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ABSTRACT

We identify negative spillovers exerted by large, successful manufacturing plants on other local production facilities in China. A short-lived alliance between the U.S.S.R. and China led to the construction of 150 "Million-Rouble plants" in the 1950s. Our identification strategy exploits the ephemeral geopolitical context and the relative position of allied and enemy airbases to isolate exogenous variation in plant location decisions. We find a boom-and-bust pattern in hosting counties: treated counties are twice as productive as control counties in 1982, but 30% less productive in 2010. The average other establishment in treated counties is unproductive, does not innovate, and charges high markups. We find that (over)specialization limits technological spillovers. This prevents the emergence of new industrial clusters and leads to a flight of entrepreneurs.

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An online appendix is available at http://www.nber.org/data-appendix/w30744

1 Introduction

The structural transformation of agrarian economies involves high spatial concentrations of economic activity (Kim, 1995; Henderson et al., 2001). Regions that attract successful industries during this process typically experience a boom followed by a bust, as illustrated by declining factory towns in the United States (Detroit and the "Rust Belt"), the United Kingdom (Manchester and other mill towns), the Ruhr region in Germany, or the Northeast of France. Explanations for this decline usually point to external, macroeconomic factors: structural change, as employment shifts away from industry (Ngai and Pissarides, 2007; Desmet and Rossi-Hansberg, 2014); exposure to import competition (Autor et al., 2013); or changes in trade policy (Pierce and Schott, 2016).

This paper takes on a micro-perspective and uncovers the role of *local* factors in the long-run decline of formerly successful industrial regions. Our analysis exploits an unprecedented industrial policy that involves the most comprehensive technology transfer in modern industrial history and constitutes the foundation stone of China's industrialization (Lardy, 1987; Naughton, 2007). As part of the Sino-Soviet Treaty of Friendship, Alliance and Mutual Assistance, the U.S.S.R. helped China build 150 "Million-Rouble Plants" (MRPs) in the 1950s. These plants were scattered over about 100 counties in an attempt to jump-start their local economies. We follow the long-run evolution of these hosting counties and present causal evidence that the MRPs generated positive spillovers in the short run (a "boom"), but exerted strong negative production spillovers in the longer run (a "bust").[1] The decline is observed in spite of the constant, continuous success of the MRPs themselves, and it is not driven by the local composition of industries or products. Since external macroeconomic trends are also not underlying the downturn, we turn to the micro level and look for negative spillovers operating *within* these local economies. Using firm-level data on production and innovative activities, we show that establishments in host economies are neither productive, nor competitive or innovative. Host regions are characterized by a specialized production structure that is oriented towards the MRPs. There are limited technological spillovers, and there is little room for other industries to emerge. In line with this, we observe that potential entrepreneurs tend to leave MRP counties to start up their businesses in other locations.

Identifying agglomeration spillovers is a challenge. In our framework, it requires exogenous variation in the allocation of large plants across space. In an ideal setting,

[1] A recent contribution (Giorcelli and Li, 2022) studies a subset of firms that were operating in the steel industry and shows that the reception of Soviet knowledge and equipment benefited plants in the long-run.

actual project sites would have a natural set of counterfactual sites and random variation in the selection process among these sites. We emulate this setup in our quasi-experimental setting. We first rely on the economic criteria that policymakers used to select a set of suitable counties (Bo, 1991).[2] We then exploit the ephemeral geopolitical context—the short-lived Sino-Soviet Treaty of Friendship, Alliance and Mutual Assistance—to isolate temporary, exogenous variation in the probability to host a large factory within the subset of suitable counties. After the Korean war, planners were keenly aware of the vulnerability of potential sites to enemy bombing; this had a marked effect on the location decisions.[3] We combine novel information about airplane technologies with the location of enemy and allied air bases and derive a measure of vulnerability to aerial attacks from major U.S. bases for the period 1950–1960. We use this measure as an instrument for the probability to host a MRP, and we condition the analysis on similar measures of vulnerability computed after the Sino-Soviet split in 1960 to rule out possibly confounding effects from later place-based policies and industrial investments.[4] One remaining concern is that the instrument may coincidentally correlate with geographic factors underlying recent economic growth. We present a variety of robustness checks to alleviate such concerns and show that our findings are robust to controlling for first-nature determinants (local geography, pollution), second-nature determinants (proximity to booming regions), and later spatial policies such as the Special Economic Zones or the Third Front Movement.[5]

Our paper combines panel data on county-level economic activity with a census of manufacturing firms that we complement with patent applications, productivity measures, and markup calculations. We show that counties hosting MRPs experienced a rise-and-fall pattern. Treated counties had emerged to be more industrialized and twice as productive as control counties by 1982. Despite this head start, treated counties experienced a steady decline (in relative terms) over the follow-

[2]In stark contrast with the Third Front Movement, this program was efficiently implemented. The location choice was economically sound (e.g., based on market access and access to natural resources) and attention was paid to production efficiency, including material incentives for managers (Eckstein, 1977; Selden and Eggleston, 1979) and technology transfers (Giorcelli and Li, 2022).

[3]Senior generals were directly involved in siting decisions to protect the state-of-the-art factories from enemy air strikes, using intelligence maps of the U.S. and Taiwanese air bases (Bo, 1991). Historical U.S.S.R. documents report the same strategy to locate Soviet "Science Cities" out of the reach of enemy bombers (Schweiger et al., 2022).

[4]After the Sino-Soviet split in 1960, the set of protected locations shrunk, which called for directing new industrial investments to the interior during the Third Front Movement ("close to the mountains, dispersed, and hidden in caves").

[5]We also present an alternative identification strategy that compares locations with operational MRPs to a subset of locations where "MRP plans" of the same program were abandoned due to the unexpected Sino-Soviet split.

ing decades. By 2010, the average productivity was *lower* in treated counties, even though the (large) MRPs remained productive and innovative. This is because other manufacturing establishments in treated counties were (i) less productive, (ii) less competitive, and (iii) less innovative than establishments in control counties, conditional on controls for establishment age, ownership structure, and detailed industry or product category.

To understand how MRP(s) affected their local economies, we employ a procedure developed in Imbert et al. (2022) that associates a product code to textual product descriptions provided by manufacturing establishments. This allows us to infer product linkages and technological connections between local firms, including the MRP(s).[6] We use product linkages to show that production in treated counties is concentrated along the MRPs' production chain. Outside this chain, production is scattered across small production clusters. We do find some differences in treatment effects. This heterogeneity either depends on the linkages between local firms and the MRP, e.g., with a productivity premium for downstream establishments, or on the MRPs' types, e.g., whether they operate upstream the production chain or not. In general, however, treatment heterogeneity is limited, and firms tend to be less productive, less competitive, and less innovative across the board. In a last step, we shed further light on the far-reaching externalities exerted by MRPs and look at *missing* production: we show that individuals responsible for firm creation tend to export their skills to other locations. More specifically, the average emigrant from treated counties is much more likely to be a high-skilled entrepreneur or a manager at their destination (a finding reminiscent of Chinitz, 1961).

Our main contribution is to study the evolution of production externalities over a long period of time. Our careful analysis of innovation, productivity, and production linkages at the firm level reveals *negative* long-run production externalities. The increasingly specialized production structure around the MRP(s) comes at a cost: linked firms get locked in and face little incentive to innovate; this limits between-industry spillovers that would otherwise benefit new industries and entrepreneurs. The following paragraphs place our novel insights in the context of the existing literature on the benefits and costs of agglomeration and also discuss other research on negative spillovers that is less directly aligned with our findings.

Our first contribution is to show that the nature of agglomeration economies

[6]We have to overcome a methodological challenge. Each MRP draws on different factor markets and operates a different technology to produce different products. With such treatment heterogeneity, we need to identify sub-populations of firms in *control counties* that are similar to the sub-populations of firms with possible links to MRP(s) in treated counties. We leverage our matching strategy, which pairs one treated county with one control county, and we hypothetically allocate the associated MRP(s) of the treated county to the control county.

changes as industrial clusters mature. There is ample evidence that agglomeration economies benefit the emergence of industrial clusters and local economic growth, as reviewed in Duranton and Puga (2014). Recent evidence on the positive economic effects of early and/or large-scale industrialization include Greenstone et al. (2010), Fan and Zou (2019), Mitrunen (2019), Garin and Rothbaum (2022) and Méndez-Chacón and Van Patten (2022). We find the same positive effects on local economic development during the initial boom phase. However, as the industrial clusters mature, they become more specialized (Kim, 1995; Henderson et al., 1995; Ciccone, 2002), and we observe that increasing specialization gives rise to negative externalities that lead to a decline of the local economy.[7] Our finding casts doubt on the effectiveness of place-based policies in the creation of *self-sustaining* economic gains in the long-run.

Our second contribution is to provide a detailed analysis of negative externalities arising as a result of specialization. We use firm-level data to show that establishments operating upstream or downstream from the MRPs refrain from innovation, which limits technological spillovers and stifles the entry of new industries (Glaeser et al., 1992; Henderson et al., 1995) and entrepreneurs (Chinitz, 1961; Glaeser et al., 2015). We consider a range of competing channels and show that the decline of the local economies is not due to: (i) high production costs and an inefficient provision of factors (Duranton, 2011); (ii) distortions in the allocation of physical capital (Hsieh and Klenow, 2009; Song et al., 2011), human capital (Franck and Galor, 2021), land (Brueckner et al., 2017; Yu, 2019) or labor (Brandt et al., 2013; Tombe and Zhu, 2019; Mayneris et al., 2018); (iii) urban (dis)amenities like pollution (Chen et al., 2022; Khanna et al., 2021) or sprawl; (iv) the local political environment and its interaction with the business environment (Chen et al., 2017; Wen, 2019; Fang et al., 2018; Harrison et al., 2019); or (v) the life cycle of firms, industries, and public establishments (Brandt et al., 2020). This strengthens our argument that the absence of production and technological spillovers is the key force driving the decline of hosting counties.

Finally, our work contributes to a growing body of research on place-based policies, reviewed in Neumark and Simpson (2015), and including Busso et al. (2013), Kline and Moretti (2014), von Ehrlich and Seidel (2018), Schweiger et al. (2022), and Fajgelbaum and Gaubert (2020). A subset of this literature focuses on place-based policies in China: Fan and Zou (2019) analyze the agglomeration effects of industrial clusters that were established under the Third Front Movement; and Wang (2013),

[7] Our findings at the micro scale are consistent with a literature discussing the negative effects of specialization (Duranton and Puga, 2001; Faggio et al., 2017).

Alder et al. (2016) and Zheng et al. (2017) evaluate Special Economic Zones and industrial parks. Related to our work is a recent paper by Giorcelli and Li (2022) who focus on MRPs in the steel industry in an attempt to disentangle the effect of technology versus knowledge transfers on longer-run plant performance. Our paper focuses on the long-run development of the local economies around all MRP projects and shows that the growth stimulus of place-based policies may have undesirable long-run effects.

The remainder of the paper is organized as follows. Section 2 describes the historical context. Section 3 details the data and the empirical strategy. Section 4 presents empirical facts about the rise and fall of early-industrialized counties. Section 5 provides evidence about the mechanisms behind the relative decline of treated counties. Section 6 briefly concludes.

2 Historical context and the "156" program

The "156" program is a unique experiment to study agglomeration spillovers in the long run. First, the geopolitical context introduces unique exogenous variation in the decision to locate projects. The "156" program was unanticipated before 1950; and strategic considerations behind the opening and location of plants became irrelevant a few years later, after the Sino-Soviet Split. Second, the program constitutes a large push shock for an agrarian economy (Rawski, 1979), and very different types of factories were built across a wide range of sectors.

