Fukoku kyohei: evaluating the impact of public investment in Meiji Japan, 1868-1912

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Current version: July 2011

Abstract

Weak institutions, capital scarcity, and risk aversion may motivate the state to lead industrialization in developing economies. Nevertheless, it is unclear whether public-led industries differ systematically from those led by private investors. Using a new dataset of firm establishment from pre-war Japan, I compare the development of industries pioneered by either the government or entrepreneurs. I find public investment was directed toward capital-intensive industries and in less populated regions, suggesting both capital market failure and market fragmentation. Private-led industries, despite modest capital requirements, had lower rates of entry among startup firms, which may indicate high risk aversion among entrepreneurs. Government-pioneered sectors also had higher levels of startup activity, but this positive selection effect diminishes in the second half of the period, which may owe to institutional reforms and improved financial access.

JEL codes: N25, N85, O14, O25

Keywords: Japan, late development, industrial policy, inverted differences-in-differences

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Introduction

To the leaders of the Meiji Restoration, a modern Japan meant a centralized government, a strong military, railroads and telegraphs, a credible currency and banking system, and factories producing textiles and machinery. Less obvious were the means to achieve these ends, and over the next five decades, a group of industrialists, financiers, and intellectuals known as the *genro*[1] embarked on an ambitious modernization program. The relative backwardness of the economy and paucity of private investment during the political transition meant the Meiji government bore the onus of creating a modern state. It purchased western technologies and equipment, employed skilled foreign labor, and founded schools, research institutes, and model factories throughout the country. On the eve of the first world war, Japan had won a colonial empire through military conquest, adopted the gold standard, and flooded world markets with merchandise carried by domestic-built steamships.[2]

In particular, it has been argued that the government's seeding of particular industries like textiles and shipbuilding provided the catalyst for economic growth.[3] Consistent with theories of late development, the turbulent political and economic climate that followed the Meiji Restoration meant that the Japanese state was arguably the sole actor able to amass sufficient capital to acquire foreign technology and invest in long-term industrial projects.[4] Factors like the alignment of managerial and ownership interests and production coordination further highlight the suitability of public leadership in industrial ventures.

Nevertheless, while many attribute the country's economic success to public policies and investments, little research exists to substantiate claims of their efficacy, primarily due to a lack of

[1] These included Okubo Toshimichi, Saigo Takamori, Kido Takayoshi, Inoue Kaoru, Ito Hirobumi, Yamagata Aritomo, and Fukuzawa Yukkichi.

[2] Japan formally annexed the Ryukyu Islands (formerly a protectorate) in 1879. From its victories in the wars with China (1895) and Russia (1905), Japan acquired Taiwan and the southern half of the Sahkalin island, respectively. Japan later annexed Korea, previously a Chinese protectorate, in 1910.

[3] Most scholars and historians agree that until the 1880s, the Japanese government was the most important contributor to industrial development. A financial breakdown from Rosovsky (1961) of public and private sector capital formation in the Meiji Period supports this conclusion; see Table 3.

[4] See Rostow (1990) and Gerschenkron (1962). The breadth of its industrial activities meant that the government could better bear the risk of failed investments, much as zaibatsu conglomerates were thought to have done later in the period; see Tang (2011).

detailed historic data.[5] Some scholarship even suggests a negative influence on industrialization from government involvement, arguing that the privatizations of public enterprises in the 1880s at fire-sale prices were indicative of mismanagement and inefficiency.[6] Other factors that bely the government's beneficent role include its militarization policies, which may have distorted industrial development and ultimately led to economic and political crisis, and the contemporaneous activities of the private sector.[7] In particular, many important industries were pioneered by zaibatsu conglomerates and much of the country's foreign exchange was earned through household production of raw silk.[8]

Uncertainty about the government's leadership role as well as recognition of modest data availability that can provide answers motivate this research. Instead of attempting to generalize the public sector's contribution to economic growth as a whole, this paper presents some specific stylized observations at the industry level, comparing sectors that were either pioneered by the government to those by private entrepreneurs. This is followed by an analysis of the impact of policies adopted by the government in the 1890s to support entrepreneurial activity and financial sector development.

