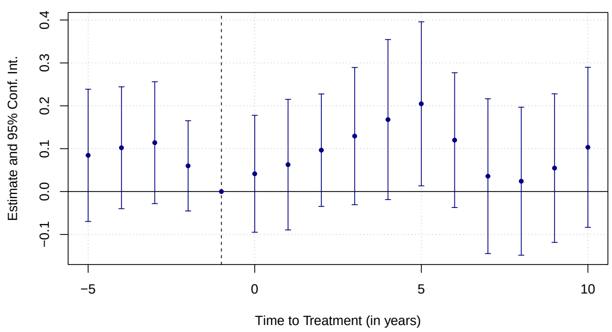
(c) Log Output per Worker of Small Establishments



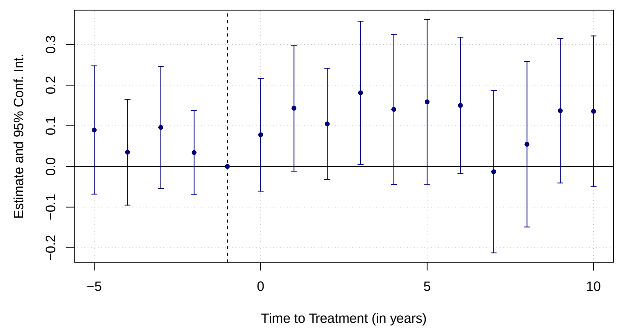
(d) Log Output per Worker of Large Establishments

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are log transformed output per worker for all (a), incumbent (b), small (c) and large establishments (d). Data is taken from the MMS.

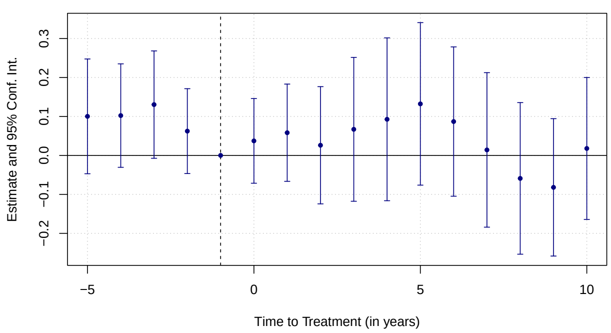
Figure 30: Effects of Industrial Complex Designation on Manufacturing Establishments' Value Added per Worker



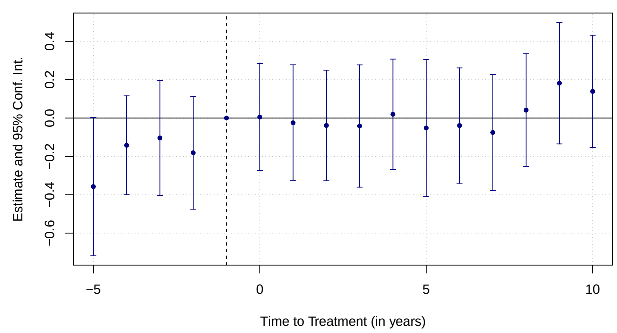
(a) Log Value Added per Worker



(b) Log Value Added per Worker of Incumbent Establishments



(c) Log Value Added per Worker of Small Establishments



(d) Log Value Added per Worker of Large Establishments

Notes: Event study estimates of model (1) with 95% confidence interval. The dependent variables are log transformed value added per worker for (a) all, (b) incumbent, (c) small and (d) large establishments. Data is taken from the MMS.