2.1 The historical context

This section provides a brief account of the historical context; a comprehensive description can be found in Appendix A.1.

Sino-Soviet cooperation (1950–1958) In 1949, after the Sino-Japanese and Chinese civil wars, Chinese leaders studied the possibility of international economic cooperation to transform China's agrarian economy and foster the development of an independent industrial system (Dong, 1999; Lüthi, 2010). The Chinese government engaged in economic cooperation with the Soviet Union for ideological, but also geopolitical reasons. The possibility of economic cooperation with the U.S.S.R., which was not based on strong pre-existing economic ties, indeed became credible after the Sino-Soviet Treaty of Friendship and Alliance of 1950—already including a large loan. In August 1952, Chinese Premier Zhou Enlai visited Moscow to formalize the involvement of the U.S.S.R. in the First Five-Year Plan (1953–1957). The

U.S.S.R. agreed to cooperate and assist China in the creation of state-of-the-art industrial sites, with the purpose of extending its influence in the region.

Sino-Soviet Split (1958–1960) Rapid ideological and geopolitical divergence however precipitated a Sino-Soviet split that ended the cooperation between the two countries. The split formally unfolded in 1960 with an abrupt termination of industrial collaboration and heightened military tensions. The termination of industrial collaboration materialized in the sudden withdrawal of experts and engineers from China, the repatriation of Chinese students from the U.S.S.R., and the cancellation of ongoing industrial projects. The only remnants of the short-lived Sino-Soviet alliance were 150 plants that had been completed and were operational by 1960.

2.2 The "156" program

This section summarizes the key features of the "156" program. We provide a more detailed description of the program in Appendix A.2, a description of later place-based policies in Appendix A.3, and descriptive statistics about the plants themselves in Appendix A.4.

An industrial collaboration As part of the First Five-Year Plan (1953–1957), the U.S.S.R. committed itself to assisting China in the construction of 50 industrial sites. In May 1953, 91 new projects were agreed on and an additional 15 in October 1954. Overall, about 150 state-of-the-art factories would be constructed between 1953 and 1958; the factories were huge investments and benefited from economic and technological assistance from the Soviet Union.

The U.S.S.R. actively participated in the design and construction of these factories. First, the economic aid from the U.S.S.R. extended beyond large loans; the U.S.S.R. provided more than half of the required equipment.[8] Second, the collaboration involved the exchange of information, human capital, and technology, which in some cases was the best in the world (see Giorcelli and Li, 2022). During the peak of the cooperation, 20,000 scientific, industrial and technical experts from the Soviet Union lived and worked in China to design the construction of factories and rationalize production (Zhang, 2001; Wang, 2003). As part of the technology transfer, 80,000 Chinese students were trained in Soviet universities and technological institutes. While some blueprints were destroyed, the existing technology could be imitated and represented a large shift in the technological frontier (Bo, 1991).

[8] The last 15 projects agreed on in 1954 even benefited from state-of-the-art equipment that few Soviet factories enjoyed (Goncharenko, 2002).

Chinese scholars credit the "156" program with having laid the foundations for the development of other industries, boosted production capacity, shifted the technological frontier, and promoted an even spatial development by industrializing central and western provinces (Dong and Wu, 2004; Zhang, 2009; Shi, 2013; He and Zhou, 2007). While these factories are known as the "156" in China, we refer to them as the "Million-Rouble Plants" (MRPs). Indeed, at the time of the Sino-Soviet Split, six factories were not yet viable and were closed; only 150 plants had been completed and were operational by 1960.

Location decisions The MRPs were regarded as iconic factories, and planners put much thought in siting decisions. First, planners selected locations using economic criteria. These criteria, detailed in Bo (1991), are: (i) connection to the transportation network and access to markets, (ii) access to natural resources through existing roads and rail, and (iii) belonging to an agrarian province, as the investments were seen as an opportunity to foster economic development outside of the few developed areas. We will use these criteria to identify a relevant set of suitable counties.

Second, this period was an era of heightened geopolitical tensions that culminated in the Korean War—where U.S. soldiers and Chinese "volunteers" directly confronted. Planners were concerned that these large, key factories might become the target of enemy attacks. The decision process involved senior military officials to decide where factories should be built, accounting for the locations of enemy air bases (in Japan, South Korea, and Taiwan) and allied air bases (in the U.S.S.R. and North Korea). Enemy air bases were remnants of U.S. air bases used during World War II and the Korean War, and bases used by the United States Taiwan Defense Command. Most of the Chinese territory was in the range of U.S. strategic bombers; the decision process thus heavily relied on the locations of *allied* air bases able to intercept them. The Sino-Soviet split made this criterion redundant for later industrial investment: while proximity to military U.S.S.R. air bases would help against aerial attacks before the Sino-Soviet Split, U.S.S.R. air bases would be considered another threat after the Sino-Soviet Split, thereby explaining the peculiar geography of later strategic decisions (e.g., the Third Front Movement).

Million-Rouble Plants and economic growth For the first 30 years of their existence, the MRPs developed in a planned economy. These factories and their local economies were fueled by the provisions of the plan. Factor movement was not free, and if more workers or capital could be productively employed, the plan would reallocate resources. We thus consider the command-economy era as a whole as the treatment: treated counties enjoy a head start at the onset of the reform period.

Reforms to deregulate the economy were introduced in the 1980s. Private firms could be set up, and a dual price system allowed market transactions alongside the old quota requirements. In the 1990s, restrictions on labor mobility were gradually loosened, and rural-urban migration began to rise as a major feature of Chinese economic growth. The MRPs successfully adapted to the market economy and remained leaders in their respective industries.[9] Many of them have diversified their activities, their products ranging from computer screens to carrier-based aircraft.

3 Data and empirical strategy

This section discusses the data, the empirical strategy, and descriptive statistics.

3.1 Data

One requirement for estimating the dynamic agglomeration effects of large plants is to collect data on the local economy, ideally covering production dynamics from their openings to the current day. In this paper, we mobilize the following main data sources: (a) information on the Million-Rouble Plants and their evolution over time, (b) county-level data on population and production (1953–2010), and (c) establishment-level data in recent years (1992–2008), linked with patent applications and other product-level information.

The Million-Rouble Plants In order to characterize the local treatment induced by the presence of MRPs, we collect information on their location, timing of construction, initial investment, original industry, and evolution of production over time. These pieces of information are extracted primarily from Bo (1991) and Dong and Wu (2004), as well as from historical archives, while the recent activity of these factories is retrieved using establishment-level data (see Appendix A.4).

County-level data We rely on Population Censuses in 1953, 1964, 1982, 1990, 2000, and 2010, nested at the county level.[10] The 1953 data only provide popula-

[9]We provide evidence for the continued success of MRPs in Appendix A.4; they are also thoroughly studied in Giorcelli and Li (2022). Note, however, that a small number of firms went bankrupt. Nine factories have been closed, all coal or non-ferrous metal mines. Two other firms, a paper mill and a former military electronics plant, were partly restructured and continue to operate. When construction plans were made in the 1950s, most plants were built in the city center. As pollution issues and the need for expansion had not been anticipated, nine plants were moved to the suburbs, within the same counties.

[10]Data collected by statistical offices—censuses, surveys, and yearbooks—rely on official administrative divisions at the time of data collection. County boundaries are subject to frequent and

tion and household counts, but subsequent censuses capture the agricultural status of households. At the time of the command economy, the household registration (*hukou*) type is a faithful reflection of both activity and the environment of residence. This piece of information offers us the opportunity to start tracking the evolution of urbanization and economic sectors from 1964 onward. Additional county-level information is available in the 1982 census, most notably a disaggregation of employment by broad sectors and measures of output. In 1990, precise information is collected on the sector and type of employment and occupation, as well as on housing and migration, a phenomenon that mostly involved agricultural-*hukou* holders moving to cities in search of better earning opportunities. The 2000 and 2010 Censuses further include information on the place of residence five years earlier, timing of the last migration spell, reason for migrating, and place and type of household registration.

Establishment-level data We rely on the National Bureau of Statistics (NBS) "above-scale" firm data, which constitute a longitudinal census of all state-owned manufacturing enterprises (SOEs) and of all non-state-owned manufacturing establishments, as long as their annual sales exceed RMB 5 million, over the period 1992–2008.[11] We use the establishment data to: (i) infer linkages between establishments and create measures of product concentration; (ii) estimate factor productivity; (iii) observe technological innovations; and (iv) create measures of markups to capture product competition. We first rely on a text analysis based on the description of products in order to associate a 6-digit product code to each establishment (following Imbert et al., 2022, see Appendix B.1). We further complement the establishment data with product-level information, in particular a benchmark input-output matrix (United States, 2000), measures of technological closeness using patenting in the United States (Bloom et al., 2013), and the revealed factor intensity using the factor endowments of countries producing each good (Shirotori et al., 2010). We use the production functions derived in Imbert et al. (2022) to measure factor productivity (see Appendix B.2). We use the link provided by He et al. (2018) to match

sometimes substantial changes in China. To deal with this issue, we use the 2010 administrative map of China as our benchmark and re-weight the data collected in other years to match the 2010 borders. More precisely, we overlay the 2010 map with the map for every other year y and create a new map with all the polygons defined by the 2010 and year-y divisions. We then compute the area-weighted value of the variable of interest for each polygon and collapse the values at the level of the 2010 counties.

[11] These data contain accounting information at the level of "legal units." A legal unit can be a subsidiary of a firm, but has its own name and is financially independent (Brandt et al., 2014). Nearly 97% of legal units in our data corresponded to single plants; we will refer to these units as establishments. We construct a panel spanning the period 1992–2008 thanks to the algorithm designed by Brandt et al. (2014) and extended in Imbert et al. (2022).

establishments with patent applications across three categories of patents (utility, invention, and design), and we rely on the procedure of De Loecker and Warzynski (2012) to estimate markups (see Appendix B.3).

3.2 Empirical strategy

We now describe the two steps of our empirical strategy: we first select control counties based on their suitability for hosting a plant; and we then use vulnerability to enemy bombings in order to explain location choices among suitable counties.

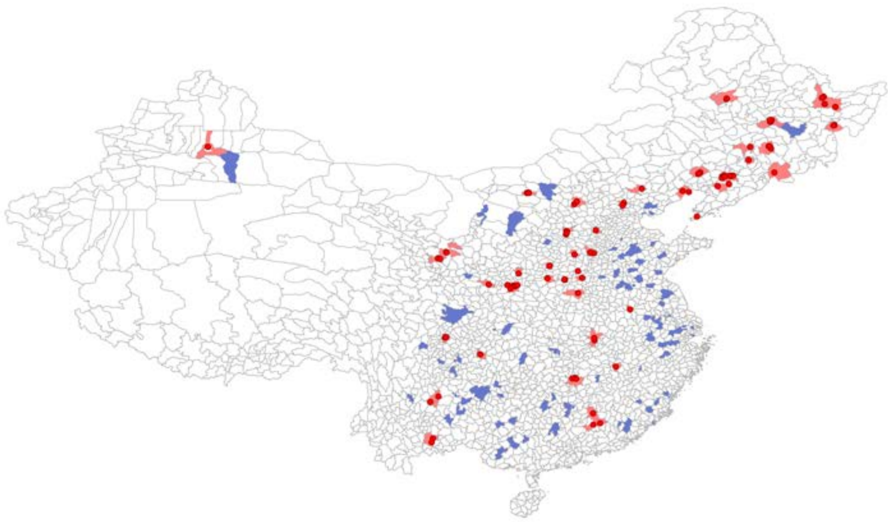
Isolating suitable locations We first isolate a group of suitable counties by implementing a one-to-one, propensity-score matching based on the eligibility criteria described in Bo (1991). This step is not crucial for identification, and our findings will be robust to its exact specification. It however disciplines the empirical strategy: reducing the sample of control counties helps identifying production spillovers through linkages between firms, as we will discuss in Section 5.