As a first pass, I look at three features: relative factor intensities, rates of entry, and the spatial distribution of firm startup activity during the during Meiji Period. These three coincide with some of the goals articulated by the government at the start of the period, and thus provide a simple means to assess the efficacy of public investments in the decades that followed. If weak capital markets failed to provide funding to entrepreneurs, this should be reflected in the type of industries (i.e., capital vs labor intensive) that the government and private sector entered. Similarly, besides financial constraints, if there were other barriers to entry like risk aversion or technology adoption that inhibited private investors, then sectors pioneered by the government would probably have greater rates of entry since the initial risks were borne by public enterprises. Finally, if the government placed market integration

[5] Rosovsky (1961) says that ``although scholars generally share the view that government influence was widely felt throughout the economy...the opinions are not backed by macro-economic facts--one can believe almost what one chooses, tending toward either one extreme or the other.'' With regard to timing, Ohkawa and Rosovsky (1973) claim that the first ``long swing'' of modern industrial development occurred between 1888 and 1897.

[6] Hirschmeier and Yui (1975). A prominent example is the first modern silk reeling facility, the Tomioka Filature, which the government built according to French design in 1872 and incurred significant losses before selling it to private investors.

[7] Tipton (1981).

[8] See Morikawa (1992), Tang (2011) and Nghiep and Hayami (1979).

at a higher priority than profit maximization, this may be revealed through the regions that were targeted for industrial investment (e.g., prefectures with lower population density or lacking coastlines).

To test these hypotheses, I employ cross-sectional and times series econometric techniques as well as non-parametric comparisons. My analysis uses a new dataset of firm establishments collected from corporate genealogies dating back to the nineteenth century.[9] Encompassing the entire industrial spectrum, the data include firm entry dates, establishment location, and ownership type. Intuitively, I find that the government were more likely to lead entry across all types of manufacturing industries, especially lighter ones like textiles and food processing, in the Meiji Period compared to private entrepreneurs. This finding is consistent with the received wisdom of financial market failure for capital-intensive investment. Furthermore, within the same broad class of industries, the average annual number of startups (i.e., entry rate) is higher in government-led sectors, which indicates that risk aversion may have had a greater influence on private investment flows. Finally, startups in public-led sectors, while fewer in number than those led by private entrepreneurs, are more typically found in prefectures with lower population densities as well as a smaller number of prefectures as a whole.

Nevertheless, the impact of initial government investment may not persist over time, particularly with changes to the institutional environment and the implementation of certain policies like the Commercial Code of 1893. To see whether significant policy reforms affected entrepreneurship, I use an inverted differences-in-differences model to test for level and trend differences in startup activity for government- and private-pioneered sectors pre- and post-reform. I find government-pioneered sectors had a higher number of startups in the pre-reform period relative to those pioneered by private entrepreneurs. However, following policy promulgation this differential was substantially reduced and trend rates were comparable for the rest of the period. These results indicate a positive selection effect from industrial intervention that diminished over time.

Taken together, it appears that the Meiji government achieved many of its main objectives: to substitute domestically produced capital goods for imports; to earn foreign exchange via light manufactures; to consolidate its political and economic authority across the country; and to encourage

[9] See Yagura and Ikushima (1986) and Tang (2011). Supplemental data sources include Smith (1974) and Yushodo (1966).

private entrepreneurial activity via incentives and institutions.[10] Despite data limitations in terms of selection and detail, the peculiar alignment between the initial aims of government policy and the outcomes manifest at the period's end as well as the emergence of a robust entrepreneurial class suggest policymakers may deserve some credit for their prescience as well as for supporting private initiative in later years.