The first suitability criterion is market access. In the baseline matching procedure, we rely on: (log) average travel cost to the nearest provincial capital at the time of the First Five-Year Plan using the existing road/railroad/waterway network around 1950; (log) population at baseline, as measured by the 1953 Census; and (log) county area. The second criterion is access to resources, which we proxy with (log) measures of travel cost to coal, ore, and coke deposits through the transportation network around 1950 (see Appendix C.1). As apparent in Appendix Figure C1, the historical development of the railway network and the location of natural resources induces that a crescent of counties are prone to receiving large industrial infrastructure. This crescent, located a few hundred kilometers from the Eastern coasts and borders, may be interpreted as a Second Front for industrialization; the later Third Front Movement will go deeper into the hinterland—a decision that will be rationalized by our empirical strategy.[12]

We regress the treatment, i.e., being in the close neighborhood of a MRP (within 20 kilometers), on the location determinants described above, $\mathbf{H}_c$, to generate a propensity measure $P_c = P(\mathbf{H}_c)$ for each county. We define the set of suitable control locations $C = \{c_1, \ldots, c_N\}$ by matching treated counties $T = \{t_1, \ldots, t_N\}$ with the nearest neighbor in terms of the propensity P_c. We restrict the matching procedure to counties with a measure P_c in the support of the treated group; we further impose

[12] Although they do not feature among the list of explicit determinants, other geographical and economic factors may have entered siting decisions, e.g., distance to major ports, and we condition our analysis on factors susceptible to affect long-term economic growth in the baseline strategy and in robustness checks (see Appendix D.1).

Figure 1. Treated counties and the group of control counties.



Notes: This map shows counties that host at least one "156"-program factory (red) and the control group of counties (blue). The control group is selected through the matching procedure described in Section 3.

that matched control counties be selected outside the immediate vicinity of treated counties, in order to avoid spillover effects into the control group.[13] The output of the procedure is a set of 98 matched pairs $\{(t_1, c_1), \ldots, (t_N, c_N)\}$.

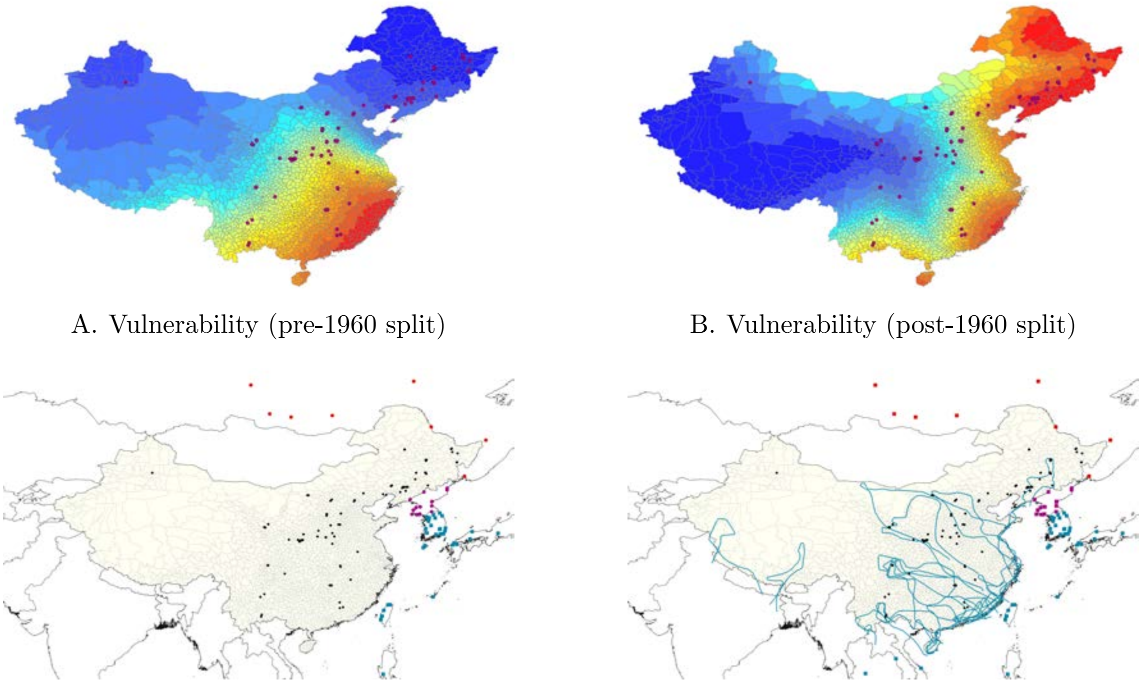
The geographic dispersion of the treated and control counties is shown in Figure 1: most treated and control counties are located along the "Second Front" crescent; treated counties are however less likely to be located in East China.

Vulnerability to aerial attacks To isolate exogenous variation in the decision to select counties, we construct an instrument based on vulnerability to airstrikes from U.S. and Taiwanese air bases, accounting for the shield provided by allied bases.

To this end, we geo-locate active U.S. Air Force bases and Taiwanese military airfields (enemy air bases), as well as major U.S.S.R. and North Korean air bases (allied air bases). We then compute a measure of local flying cost accounting for the vicinity of U.S.S.R. and North Korean bases. The procedure, discussed in Appendix C.2, is disciplined by the technical characteristics of enemy jet fighters at that time, most notably their range. It produces a map of local flying costs for enemy airplanes covering any given point of the Chinese territory. Our instrument

[13] In the baseline, we exclude counties whose centroids lie within a 4-degrees $\times$ 4-degrees rectangle centered on a treated county. This rectangle is roughly 2-3 times the size of the average prefecture, the level of government between counties and provinces (themselves directly under the central government), in China. We provide a more comprehensive description of the matching procedure in Appendix C.1, where we show the distribution of propensity scores and the balance of matching variables within the selected sample of suitable counties.

Figure 2. Vulnerability to airstrikes, bases, and surveillance flights.



A. Vulnerability (pre-1960 split)

B. Vulnerability (post-1960 split)

C. Bases (pre-1960 split)

D. Surveillance flights (post-1960 split)

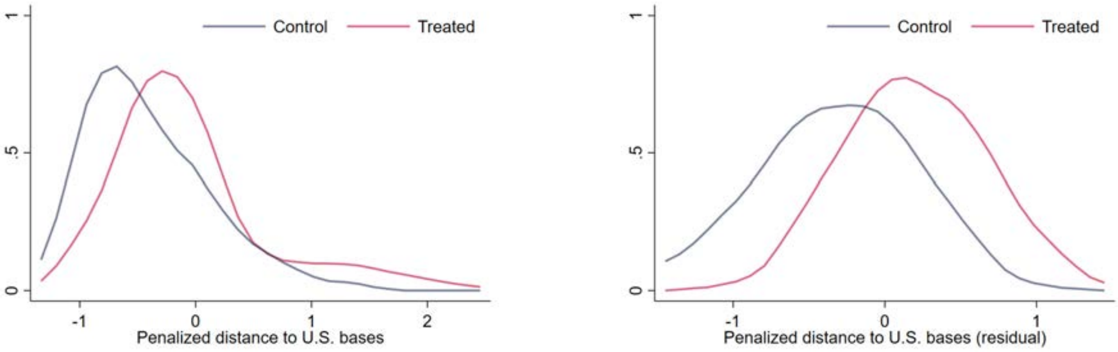
Notes: Panels A and B represent the flying cost from enemy airfields (red: low, blue: high; the color gradient corresponds to deciles) in 1953 and in 1964. Panel C shows the distribution of enemy and allied air bases in 1953. U.S. air bases are indicated by green rectangles; North Korean air bases are indicated by purple dots; Soviet air bases are indicated by red dots; the locations of MRPs are indicated by dark dots. Panel D adds the paths of U.S. surveillance flights between 1963 and 1965.

(vulnerability to aerial attacks) is defined, for each county, as the minimum across enemy bases of total flying cost from the base to the county centroid.

We illustrate the spatial variation in vulnerability to aerial attacks in Figure 2. Before the Sino-Soviet split, military concerns would favor the Northeast at the expense of East China (see Panel A showing vulnerability in 1953). The set of suitable and protected locations however became much smaller after the split, and investment during the Third Front had to be targeted toward interior provinces (see Panel B showing vulnerability in 1964). The paths of surveillance flights between 1963 and 1965 (Panel D) provide external validation for the decision to shield the MRPs and the later Third Front factories: after the Sino-Soviet split, the "Second Front" lost its location advantage, and U.S. reconnaissance aircraft appeared to target these factories. Our empirical strategy uses the pre-split measure as an instrument for siting decisions, conditioning for the post-split measure, thereby leveraging the ephemeral alliance between China and the U.S.S.R. as the source of identification.

Figure 3 provides a representation of the relationship between the vulnerability

Figure 3. Vulnerability density within treated and control counties.



A. Unconditional B. Conditional

Notes: This Figure displays the density of the unconditional and conditional vulnerability measure. *Penalized distance to U.S. bases* is the standardized flying cost to the main military U.S. or Taiwanese airfields penalized by the proximity to U.S.S.R. and North Korean airfields. Treatment is defined as a dummy equal to 1 if a county centroid lies within 20 km of a factory and 0 otherwise. The control group is selected through the matching procedure described in Section 3, and the controls used in Panel B are those of Table 1, column 3.

to aerial attacks and factory location choices. The distribution of flying cost across treated counties has a much fatter right tail than that of the control group, which shows that factories were preferably established at a (penalized) distance from enemy threats. This relationship constitutes the first stage of our empirical specification, and Table 1 shows that vulnerability to aerial attacks is quantitatively relevant in explaining siting decisions. One standard deviation in flying cost from enemy bases increases the propensity to host MRPs by about 42 percentage points within a matched treated-control pair. The average difference in travel cost between treated and control counties is about 75% of a standard deviation; our instrument thus explains $75\% \times 0.42 \approx 32\%$ of the allocation of MRPs among suitable counties.[14]

Importantly, while there is a strong relationship between our treatment (i.e., a place-based policy between 1953 and 1958) and the vulnerability to aerial attacks in 1953, the treatment is not correlated with vulnerability measures as computed after the Sino-Soviet split. Furthermore, vulnerability to aerial attacks in 1953 does not strongly correlate with later place-based policies. The geography of our place-based policy is unrelated to the geography of later investments (see Appendix D.1).

[14]Table 1 displays three specifications, one without any controls (column 1), one with matched pair fixed effects only (column 2), and one with the full set of controls (baseline specification, column 3). All specifications are restricted to the set of treated and control counties defined by matching on access to natural resources and the additional economic and geographical determinants. The extended set of controls is used to condition the analysis on characteristics that may directly affect outcomes of interest in the second stage; it is however reassuring that the predictive power of our instrument is not dependent on their inclusion.

Table 1. Treatment and penalized distance to enemy airbases (1953).

Treatment	(1)	(2)	(3)
Penalized distance	0.165	0.279	0.420
	(0.039)	(0.055)	(0.043)
Observations	196	196	196
Matching-pair fixed effects	No	Yes	Yes
Extended controls	No	No	Yes

Notes: Standard errors are clustered at level of 2-degree × 2-degree cells. The unit of observation is a county. *Penalized distance* is the normalized travel cost from the military U.S. and Taiwanese airfields penalized by proximity to U.S.S.R. and North Korean airfields. Extended controls include all matching controls, i.e., (log) travel cost to the provincial capital, (log) population in 1953, (log) county area, (log) travel cost to resources (coal, coke, ore), and additional controls, i.e., matching-pair fixed effects, (log) travel cost to major ports (through the river network), (log) distance to military airfields, and penalized flying cost to enemy airfields in 1964.

Benchmark specification Let c denote a county and T_c the treatment variable indicating whether a county is in the close proximity of a MRP. We estimate the following IV specification on the sample of suitable counties:

$$Y_c = \alpha_0 + \alpha_1 T_c + \mathbf{X}_c \beta + \varepsilon_c, \tag{1}$$

where the treatment, T_c, is instrumented by the vulnerability to aerial attacks, V_c, and Y_c is a measure of economic activity at the county level. The controls include the propensity controls, a set of matched-pair dummies (stratifying the sample into about 98 county pairs), and a set of additional controls: (log) travel cost to major ports, (log) distance to military airfields, and the post-split vulnerability to air strikes. Standard errors are clustered at the level of 2-degree × 2-degree cells.

A key assumption underlying the empirical strategy is that the instrument has no effect on outcomes of interest other than through the location of the Million-Rouble plants. We now discuss possible concerns with this assumption. First, the respective locations of military bases could have influenced investment at later stages of the Chinese structural transformation. Conditioning on later vulnerability to aerial attacks—after the Sino-Soviet Split and the start of the Vietnam War re-balanced the geographic distribution of military power in the region—should reduce this concern. We will also provide a sensitivity analysis and control for other policies with spatial impacts (e.g., Third Front Movement, Cultural Revolution, Special Economic Zones and industrial parks, etc.). Second, vulnerability may correlate with unobserved county amenities, which would both explain the decision to locate factories and be correlated with later patterns of economic growth. We will control for elevation, ruggedness, soil quality, expected crop yield, and pollution in robustness checks.

Third, vulnerability may correlate with the general geography of recent growth in China. For instance, China's Southeast, considered vulnerable, widely benefited from the opening of Chinese ports to trade in the reform era.[15] Such a violation of the exclusion restriction would induce a spurious negative correlation between economic growth and the presence of MRPs. To deal with this concern, we will run a series of robustness checks, most notably excluding a buffer around the Pearl river delta, excluding all Chinese counties below a certain latitude, or controlling for travel cost to the coast. Further, we will exploit an alternative strategy comparing counties hosting actual factories with counties planned to host unfinished projects, both being parts of the same, later wave of investments.

Table 2. The 156 Million-Rouble Plants: sector, construction period and initial investment.

		Construction		Investment	
Sector	Number	Start	End	Planned	Actual
Aviation	14	1953.9	1957.3	7271	7204
Chemical	7	1955.3	1958.4	15291	15474
Coal mining	25	1954.3	1958.5	5323	5832
Electronic	10	1955.5	1957.9	5661	4752
Iron and Steel	7	1953.9	1959.0	78361	84586
Machinery	23	1954.8	1958.2	9972	10336
Nonferrous Metals	13	1955.1	1959.0	15018	15451
Powerplants	23	1954.0	1957.9	13039	9023
Weapons	16	1955.1	1958.4	13533	12262
Other	12	1955.3	1959.3	11751	12513

Notes: Other industries are shipbuilding, pharmaceutical and paper-making industries. Investment is in 10,000 yuan. The average planned investment by factory was about 130,000,000 yuan, which amounts to 20,000,000 Soviet roubles in 1957 ($160,000,000 in 2010 U.S. dollars).

3.3 Descriptive statistics

The MRPs expanded and modernized the Chinese industry in a wide range of sectors, but with a bias towards heavy, extractive, and energy industries (e.g., coal mining or power plants, see Table 2).[16] Construction started between 1953 and 1955, and was achieved at the latest in the first quarter of 1959. The last two columns of Table 2 show planned and actual investment; the figures attest the scale of the program for an agrarian economy like China in the 1950s. The average planned investment by factory was about 130,000,000 yuan, which amounted to 20,000,000 Soviet roubles

[15]Note, however, that the vulnerability measure does not overlap with the coast-interior divide that characterizes the spatial distribution of economic activity in China. Some factories were indeed set up on the coast, first and foremost in Dalian, but not on the southern shore, too exposed to American or Taiwanese strikes.

[16]The "156" program follows the "Russian model" of industrialization (Rosenstein-Rodan, 1943), with coordinated and large investments across industries to modernize agrarian economies. These upstream factories were expected to irrigate the economy downstream.

in 1957 ($160,000,000 in 2010 U.S. dollars); total investment was of the order of a fourth of annual production in 1955.

Table 3 provides key descriptive statistics for treated and control counties. About 5% of Chinese counties are defined as being treated, and we use 5% of Chinese counties as suitable control counties in our baseline specification. As expected from a context of heightened international tensions following the Korean War, treated counties are located at a much greater distance from U.S.A.F. and Taiwanese bases. The difference in vulnerability between control and treated counties is about 75% of a standard deviation. Note, however, that control and treated counties do not differ so markedly in their exposure to enemy raids *after* the Sino-Soviet split.

Differences in terms of population between treated and control counties are sizable at baseline, in 1953 (Panel D), and increase afterwards (Panel B).[17] Interestingly, the employment share in industry is much larger in treated counties in 1982, but this difference has fully waned by 2010.

The bottom panels of Table 3 describe possible differences in matching variables and additional controls used in the baseline. Consistent with the propensity matching procedure, differences in topography and connectedness are less pronounced among suitable locations. Treated counties exhibit better access to coal mines, but not to coke and ore deposits.

4 The rise-and-fall pattern

This section presents the implications of early industrialization in counties hosting MRPs, with an aggregate rise and a fall driven by production outside of MRPs.

4.1 Baseline results

The influence of the MRPs on their local economy spans two periods: the rise and the fall, which we capture with cross-sectional analyses in 1982 and 2010.[18]

The rise We first describe empirical facts about the local treatment effect of MRPs in 1982; the analysis and the choice of outcomes are unfortunately limited by the

[17]Unreported descriptive statistics about urban registration show a persistent gradient between treated and control locations. Households in treated counties are more likely to hold an urban registration even after the reform. These differences are, however, not indicative of economic activity from 1990 onward, given the large number of rural migrants working in cities.

[18]We use the year 1982 for two reasons: (i) it is the earliest year where county-level output can be observed (about 25 years after the initial investment); and (ii) it coincides with the end of the command-economy thus capturing the possible head start of industrialized counties before reforms of the non-agricultural sector were gradually introduced.

Table 3. Descriptive statistics (control and treated counties).

	Mean	Std dev.	Factory	No factory
Panel A: Vulnerability to air strikes				
Penalized distance (1953)	0.02	1.07	0.39	-0.36
Penalized distance (1964)	-0.34	0.77	-0.24	-0.44
Panel B: Population				
Population (1982, log)	12.86	0.91	13.05	12.68
Population (2010, log)	13.29	0.98	13.54	13.04
Panel C: Economic development				
Employment share (ind, 1982)	0.28	0.21	0.33	0.22
Employment share (ind, 2010)	0.28	0.15	0.28	0.29
Panel D: Matching controls				
Travel to province capital (log)	13.22	2.83	13.20	13.24
Population (1953, log)	12.14	1.07	12.17	12.11
County area (log)	6.78	0.94	6.88	6.67
Travel cost to coal mines (log)	11.84	4.19	11.45	12.23
Travel cost to coke (log)	9.93	5.72	9.94	9.92
Travel cost to ore (log)	14.63	2.02	14.65	14.61
Panel E: Additional controls				
Distance to military airfields (log)	10.52	0.98	10.40	10.63
Travel cost to major ports (log)	13.21	2.73	13.57	12.84
Panel F: Later economic shocks				
Third Front Movement	0.17	0.38	0.20	0.14
Cultural Revolution (victims)	0.04	0.08	0.05	0.03
Industrial parks (log, 1990–2010)	0.30	0.38	0.25	0.35
Observations	196		98	98

Notes: Penalized distance is the standardized flying cost (with mean 0 and variance 1 over all counties in China)—see Appendix C.2 for details. The variables in Parnels B and C come from Population Censuses. The construction of the matching variables (Panel D) and additional controls (Panel E) is explained in Appendix C.1. Third Front Movement is an indicator variable equal to 1 if the county is located in a Third-Front province (see Fan and Zou, 2019) and 0 otherwise. Cultural Revolution (victims) is the logarithm of (1 plus) the share victims of the Cultural Revolution in the 1953 Census population, from Walder and Su (2003). Industrial parks refers to the logarithm of (1 plus) the number of industrial parks created in the county between 1990 and 2010 (see Zheng et al., 2017) per 10,000 inhabitants (using population from the 1953 Census).

availability of information at the county level. Table 4 shows OLS and IV estimates of the relationship between the presence of a MRP and population, share of urban residents, output per capita, and the employment share in industry.

We find that industrial investment under the "156" program has a positive and significant impact, albeit moderate, on population in the earlier period. Treated counties are 56% more populated than control counties in 1982 (column 1, Panel B, $\exp(0.45) - 1 \approx 0.56$). The treatment effect on urbanization is large; the share of the population that has non-agricultural household registration is about 35 percentage points higher in treated counties (column 2, Panel B). The impact of the MRPs thus shows a large reallocation of labor, which could be interpreted as evidence of structural transformation and urbanization. The higher share of urban residents is associated with a much higher output per capita, and a higher industry share in the local economy (columns 3 and 4, Panel B). GDP per capita is more than twice as large as in treated counties, and the employment share in industry is 24 percentage points higher. The magnitude of these differences is far beyond the mere output of the average MRP (see Appendix A.4), indicating that counties are richer and more developed—the effect on output per capita is equivalent to the difference between the 25^{th} percentile and the 75^{th} percentile of the control-group distribution.

A few remarks are in order. First, the IV estimates are larger than the OLS estimates, possibly reflecting the fact that places selected to host a MRP were less likely to host industries prior to the First Five-Year Plan (Bo, 1991). Second, the rise of our treated counties may have limited external validity. Before the advent of the reforms, the government would instruct workers where to live and where to work in order to accommodate rising demand for labor and control the growth of the plants and of the local economy.[19] Changes in labor allocation mostly reflected government intervention, which may temper agglomeration effects. The population increase, while one order of magnitude larger than the expected labor force of the MRP itself, probably lags behind labor demand in treated counties.

To summarize the impact of the "156" program between 1953 and 1982, we find a moderate to large effect on urban population, and a *very* large effect on local output. The substantial productivity gap between treated and control counties indicates that treated areas enter the subsequent period with a substantial head start. The liberalization of the economy should allow agglomeration economies to operate, and one could expect treated counties to drift further apart from the rest

[19] While some free movement of labor still occurred after the advent of "New China" in 1949, mobility was subject to authorization from the late 1950s onward. The government had tightened its grip on labor movement in the wake of the Great Leap Forward, when famines threatened the sustainability of urban food provision systems.

Table 4. Treatment effect on employment, output and urbanization in 1982 and 2010.