Public Enterprise in the early Meiji Period

Having been largely closed to international exchange until the arrival of a fleet of American battleships in 1853, Japan possessed virtually no modern industries, infrastructure, or institutions at the beginning of the Meiji Period (1868-1912).[11] To rapidly modernize its economy, the new Meiji government made substantial investments in some strategic industries: transport and communications; metal and coal mining; metal processing and manufacture; shipbuilding and machinery; armaments; chemicals; and textiles.[12] These were chosen for a number of reasons, such as to encourage domestic production of capital goods; to earn foreign exchange; to ease commercial transactions and extend political control; and to increase military power.[13]

Underlying these aims was the recognition of weak capital markets, the scale and skill required for industrial startup, and risk aversion to unfamiliar technology.[14] In absolute terms, government expenditure to promote industry was modest, totaling 32 million yen between 1870 and 1885 (or less

[10] Smith (1974). Investing across multiple industries also provides supporting sectors and linkages along the production chain (i.e., intermediate goods) on which the targeted industries rely.
[11] Prior to this, Japan maintained limited trading relationships with the Dutch and Chinese in the port city of Nagasaki. On 31 March 1854, Japanese officials signed the country's first foreign trade agreement, opening the two port cities of Shimoda and Hakodate to American commerce; U.S. Navy (2007). While a number of regional governments, and ultimately even the national government, invested in modern sectors toward the end of the Tokugawa Period (1603-1868), these were one-off projects and remained small-scale; Smith (1974).
[12] Rosovsky (1961), Smith (1974).
[13] Ibid.
[14] Despite some wealth accumulation by merchants, private individuals remained largely in the fields of commerce and not manufacturing industries. Smith (1974) notes that the private sector was more effective in manufacturing industries, but even then they were ``least active in heavier branches.''

than 20 percent of the government budget).[15] However, the government sought to encourage private enterprise by leading entry into targeted sectors with its pilot factories, acquiring and demonstrating new technologies, and supporting the opening of new markets.[16]

To get a sense of the contribution of the government, I briefly describe some of key industries it helped to pioneer. These range from services (rail and shipping) to manufacturing (shipbuilding), from capital-intensive sectors (mining and metals processing) to lighter ones (textiles).

Transport and Communications

The first railroad in Japan was laid by the government in 1872, connecting Tokyo to Yokohama, while a second line followed two years later, connecting Kobe to Osaka. Until 1881, all railroads were financed by the public sector, totaling 76 miles in length.[17] Private sector activity took on a bigger role in the 1880s, with a group of aristocrats putting up 20 million yen to establish the Nippon Railway Company, which was the largest establishment at the time.[18] Nevertheless, even after private investors began to build railways, they were offered subsidies and guaranteed returns for their undertaking. Notwithstanding its meager mileage, the railway system was intensively used, which in turn provided a source of technical and managerial knowledge for industrial development at large.[19] The related telegraph industry was adopted more rapidly, extending throughout the main islands of Honshu, Shikoku, and Kyushu by the mid 1880s. The government also prohibited private ownership of the main telegraph lines and maintained a monopoly throughout the Meiji Period.

The other major, and arguably more important, form of transportation was shipping. The government, fearing foreign takeover of coastal routes and wanting to increase exports, sought to create a domestic shipping industry. However, after an early attempt at direct management of the Kaiso Shipping Company, which operated liner service between Osaka and Tokyo, the government

[15] This figure excludes, however, the non-negligible expenses paid to foreign experts; see Hirschmeier and Yui (1975). Along similar lines, DeLong and Eichengreen (1993) contend that despite a small absolute amount of funding, the Marshall Plan provided the strategic margin of support and institutional reform to induce rapid economic growth in postwar western Europe.
[16] Rosovsky (1961). Smith (1974) writes "[g]overnment mills had served as models for private enterprise, working out technical difficulties and problems of plant organization."
[17] Smith (1974).
[18] Hirschmeier and Yui (1975).
[19] Ibid.

recognized its inefficiency and began to indirectly support the sector's development.[20] This included leasing ships to the Mitsubishi Trade Company, which transported government troops to Taiwan in 1874. Domestic ship operators received exclusive rights to certain routes and subsidies for postal and trade activities, like the 1896 Navigation Promotion Law. This act, amended in 1910, provided increasing subsidies for ships of large size and high speed.[21]

Shipyards and Machinery

Like the shipping industry, shipbuilding was underdeveloped in the early Meiji Period due to the isolationist policy of the previous shogunate government. The shipbuilding sector took longer to develop, however, due to its large financial and technological costs as well as the absence of supporting industries like metal processing and machinery.[22] Of the three main shipyards (Yokosuka, Nagasaki, Hyogo) in the country, all were owned by the government at the start of the Meiji Period and produced machinery like marine engines and boilers in addition to ships.[23] By the 1880s, however, the government decided to privatize its enterprises due to the high cost of operation and inefficient production.[24] After its withdrawal from direct operations, the government subsidized shipyards with the Shipbuilding Promotion Law in 1896, although private producers remained small in scale until the Russo-Japanese War a decade later, when demand for both repairs and construction due to military conflict aided the industry's growth.