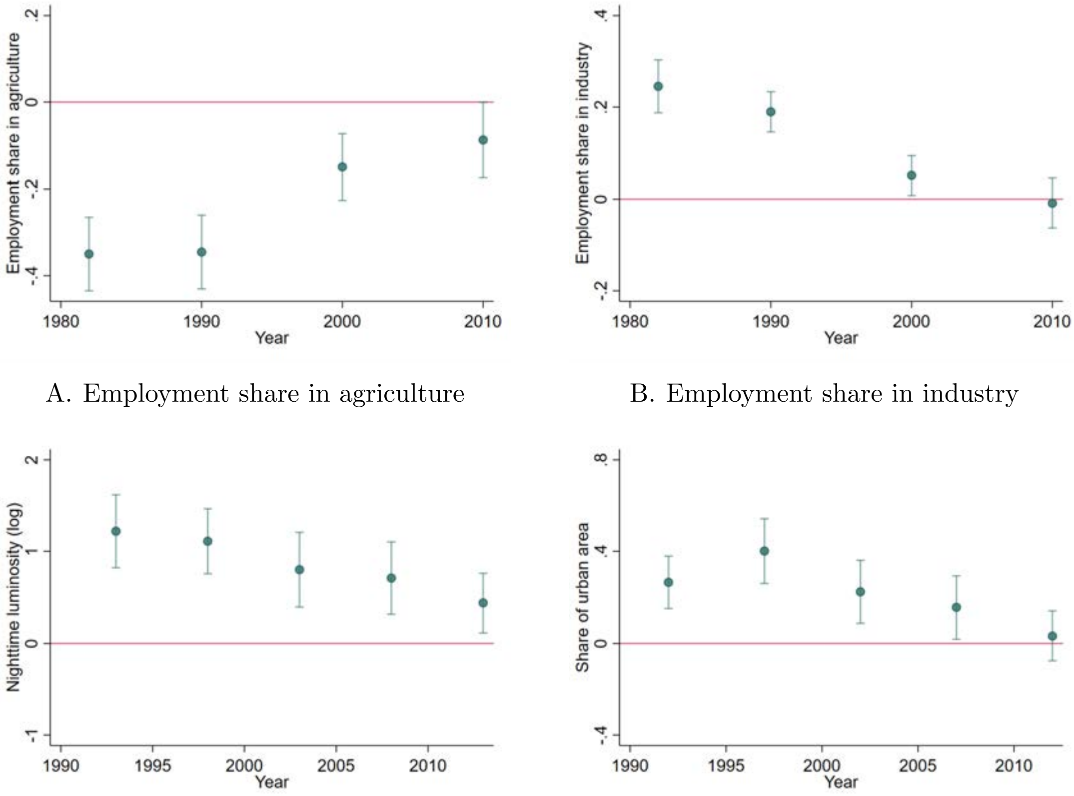
	Population	Urban reg.	GDP p.c.	Share industry
	(1)	(2)	(3)	(4)
Panel A: OLS specification				
Treatment effect (1982)	0.218	0.189	0.462	0.135
	(0.072)	(0.040)	(0.098)	(0.030)
	[196]	[196]	[196]	[196]
Treatment effect (2010)	0.375	0.204	-0.013	0.010
	(0.096)	(0.039)	(0.089)	(0.026)
	[196]	[196]	[196]	[196]
Panel B: IV specification				
Treatment effect (1982)	0.445	0.350	0.755	0.245
	(0.076)	(0.043)	(0.104)	(0.029)
	[196]	[196]	[196]	[196]
	95.68	*95.68*	*95.68*	*95.68*
Treatment effect (2010)	0.583	0.355	-0.350	-0.009
	(0.099)	(0.035)	(0.100)	(0.028)
	[196]	[196]	[196]	[196]
	95.68	*95.68*	*95.68*	*95.68*

Notes: Each cell is the outcome of a separate regression. Standard errors are clustered at the level of 2-degree × 2-degree cells (reported between parentheses). The unit of observation is a county (Administrative level 3); the number of observations is reported between square brackets. The instrument is the minimum distance to the military U.S. and Taiwanese airfields penalized by the proximity to U.S.S.R. and North Korean airfields; we report the first-stage F-statistics in italic. All specifications include (i) matching-pair fixed effects, (ii) matching controls (all in log), i.e., travel cost to the provincial capital, population in 1953, county area, travel cost to resources (coal, coke, ore), and (iii) the additional controls, i.e., (log) travel cost to major ports (through the river network), (log) distance to military airfields, and penalized flying cost to enemy airfields in 1964. *Population* is the logarithm of total population in the county, *Urban reg.* is the share of the population that has a non-agricultural household registration (*hukou*), *GDP p.c.* is the logarithm of GDP per capita within the county, and *Share industry* is the industrial employment share.

of the economy. As we see next, we find the opposite.

The fall There is (more than) a full catch-up between 1982 and 2010—see Table 4. We find that population is still high in treated counties (column 1, Panel B); treated locations also continue to have a higher share of registered urban population (column 2, Panel B). In stark contrast with the treatment effect in 1982, however, output per capita and the industry share are now lower in treated counties (columns 3 and 4, Panel B). The significant gap in industrialization before the transition has thus fully eroded: treated counties are about 30% less productive than control counties and the employment share in industry is not statistically significantly different, and—if anything—slightly smaller.

Figure 4. The dynamics of counties hosting MRPs.



A. Employment share in agriculture

B. Employment share in industry

C. Nighttime luminosity

D. Urban extent

Notes: Panels A-D display the treatment effect for the employment share in agriculture and industry (1982, 1990, 2000, 2010), nighttime luminosity, and the share of urban area in the county, as computed using impervious surface recognition. In Panels C-D, we show the treatment effect on the following constructed variables: the (log) average nighttime luminosity in 1993, 1998, 2003, 2008, and 2013; and the average share of urban land in 1992, 1997, 2002, 2007, and 2012.

We provide further insights into the dynamics of treated counties from 1982 onward in Figure 4. More specifically, we show the evolution of counties hosting MRPs across a set of aggregate variables that can be consistently harmonized over time: employment shares in agriculture and in industry (1982–2010); nighttime luminosity (1990–2010); and urban "extent" as identified from satellite imagery (1990–2010). More specifically, we estimate Equation (1) separately for different years and we report the treatment effect. We find that there is a gradual decrease in economic activity in treated counties, with a clear inflection during the 1990s.

This fast reversion to the mean is puzzling for two reasons. First, it does not result from a swift decline of MRPs themselves; they remain very large and productive (as separately documented in Giorcelli and Li, 2022).[20] Second, their own,

[20]The dynamics of the local economy could be affected by the dynamics of the MRPs themselves,

direct influence on aggregate productivity is non-negligible and positive: the previous results thus indicate that other firms must be unproductive. Before turning to the characterization of these other establishments in treated counties, we provide a series of robustness checks.

4.2 Robustness checks and sensitivity analysis

The empirical strategy exploits temporary, exogenous variation in the probability to host a MRP among suitable counties. The geographical variation induced by the vulnerability to bombing between 1950 and 1960 may however coincidentally correlate with other geographic determinants of later economic growth. We provide a comprehensive sensitivity analysis to reduce concerns that the rise and the fall are related to other factors than hosting MRPs. This section summarizes these robustness checks and a detailed discussion of the results can be found in Appendix D.1.

We interpret the previous estimates as the effect of MRPs on the local economy. One concern is that the instrument, which relies on the distribution of air bases across space, may correlate with other geographic factors that have independent effects on the distribution of economic activity across China over time. In Panel A of Table D3, we first condition the baseline specification on measures capturing an environment that is (un)favorable to economic take-off, e.g., land supply restrictions, pollution, connectedness, access to ports, natural amenities, elevation, soil characteristics, and crop yield, to reduce concerns about biasing effects from unobserved county characteristics. Second, we better control for (log) distance to the coast, and we exclude all coastal provinces, the Pearl river delta, and the South of China to show that our results are not driven by the overall geography of the economic take-off in China (Panel B of Table D3). Third, we control for later place-based policies that could reduce the gap between treated and control counties (e.g., Third Front Movement, Special Economic Zones, industrial parks), for factors underlying these later decisions (e.g., vulnerability to U.S.S.R. strikes after the rapprochement between the U.S. and China in 1972), for other policies driving the economic evolution of China (e.g., the Cultural Revolution), and for possible direct, negative impacts

as they are large employers within a county. In Appendix A.4, we describe the dynamics of production in the average MRP. More specifically, we show that: (i) they experience an *increase* in patenting activity and stable employment throughout the recent period; and (ii) their production share in local economies is non-negligible (around 4% of the wage bill and value added within their county) but insufficient to explain our findings without spillovers on the rest of local production. Further, we provide a sensitivity analysis in Appendix D.1 where we exclude the few counties hosting closed and displaced factories to show that the fall is not related to the fall of MRPs themselves. Finally, we look at treatment heterogeneity in Appendix A.4 where we show that the fall of treated counties is quite homogeneous across the different MRP types.

of MRPs on local employment (e.g., whether they were among the few having been liquidated)—see Table D4. Fourth, we exploit another source of exogenous variation by using abandoned projects of the 2nd Five-Year Plan as a control group for counties hosting late MRPs within the same Plan (see Table D5).

In Appendix D.1, we also consider variations in: the matching strategy, e.g., by changing the set of variables used for matching or the process to select control counties (Panel A of Table D6); the measurement of GDP (Panel B of Table D6); the treatment of spatial correlation (Panel C of Table D6); the construction of the vulnerability instrument (Figure D1); and alternative measures of economic development (Table D7).

4.3 The production in *other* establishments

Treated counties experience a swift reversion to the mean in *aggregate* output, including MRP(s). Production in *other* establishments must therefore be limited to understand this county-level reversion pattern. We now rely on micro-data to better characterize the structure of production in those non-MRP establishments.

Our analysis relies on: measures of factor productivity at the establishment level, with a production function identified using an exogenous labor supply shifter (see Imbert et al., 2022, and Appendix B.2); patents linked to establishments (He et al., 2018); and markups (computed following De Loecker and Warzynski, 2012, see Appendix B.3).[21] In Panel A of Table 5, we estimate Specification (1) at the establishment-level, pool all establishment × year observations between 1998 and 2007, and regress an outcome on the treatment T_c, instrumented by V_c. We exclude the MRPs from the sample, and we cluster standard errors at the level of 2×2-degree cells. Differences in firm outcomes across counties could theoretically be tied to composition differences induced by the local industrial composition, local products, the presence of public and subsidized enterprises (Harrison et al., 2019), and the age of establishments. We thus add: year interacted with 4-digit industry fixed effects; year interacted with 6-digit product fixed effects; and year interacted with firm ownership type, a dummy for receiving subsidies, and age.[22]

[21] In this section, we describe the treatment effect on the structure of production using a selection of outcomes, and we leave the detailed analysis of factor use, factor productivity, firm characteristics, investment and subsidies, patenting behavior, and price setting (and their evolution over time) to Appendix D.2.

[22] We provide a sensitivity analysis with more limited sets of controls in Appendix D.2. Cleaning for the local industry structure is quite important for patenting behavior. Indeed, the presence of the MRP(s) tilts the local industrial fabric toward innovative and competitive sectors; these innovative sectors are however far less innovative and competitive in treated counties. By contrast, we find that controlling for the local industry structure is innocuous for factor productivity and factor use. In particular, our results are orthogonal to the life-cycle of local firms and to the

Table 5. Structure of firm production in the average other establishment.

	Labor (1)	Capital (2)	Wage (3)	TFP (4)	Patents (5)	Markup (6)
Treatment	0.301	0.496	-0.256	-0.202	-0.079	0.125
	(0.087)	(0.135)	(0.077)	(0.103)	(0.033)	(0.049)
Observations	304,305	304,305	304,305	304,305	304,305	193,086

Notes: Standard errors are clustered at the level of 2-degree × 2-degree cells. The unit of observation is a firm × year. We exclude the MRPs from the sample. All specifications include the extended controls of Table 4 (column 3, including matching-pair fixed effects interacted with year fixed effects), 4-digit industry × year fixed effects, 6-digit product × year fixed effects, age × year fixed effects, firm type × year fixed effects, and whether the firm receives public subsidies × year fixed effects. *Labor* is the logarithm of the number of workers; *Capital* is the logarithm of real capital; *Labor cost* is the logarithm of total compensation per employee; *TFP* is the logarithm of firm-specific total factor productivity as computed in Imbert et al. (2022); *Patents* is the number of patent applications registered by the firm; *Markup* is a dummy equal to one if the markup is above the median within a 4-digit industry × year cell, computed following De Loecker and Warzynski (2012)—see Appendix B.

We find that establishments in treated counties are larger and slightly more capital-intensive than in control counties (columns 1 and 2). Labor cost markedly differs across counties; the average compensation per employee is around 25% lower in treated counties (column 3). In line with this finding, total factor productivity is about 20% lower in treated counties than in control counties (column 4). This could either indicate that the treatment generates differences in technology or differences in price setting between control and treated counties. We investigate these two aspects next. We find that establishments in treated counties produce (much) fewer patents. The treatment effect on patents is of the order of magnitude of the yearly number of patents produced in the average establishment: very few patents are thus registered in treated counties. Finally, the TFP effect cannot be explained by markups; they are on average higher in treated counties (column 6): the probability for a firm to charge a markup above median is 12 percentage points higher in treated counties.

The next section identifies the spillovers within the local economy that drive this marked decline in innovation, productivity, and competition.

5 Mechanisms behind the fall of treated counties

This section analyzes the negative spillovers exerted by MRP(s) on local production. In a first step, we zoom in and out the production chain of MRPs, characterize the structure of local production, and look at the treatment effect of MRP(s) on

demise of public establishments. Public establishments in treated counties are not relatively less innovative or less productive than in control counties. If anything, their likelihood to register a patent and their total factor productivity are larger. We provide an analysis of composition effects in Appendix D.3, in which we study how differences in production structure may reflect differences in the ownership structure, or the presence of establishments at different stages of their life cycle.

closely-linked establishments versus average establishments within the same county. In a second step, we study treatment heterogeneity across MRP characteristics to shed further light on the possible source of negative spillovers. In a third step, we identify the effect of hosting a MRP on *missing industries* through the local supply of entrepreneurs. In a last step, we discuss the role of other externalities than production/technological spillovers, e.g., operating through the provision of factors or political favoritism.

5.1 Production structure around MRPs

We first identify linkages between establishments to better understand the concentration *around the MRP(s)* and the characteristics of linked plants.

Product concentration around MRPs The use of establishment-level data implies that we can identify differences in the local structure of production from observing potential links between establishments and local MRP(s), or from observing production in those linked establishments. For instance, one may benchmark the activity of downstream establishments in a treated county against similarly defined establishments in control counties. A difference-in-difference specification cannot however be implemented as such, due to treatment heterogeneity, and we rationalize the use of a slightly more involved empirical strategy in Appendix C.3, where we (counterfactually) allocate MRP(s) of their matched treated county to each control county.

In order to capture potential linkages between establishments and the local MRP(s), we rely on input-output accounts in the United States (Stewart et al., 2007) and on our classification of manufacturing establishments across product codes (Imbert et al., 2022). Considering $m_{p,p'}$ as the input share of product p into product p', we define an indicator, *Downstream*, equal to 1 if $\max_{P\in\Theta}\{m_{P,p}\}$ is higher for an establishment producing p than the 95% quantile across all establishments of the sample—where $\Theta = \{P\}$ is the set of products produced by the local MRP(s).[23] We define an indicator, *Upstream*, in a similar way to characterize upstream establishments (using $\max_{P\in\Theta}\{m_{p,P}\}$ against its 95% quantile). We define an indicator, *Same product*, equal to 1 if the establishment produces at least one good (6-digit level) also produced by a local MRP. We proceed in a similar fashion to define: (i) a measure of technological closeness, *Tech. clos.*, based on the 95% quantile in the intensity of patent citations across different industries (Bloom et al., 2013); and (ii)

[23] We show that our findings do not crucially depend on these thresholds in Appendix D.4.

a measure of competition on factor markets based on revealed factor intensities as predicted by trade patterns in 2000 (see Shirotori et al., 2010).[24]

Table 6 (Panel A) reports the relative presence of establishments operating downstream, upstream, and in the same product market as the local MRP(s). We report an unweighted measure capturing the probability for an *establishment* to be tied to MRPs and an employment-weighted measure capturing the probability for a *worker* to be tied to MRPs. In column 1, we report the result of a specification in which the measure of downstream linkages at the establishment level is regressed on the treatment, instrumented by vulnerability to air strikes (with the same controls as in Table 5). We find that the treatment increases the probability for an establishment to operate downstream of the MRP by about 0.9 percentage points, which is arguably small. Columns 2 and 3 of Table 6 report the relative incidence of upstream linkages and horizontal linkages in treated counties. The treatment effect on the probability for an establishment to operate upstream of the MRP is non-negligible (3.7 percentage points, to be compared with an average of 5% across treated and control counties), even though MRPs tend to operate early in the production chain. The treatment does also affect the probability to operate in the same product market, which increases by 2.8 percentage points—an effect that we can attribute to economies of scale (Ciccone, 2002). Overall, while the hypothetical production chain of MRP(s), excluding the MRP(s), would represent about 7% of all establishments in the average control county, the actual production chain accounts for 13% of establishments in the average treated county.

Panel B of Table 6 reports the relative presence of establishments with more acute demand for human capital (column 1), physical capital (column 2), and land (column 3) than the local MRP(s). The differences between treated and control counties are not very large—a few percentage points, to be compared with averages at around 50 percentage points. These findings provide little support for the existence of spillovers in factor markets. Finally, Panel C reports the relative presence of establishments with a technology closeness measure above the 95%-quantile. The difference between treated and control counties is positive, albeit much smaller than for production linkages.

[24]We provide a detailed description of these two sets of measures in Appendix B.1. About the latter measures, letting f_p denote the revealed factor intensity for factor f (human capital, physical capital, or land) and good p, we define a dummy, *More F-intensive*, equal to one if the average f_p over the goods produced by an establishment is higher than the average f_P over the goods produced by local MRPs. The rationale is that MRPs may have a higher bargaining power on factor markets, e.g., because of lower search frictions; their privileged access to resources may affect those firms whose needs for this production factor are pressing.

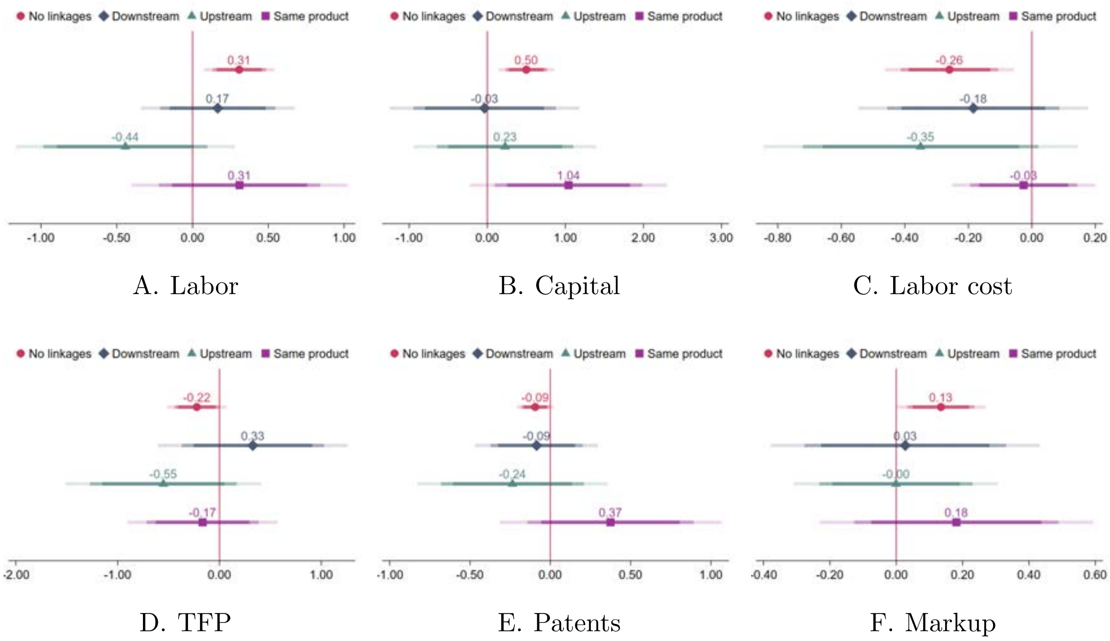
Table 6. Production linkages with the MRPs.

	Downstream (1)	Upstream (2)	Same product (3)
Panel A: Production linkages			
Treatment (unweighted)	0.009	0.037	0.028
	(0.020)	(0.022)	(0.013)
	[304,305]	[304,305]	[304,305]
Treatment (weighted)	0.019	0.041	0.036
	(0.022)	(0.024)	(0.017)
	[304,305]	[304,305]	[304,305]
VARIABLES	More H-intensive (1)	More K-intensive (2)	More T-intensive (3)
Panel B: Factor demand			
Treatment (unweighted)	-0.033	-0.047	-0.049
	(0.025)	(0.024)	(0.024)
	[195,611]	[195,611]	[195,611]
Treatment (weighted)	-0.059	-0.052	-0.080
	(0.026)	(0.028)	(0.043)
	[195,611]	[195,611]	[195,611]
VARIABLES	Tech. clos. (1)	Tech. clos. (Mah.) (2)	
Panel C: Technology closeness			
Treatment (unweighted)	0.013	0.014	-
	(0.006)	(0.015)	-
	[304,305]	[304,305]	-
Treatment (weighted)	-0.013	0.005	-
	(0.021)	(0.014)	-
	[304,305]	[304,305]	-

Notes: The unit of observation is a firm × year, we exclude the MRPs from the sample, and standard errors are clustered at the level of 2-degree × 2-degree cells. All specifications include the baseline controls of Table 5. *Downstream* (resp. *Upstream*) is a dummy equal to one if the firm is down (resp. up) the supply chain with respect to one of the 156 factories; *Same product* is a dummy equal to one if the firm is in the same product market as one of the 156 factories (see Section 5 for a description of the empirical strategy and the definition of these dummies in control counties). *More F-intensive* is a dummy equal to 1 if the revealed factor intensity of factor F (using product codes) is higher than that of the average associated MRP. *Tech. clos.* is a dummy equal to one if sectors in which the establishment and the MRP(s) operate are linked through patent applications.

Production in linked and non-linked establishments The previous evidence has identified the change in the structure of production as induced by the presence of the MRP(s): there are many establishments operating along their production chain.

Figure 5. Productivity, innovation, and pricing in establishments along MRPs' production chain.



Note: This Figure displays the treatment estimates for the following outcomes: *Labor* is the logarithm of the number of workers; *Capital* is the logarithm of real capital; *Labor cost* is the logarithm of total compensation per employee; *TFP* is the logarithm of firm-specific total factor productivity as computed in Imbert et al. (2022); *Patents* is the number of patent applications registered by the firm; *Markup* is a dummy equal to one if the markup is above-median within a 4-digit industry × year cell, computed following De Loecker and Warzynski (2012)—see Appendix B. The unit of observation is a firm × year, we exclude the MRPs from the sample, and standard errors are clustered at the level of 2-degree × 2-degree cells. All specifications include the extended controls of Table 5. In each panel, we report four estimates: one obtained using the sample of non-linked firms (*No linkages*); one obtained using the sample of upstream firms (*Upstream*); one obtained using the sample of downstream firms (*Downstream*); and one obtained using the sample of firms within the same 6-digit product (*Same product*).