Mining and Metal Processing

While there were numerous private coal and ore mines throughout the country, they were small and used traditional extraction techniques.[25] Furthermore, none employed foreigners or could afford foreign equipment like mechanical drills or steam power. In contrast, the government owned

[20] Chida and Davies (1990).
[21] At least 1,000 gross tons and 10 knots per hour; see Travis (1945).
[22] Chida and Davies (1990).
[23] For example, the (private) Kawasaki shipyard also produced Japan's first locomotives and rail coaches in 1907; see Hirschmeier and Yui (1975).
[24] Ibid. Thus, the first steel steamship was built in 1895 by the Mitsubishi zaibatsu, which had bought the Nagasaki shipyard from the government; Smith (1974).
[25] Smith (1974).

nine mines that used modern machinery, of which six collectively produced approximately half of Japan's mining output by value in the 1880s.[26] Domestic production as a whole, however, was insufficient to meet demand, where at least half the tonnage of iron and steel was imported throughout the period.[27]

One of the largest investments the government made was the Kamaishi Iron Works, completed in 1878 at a cost of 2,376,625 yen. This facility was plagued with operational problems, including low quality ore and a lack of adequate fuel supplies, and was sold in 1882 to private investors for 57,000 yen. A commissioned report on Kamaishi's failure revealed broader difficulties of managerial disorganization, low demand, and inadequate technological expertise. Nevertheless, the Kamaishi experience served the government's purposes by ``[providing] a model of investment for the private sector to imitate,... absorbing unavailable initial costs and losses that private entrepreneurs could hardly be expected to bear,... [and] helping overcome certain technological difficulties that previously had been considered insurmountable.''[28] Undeterred, the government invested in a larger, more advanced steel production facilty, Yawata Works, which opened in 1901.

Cotton and Silk Textiles

It is hard to underestimate the contribution of textiles to early Japanese industrialization, not only because of the foreign exchange the industry earned, but also for its introduction of mechanized labor to an agrarian economy. While the country began exports of raw silk and silkworms a decade before the Meiji Period, it was not until the late 1800s, with technological advances as well as government-instituted quality measures and factory production, that the industry took off.[29] The country's first modern manufacturing factory, the Tomioka Silk Filature, was built in 1872 by the government to promote mechanized reeling of silk (as opposed to hand-reeling). The Tomioka plant, with its French design and utilization of the latest equipment, operated at a loss for many years, until the government privatized it in 1893. Despite its inauspicious start, the success of the industry was

[26] This figure obscures the fact that government-owned mines were the primary producers of precious metals while private mines produced most of the country's copper and coal.
[27] Yonekura (1994). The figures for domestic production may be underestimated because they exclude small indigenous producers using the Tatara method to produce pig iron.
[28] Ibid.
[29] See Nghiep and Hayami (1992) for discussion of the silk industry and the role of technology.

clear by the end of the Meiji Period, when Japan had become the largest silk textile exporter in the world.

The cotton textile industry, on the other hand, was initially viewed with skepticism, given negligible domestic production of raw cotton and unfamiliarity with spinning technology. Although Japan's first cotton-spinning mill was built in 1867 by officials in Kagoshima prefecture, it was only after cotton textiles reached nearly a third of all imports during the 1870s did the government react with substantial investment.[30] Two additional public mills were built in Hiroshima and Aichi prefectures, each equipped with 2,000 spindles, but were sold off in 1882 and 1886 due to their inefficiency and cost. The government also provided loans and spindles to entrepreneurs to encourage private factories. These independent firms had greater success, notably the Osaka Spinning Mill established by Shibusawa Eiichi in 1882 with 10,500 spindles. By the mid-1890s, Japan was exporting over four million pounds of cotton yarn.

Research Design

Data

To analyze differences between public- and private-led industries throughout Japan's economic development in the Meiji Period, I use a new firm-level dataset collected from corporate genealogies.[31] Of the 2,231 establishments with identifiable industries founded between 1868 and 1912, there are 66 in agricultural and other primary industries, 560 in manufacturing ranging from food processing to miscellaneous machinery, and the remaining 1,605 in service sectors like banking and retail sales.[32] These startup firms represent 162 different industries at the three-digit classification level, which I group together more broadly as modern, heavy, and light sectors, following Rosovsky's tripartite classification scheme.[33] Besides a date of establishment and an industry code, each establishment may

[30] Fletcher (1996).
[31] Yagura and Ikushima (1986). See also Tang (2011) for example of data application.
[32] The Japanese industry classification system (JSIC) is similar to the contemporaneous (but now discontinued) American Standard Industry Classification (SIC) system, but not identical; see Statistics Bureau of Japan (1984).
[33] Rosovsky (1961). The modern sector comprises chemicals, metal processing, machinery, utilities, textiles, and transportation and communication. Heavy industries include the first four groups in the

also provide the type of ownership (government versus private) and the location of establishment (prefecture).[34] Because not all entries have this information, the respective numbers of establishments with ownership and location are 1,877 and 1,009. Table 1 presents some descriptive statistics.

[Table 1 here]

Knowing the ownership and date of entry of a firm enables me to determine whether the government or an entrepreneur led entry into an industry (i.e., provided funding for the first identified establishment in a given sector). This, in turn, allows me to classify industries as being either public- or private-led.[35] Location identification makes it possible to control for differences in natural resource endowment, geographic features, and population density. I indicate the availability of four different types of resources: timber, coal, petroleum, and metal ores.[36] While no figures exist for the initial size of each resource deposit by prefecture, these categorical indicators may provide exogenous explanations for industrial development. Differences in prefecture geography are measured continuously and include average annual temperature and rainfall, latitude and longitude coordinates, length of coastline, and area covered by water.[37] These features may serve as proxies for agricultural production suitability (i.e., climate, surface water), which may compete with manufacturing industries for both labor and capital; lower transportation and transaction costs; and availability of hydropower used in industries like millwork and papermaking. Finally, population density may correspond to market demand and proximity, with urban areas also having better infrastructure and greater financial capital.

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modern group, while light industries include textiles, food processing, woodwork and papermaking, and miscellaneous manufacturing.

[34] Private ownership can be further subdivided into unlisted firms (e.g., sole proprietorships, limited and unlimited liability partnerships and mutual associations) and listed firms (e.g., limited and unlimited liability joint stock firms).

[35] More detail is in the following subsection. Given the typical fanfare accompanying public-sponsored first entrants, it is plausible that industries pioneered by the government are adequately identified. I further refine industry entry order with the genealogical records.

[36] Trewartha (1945).

[37] Annual measures are approximated with modern figures; Weather Channel (2007). See Japan Statistical Association (1987) for physical geography measurements.

Testing period-wide differences in startup activity

While this dataset provides sufficient information to test hypotheses on the role of industrial policy, there remain some conceptual and framing clarifications. A crucial question is whether the definition of government intervention is limited to enterprises it had set up (e.g., model factories) and financial assistance of any form or if it should also include the broader industrial impact issuing from its policies.[38] While the former may be more easily measured, it seems the latter is a more realistic description of development, given the government's long-term social planning and the knock-on effects of initial investments.[39]

Asserting the latter position leads to the difficulty of measurement, which this study addresses with the new dataset and the assumption that industries selected by the government differ in character and developmental paths from those pioneered by the private sector. This assumption is plausible because limited resources forced public leaders to choose among many investment opportunities, and arguably the interest of the government was in long-term national welfare, not short-term profit maximization. With this in mind, I consider any industry that the government was the first entrant to be ``public-led'' for the whole of the Meiji Period. This applies even if the government had exited prior to the period's conclusion, as was the case with its privatizations in the 1880s. Similarly, industries initiated by private entrepreneurs, even if subsidized or saw later entry by the government, are designated as ``private-led.'' This public-private delineation allows me to compare industrial development over time as well as examine industry-wide characteristics like capital intensity and firm entry.