We now characterize these establishments by looking at treatment heterogeneity on the following selected outcomes: factor use (labor and capital), labor cost, total factor productivity, the number of registered patents, and markups.

Figure 5 reports these estimates for: non-linked establishments (red circle), downstream establishments (blue diamond), upstream establishments (green triangle), and same-product establishments (purple square). Treatment heterogeneity is not negligible. First, the average non-linked establishment is larger, less productive, less innovative, charging higher markups, and facing lower labor costs than in control counties. The spillovers exerted by MRPs thus seem to reach beyond their production chains—an effect that we further investigate in Section 5.3 where we look at (missing) entrepreneurship and firm entry.

Second, the treatment effects on downstream/upstream establishments slightly differ from the average effect: the average downstream establishment is as large as in control counties and charges similar markups, but it is *more* productive than control establishments (although the difference is not statistically significant at conventional levels). One interpretation of this finding is that establishments along the production chain of MRP(s) enjoy a rent from their proximity with a highly productive and innovative factory. By contrast, while we cannot reject that the average upstream establishment charges similar markups,[25] it is smaller and *far less* productive and innovative than control establishments (once again, these coefficients are estimated with noise). In general, these linked establishments extract part of the final value added when operating at one point of the production chain, whether upstream or downstream, and do not need to incur innovation efforts. This technological rent provides incentives for establishments and entrants to tie their production to the MRP technology, thereby explaining the cluster of specialized production units around the MRP. Third, same-product establishments are very large, charge high(er) markups, and appear to register many patents—an effect that could be attributed to direct technological linkages with the local MRP(s) and that cannot be found in upstream/downstream establishments.[26]

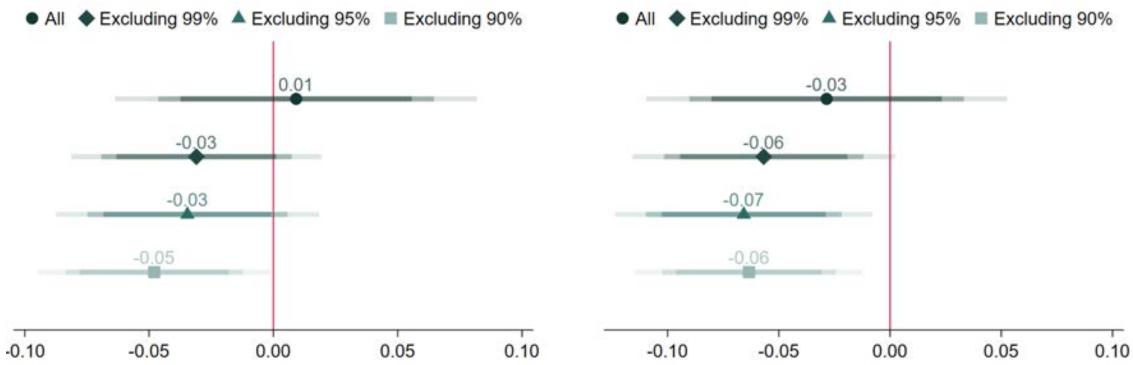
Production concentration in treated/control counties The previous evidence documents a grouping of production units through the production chain of MRPs. This expected result, however, masks a less intuitive picture of production concentration across counties. We now shed light on this general production structure by extracting county-level Herfindahl indices of production concentration (see Appendix B.1 for a detailed description of these indices).

More specifically, we construct a county-specific vector $\mathbf{S}_c = (s_{pc})_p$ of output shares across 6-digit product categories indexed by p. An oft-used measure of product concentration is the Herfindahl-Hirschman Index, $h_c = \sum_p s_{pc}^2$ (thereafter

[25] The effect of a large, innovative establishment on the markup set by intermediaries or firms benefiting from technological spillovers could be ambiguous. On the one hand, the production chain probably generates high rents, which should influence the markup set by intermediaries. There may also be a hold-up problem if the final good requires all intermediary inputs to be produced. On the other hand, the large establishment may benefit from a more advantageous bargaining position when negotiating with intermediaries.

[26] The present exercise focuses on "production" linkages, i.e., on establishments that operate in product markets through the production chain of local MRPs. We expand the previous exercise to technological linkages and other firm characteristics (public, subsidized, young) in Appendix D.3. In particular, we find that establishments with direct technological linkages to the MRPs appear to suffer from competition with the large plant(s): they are quite small, unproductive, and charge very low markups. They do however seem to enjoy technological spillovers from their technological closeness to large plants at the technology frontier, and their patenting activity is very high. We do not see, however, marked differences in treatment effects along other firm characteristics, e.g., when focusing on public firms, subsidized firms or young establishments in treated counties.

Figure 6. Production clusters in treated/control counties.



A. Herfindahl index B. IO-weighted Herfindahl index

Note: This Figure displays the treatment estimates for the following outcomes: *Herfindahl index* is the Herfindahl index based on output shares within 6-digit product categories (panel A); *IO-weighted Herfindahl index* is a Herfindahl index based on output shares within 6-digit product categories, mediated by input shares from the U.S. IO matrix (panel B). In each specification, the unit of observation is a county, standard errors are clustered at the level of 2-degree × 2-degree cells, and we include the extended controls of Table 4. See Section 5.1 and Appendix B.1 for the construction of these indices.

"Herfindahl index"). This standard index can be written as,

$$h_c(\mathbf{I}) = \mathbf{S}_c'\mathbf{I}\mathbf{S}_c,$$

where $\mathbf{I}$ is the identity matrix. However, this index does not measure product concentration through production chains: a pair of establishments would be linked—with intensity 1—if, and only if they operate in the exact same 6-digit product market. To better account for production linkages, we further rely on the input share of product p into product p', $m_{p,p'}$, and the associated square matrix $\mathbf{M} = (m_{p,p'})_{p,p'}$. An "IO-weighted Herfindahl index" can be written as,

$$h_c(\mathbf{M}) = \mathbf{S}_c'\mathbf{M}\mathbf{S}_c.$$

We estimate the treatment effect on these product concentration indices by considering the county-level specification (1), and we report the estimates in Figure 6 for two outcomes: the standard "Herfindahl index", $h_c(\mathbf{I})$ (panel A); and the "IO-weighted Herfindahl index", $h_c(\mathbf{M})$ (panel B). The first estimate relies on all product codes in each county and shows that there is no significant difference between treated and control counties, in spite of the previously-documented inflated production chain of MRPs in treated locations. The second estimate drops the top-1% county/product-code output shares from the calculation of the "Herfindahl index"; the third estimate drops the top-5% county/product-code output shares; and the last estimate drops the top decile of output shares. These latter estimates show that product concentration is (much) lower in treated counties once we exclude the largest products, and the differential is even more pronounced when accounting for production linkages. For instance, the differential between treated and control counties of -0.06/-0.07 in product concentration indices (as shown for the last three estimates of panel B) is equivalent to about half of a standard deviation: outside of the production chain of MRPs,—which is typically dropped from those selected product samples,—there are much fewer product clusters in treated counties and production is largely scattered across smaller production chains.[27]

In summary, with a structure of production that is mostly concentrated around MRPs and a non-innovative nucleus of firms, treated counties do not benefit much from externalities in local technological progress, whether it be within or across industries (Glaeser et al., 1992). One question remains: why are there so few clusters of establishments outside the production chain of MRPs and why are they less productive, innovative, and competitive than elsewhere? Before we look at these missing industries, we explore treatment heterogeneity *across treated counties* in the next section.

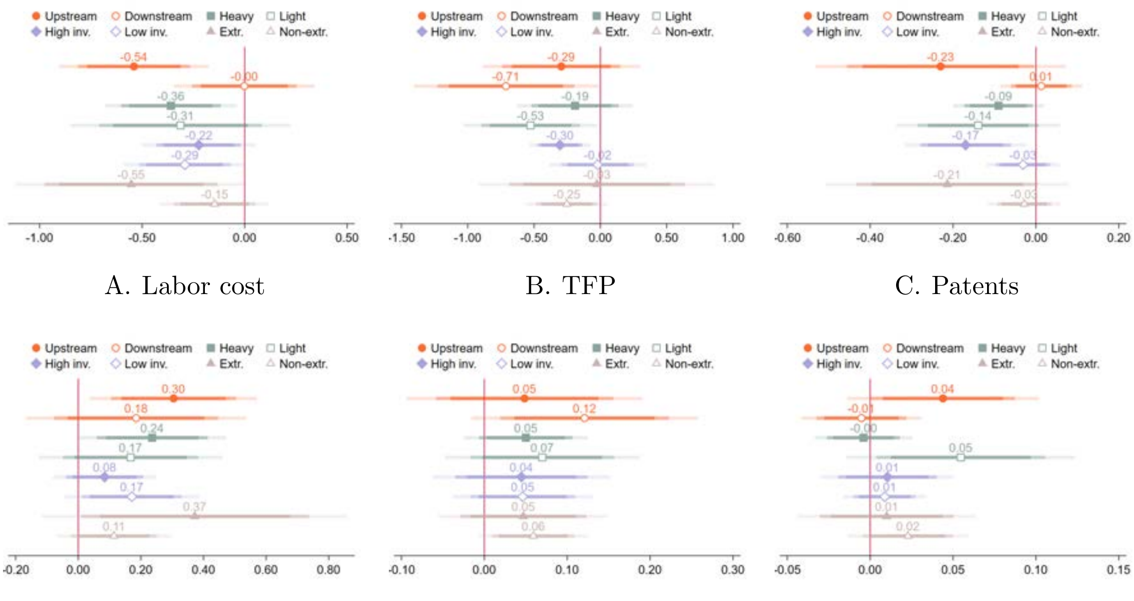
5.2 Heterogeneity across MRP characteristics

After having analyzed heterogeneous treatment effects across establishments of the same county, we study a simpler aspect of treatment heterogeneity: the heterogeneity in treatment effects across MRP characteristics. We report the analysis of treatment heterogeneity on labor cost, productivity, patents, markups, and the incidence of linkages to MRP(s) in Figure 7 and restrict the analysis to simple differences across MRP(s). More specifically, we display treatment effects associated with: (i) MRPs operating upstream/downstream (orange circles; upstream MRPs are those with a relative intensity of downward linkages versus upward linkages above median); (ii) heavy/light-industry MRPs (teal squares); (iii) high/low-investment industry MRP (lavender diamonds; high-investment MRPs are those with above-median initial investment); and (iv) extractive/non-extractive MRP (gray triangles).

Among these dimensions of treatment heterogeneity, the position of MRPs in production chains does seem to matter the most. The effect of having upstream MRP(s) on innovation and competition is (much) more negative than receiving downstream

[27] We provide further robustness checks in Appendix D.5 where we use other matrices based on (i) technological linkages or (ii) product similarity based on language similarity, and we show the evolution of concentration across counties and over time.

Figure 7. Treatment heterogeneity across MRP characteristics.



A. Labor cost B. TFP C. Patents

D. Mark-up E. Production links F. Technological links

Note: This Figure displays the treatment estimates for the following outcomes: *Labor cost* is the logarithm of total compensation per employee; *TFP* is the logarithm of firm-specific total factor productivity as computed in Imbert et al. (2022); *Patents* is the number of patent applications registered by the firm; *Markup* is a dummy equal to one if the markup is above-median within a 4-digit industry × year cell, computed following De Loecker and Warzynski (2012)—see Appendix B; *Production links* is a dummy equal to one if the firm operates along the production chain of local MRP(s); *Technological links* is a dummy equal to one if sectors in which the establishment and the MRP(s) operate are linked through patent applications. The unit of observation is a firm × year, we exclude the MRPs from the sample, and standard errors are clustered at the level of 2-degree × 2-degree cells. All specifications include the extended controls of Table 5. In each panel, we report four estimates: one obtained using treated and control counties associated with a MRP operating upstream/downstream [*Upstream MRP*/*Downstream MRP*]; one obtained using treated and control counties associated with a heavy/light-industry MRP [*Heavy*/*Light*]; one obtained using treated and control counties associated with a high/low-investment MRP [*High-inv.*/*Low-inv.*]; and one obtained using treated and control counties associated with extractive/non-extractive MRP [*Extr.*/*Non-extr.*].

MRP(s); there is also a different effect on the incidence of linkages: downstream MRP(s) are associated with many establishments through their production chain, while upstream MRP(s) produce more technologically-linked establishments. By contrast, we do not find such stark differences in the treatment impact of hosting light-industry versus heavy-industry MRP(s) (or along the size of the initial investment). Lastly, the treatment impact of hosting extractive plants is more negative on returns to labor, patenting, and competition.[28]

[28] In Appendix D.4, we provide the treatment estimates on county-level outcomes such as population and GDP per capita in 1982 and 2010. We also consider other dimensions of treatment heterogeneity: whether the MRP is still operating at the same location; whether the time spent to construct the MRP(s) is above/below the median; whether the time at which MRP(s) were completed is above/below median (to control for heterogeneity in the success of MRPs themselves, as shown in Giorcelli and Li, 2022); and the variety of products offered by the local MRP(s). We find that counties associated with closed MRP(s) tend to perform better, if anything, than those with operating MRP(s).

Table 7. Selection of (possible) entrepreneurs into emigration across counties.

	College (1)	Manager (2)	Self-empl. (3)	Top-inc. (4)
Treatment	0.099	0.014	0.048	0.031
	(0.029)	(0.004)	(0.020)	(0.019)
	[0.657]	[0.611]	[0.505]	[0.310]
Observations	196	196	196	196
Mean	0.174	0.013	0.143	0.146

Notes: Standard errors are clustered at the level of 2-degree × 2-degree cells and reported between brackets, and standardized effects are reported between square brackets. The unit of observation is a county. All specifications include the extended controls of Table 4. *College* is the share of emigrants with a tertiary degree; *Manager* is the share of emigrants working as "Managers of Enterprises, Institutions and Related Work Units" (Chinese Standard Classification of Occupations); *Self-empl.* is the share of emigrants who are own-account workers; *Top-inc.* is the share of emigrants with incomes in the top 10% of the income distribution in their prefectures of destination.

5.3 Missing production and entrepreneurs

So far, we have shown that treated counties do have a nucleus of establishments possibly tied to MRPs, but: (i) their own contribution to local production and local innovation is limited; (ii) other productive production chains appear to be missing; and (iii) the average other establishment outside of the MRPs' production chains is not productive, not innovative, and not competitive. One explanation is that treatment directly affects the local production of entrepreneurs or their "retention." We now shed better light on missing industries by studying the selection of possible entrepreneurs into emigration across counties.

We rely on the 1% Population Survey of 2005 to compare the profiles of emigrants, i.e., individuals whose current location differs from their county of household registration (*hukou*), from treated and control counties. Table 7 shows that emigrants very strongly differ in their characteristics depending on treatment at their origin location. Indeed, the typical emigrant from treated counties is more likely to have college education (column 1), to be a manager at her destination (column 2), to be self-employed (column 3), and to be among the top-10% of the income distribution at destination (column 4). More specifically, emigrants from treated counties are 10 percentage points more likely to have college education (when 17% of all emigrants from our sample have college education); they are about 1.4 percentage points more likely to be a manager, which is higher than the sample average of 1.3%, and 5 percentage points more likely to be self-employed; and they are 3 percentage points more likely to be in the top-decile of the income distribution at destination (when it is the case for 14% of all our emigrants).[29] These effects are large: they

[29]The fact that 14% of all our emigrants are in the top-decile of the income distribution at

range between 0.3-0.7 standard deviations of their respective outcomes across origin counties.

The allocation of MRPs thus appears to generate a local environment that is not conducive to firm creation outside the production chain of MRPs. Even when potential entrepreneurs/managers are produced, they prefer to export their skills and set up/manage firms in other locations.

5.4 Dutch disease, local politics, and confounding aggregate factors

The previous sections present findings that are consistent with negative production and technological spillovers. In this section, we discuss additional evidence that could shed light on how the local business environment is affected by: (i) the allocation of factors (labor, credit, land) across production facilities in treated and control counties; (ii) urban (dis)amenities; (iii) local values and the local political environment; and (iv) the role of confounding macroeconomic factors.

Dutch disease and misallocation of factors In China, recent research discusses factor market imperfections, e.g., labor (Brandt et al., 2013; Tombe and Zhu, 2019; Mayneris et al., 2018), capital (Hsieh and Klenow, 2009; Song et al., 2011; Brandt et al., 2020), and land (Brueckner et al., 2017; Yu, 2019). The presence of a large factory may further distort the allocation of resources and factors across production units. For instance, treated counties may experience a form of Dutch disease, whereby production costs become prohibitive for smaller firms to enter (Duranton, 2011), or the presence of large factories could affect the availability of prime land parcels for other businesses or residents. We provide evidence in Appendix D.2 and Appendix D.3 that: (a) labor costs are lower in treated counties in spite of a more educated workforce—the accumulation of human capital is indeed higher (in stark contrast with Franck and Galor, 2021), and parents appear to have high aspirations about their children's education (see Appendix D.6); (b) access to capital and public subsidies does not seem particularly restrained for the average (other) establishment; and (c) our main results are robust to controlling for local land prices and characteristics of the local housing stock (see Appendix Figure D4). These findings are inconsistent with stories that are purely based on the (distorted) allocation of

destination may appear puzzling. Indeed, migrants during this period typically come from rural areas, are less educated than urban-registered residents and receive lower wages (see, for instance Imbert et al., 2022). Our sample is however restricted to migrants from a selected sample of counties: our treated and control counties are typically urban, and the local population is well educated.

production resources.[30]

Urban (dis)amenities The rapid urbanization of China over the past decades has led to numerous challenges for policy makers (e.g., urban sprawl, pollution). The presence of a large factory might have exacerbated these issues in treated counties; a few factories were indeed relocated to rural hinterlands within the same county in their first years of existence. In Appendix D.3 and Figure D4, we show, however, that our main findings are robust to controlling for: NO2, PM10, and PM2.5 concentration, and the availability of public commuting facilities and average commute time.

Communist spirit and local political environment The influence of MRPs may affect the business environment through less observable channels. For instance, there may be a tight link between the MRPs and local politicians, which could operate in two ways. First, MRPs may use their influence on the local business environment to gain preferential access to resources (Fang et al., 2018; Harrison et al., 2019). Second, the MRPs may be used and favored by local leaders to alleviate social unrest (Wen, 2019). We have very limited data to shed light on these issues, and we look at indirect indicators about the local business environment, its "fairness," and its possible impact on entrepreneurial values: the provision of subsidies (Appendix D.2), indirect measures of corruption (Appendix D.2), a survey about entrepreneurial values and fairness (Appendix D.3 and Appendix D.6), and the local presence of pre- and post-Revolution elites (Appendix D.3), who have been shown to differ markedly in their values (Alesina et al., 2020). While we do not find evidence that subsidies are differently allocated in treated and control counties or that corruption is higher in treated counties, we do find evidence that individuals have different beliefs about returns to hard work and different values. The less dynamic business environment is thus accompanied by an adjustment of priors about social mobility and returns to effort. We however show in Appendix Figure D4 that none of these possible mitigating factors explain the large and swift decrease in output observed in treated counties.

Public sector, life cycle of establishments, and obsolete sectors To condition the analysis on the role of confounding aggregate factors (e.g., reforms of the public sector or industrial cycles), our baseline specification in Table 4 does

[30]In unreported checks, we also investigate the dispersion of factor productivity in treated and control counties and do not find evidence of a higher misallocation of capital and labor across and within sectors.

already control for the age of manufacturing establishments, their industry, their 6-digit main product, and their "type" (e.g., whether they are State-Owned Enterprises).[31] Indeed, the presence of a large (initially public) factory may affect the involvement of the state in other establishments. The boom and bust of treated counties could then reflect the boom and bust of the state sector over the period 1950–2015 in China (Brandt et al., 2020). We further show in Appendix D.3 that our findings are robust to controlling for: (i) the percentage of Communist Party members and "red categories" within the population, (ii) the share of subsidized housing, and (iii) the incidence of the state sector within counties. Also, we find a higher incidence of public establishments in treated counties, but the productivity/innovation/competition effects are similar for those establishments and for private establishments. In summary, our main results are not driven by the boom and bust of the MRPs themselves, the demise of public firms, the life cycle of local firms, or the marked change in aggregate sectoral activity over the period.

6 Conclusion

Industrialization and the concentration of large industrial clusters may have long-lasting effects on local economies. This paper provides evidence of a rise-and-fall pattern in the long run, even without *aggregate* manufacturing decline and despite the continued success of the initial investments at the origin of the clusters.

The paper relies on a unique experiment in which large factories (MRPs) were (quasi-)randomly allocated across suitable counties in China, and it follows the evolution of these locations—rather than of the plants themselves—in the long run. As in Kline and Moretti (2014), we find that the initial investment was effective in spurring transformation from agriculture to manufacturing and in raising local living standards. However, this head start failed to generate positive agglomeration economies in the later period.

The large productivity gains observed in the 1980s fully vanished in the period 1990–2010. This reversal of fortune occurred even though the MRPs were still productive, innovative, and dynamic. Treated areas did not merely revert to the path followed by control areas; the (other) production units in treated counties are now less productive, competitive, and innovative than in control counties.

We provide a careful characterization of the structure of local production and innovation to shed light on the nature of these negative externalities. We find that the structure of production is concentrated around the production chain of

[31] We also show in Appendix D.2 and Figure D3 that our findings are not so much affected by the previous set of controls.

the MRPs themselves, but the rest of the local economy is scattered across small production clusters. Through the MRPs' production chains, firms appear to extract rents without incentives to innovate; technological spillovers might thus be minimal. However, firms are also unproductive, non-innovative and charging high mark-ups outside of these production chains. One plausible explanation is that these counties do not retain potential entrepreneurs and possible managers; the latter export their skills to other locations. Through these two channels, early industrialization has a persistent, albeit now adverse, influence on local economies.

Our focus on the long-run effects of industrial policies that lead to the emergence of industrial clusters speaks to a wider literature on place-based policies. A rising body of evidence is investigating their short and medium-run effects on local economic development and finds positive effects on economic activity and possibly welfare gains. However, as discussed in Neumark and Simpson (2015), there is not much evidence on whether these policies induce the creation of self-sustaining economic gains in the long run. Put differently, we would like to understand if place-based policies do indeed change the development path of treated regions and successfully shift them to a new steady state, or whether regions revert to their previous steady state in the long-run. To our knowledge, this is the first paper to shed light on this question. We show that treated regions have a tendency to overspecialize, which comes at the expense of economic diversity and productive spillovers that are necessary for economic gains to self-sustain in the long-run. In our empirical assessment, we carefully account for specific circumstances of the Chinese economy that may affect the external validity of this exercise. We cannot find any evidence that institutional differences are driving our results and therefore conclude that our finding is driven by negative economic spillovers from large industrial investments. In line with this interpretation, our results corroborate findings and postulated mechanisms in, e.g., Glaeser et al. (1992) or Glaeser et al. (2015) for the U.S.

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