Based on this distinction, I can test a number of hypotheses that compare industry characteristics. One hypothesis is that the government led entry in capital-intensive industries while the private sector led those that were labor-intensive. This may occur if private capital is weak and few financial intermediaries exist, suggesting difficulties in mobilizing funding for scale-oriented and high

[38] The definition of ``assistance'' remains controversial even today, such as in the debate on whether American government contracts awarded to the airplane manufacturer Boeing are implicit subsidies (compared to the explicit funding provided by European governments to Boeing's competitor Airbus).
[39] Aubrey (1954) writes: "[t]he importance of government expenditures for economic development is inadequately expressed by investment figures, for they are the nucleus of further progress in which private investment can participate more prominently."

fixed-cost industries.[40] I test this with a discrete choice probit model, using whether an establishment was public-led or not as the binary dependent variable. The reduced form model is:

$$Pr(Y = 1 \mid X) = \Phi\,(\beta_i \cdot X_i + \beta_k \cdot X_k + \beta_n \cdot X_n + \beta_s \cdot X_s),$$ where

Y = indicator variable for government-pioneered sector

Φ is the cumulative normal distribution function

X_i = capital intensity (industry type) categorical variable i

X_k = geography and resource control variables k

X_n = interactions of industry type and other variables n

X_s = prefecture and year fixed effects s

The primary independent variable is relative factor intensity based on Rosovsky's tripartite division: heavy, light, and non-manufacturing. Setting this as a control variable assumes that the government had knowledge of an industry's capital intensity prior to entry, which is consistent with the theory of late development. In addition, I control for population density, indicators for natural resources, and geographic features, and interact industry type with population density to account for labor supply and market demand. I interpret positive coefficients on these variables as indicating an increased likelihood of public sector first entry.

Another hypothesis is that rates of entry into industries pioneered by the government are higher than those led by private entrepreneurs. It is likely that besides possible capital market failure, unfamiliarity with technology and risk aversion may inhibit industry formation and that government entry into an industry is an implicit vote of confidence in the industry's long term development.[41] This signal may arguably be more credible than that given by private individuals considering the relatively greater expertise and resources that the government possessed.[42]

To see if different entry rates exist, I compare the means and standard deviations of the average number of establishment for the two series within the same broad industry type. These

[40] Smith (1974).

[41] Of course, the government's presence may also deter private competitors because it may not behave like a rational agent and pursue profit maximization.

[42] The government both sponsored foreign travel for students and officials as well as employed costly foreign workers to introduce new technology; see Hirshmeier and Yui (1975) and Jones (1980).

include both the heavy and light classes designated by Rosovsky as well as a set of modern industries similarly identified by him. By comparing entry rates for industries within the same broad class, I mitigate inter-industry heteroegeneity in terms of production technology and initial investments. Consequently, if the average number of public-led industrial establishments is larger, ceteris paribus, I interpret this as suggesting possible entry barriers and risk aversion among investors toward sectors not endorsed by the government. Besides first moments, I can also assess second moment properties, i.e., whether there are trends in either the public- or private-led industrial series and if they differ. For this, I use standard unit root tests for stationarity. The existence of a positive trend (i.e., greater entry) over time may indicate imitative competition or lower risk aversion.[43]

Additionally, I look at the spatial dispersion of establishments by sector affiliation. The government may have a greater interest in spreading the effects of industrialization to less densely populated markets and over a greater geographic area, unlike a profit-maximizing private firm. Similar to the above approach with entry rates, I compare means and standard deviations to determine whether there were differences in population densities between affiliated sectors.

Testing within-period differences in startup activity

Notwithstanding these stylized measures of period-wide differences between government- and private-pioneered sectors, changes to the institutional environment over time suggest looking at subperiod trends and with a more robust analytical framework. To assess the impact of policy change and to test for structural breaks in trends, I compare government- to private-pioneered sectors both prior to reform and afterward using an "inverted" differences-in-differences model. Unlike standard differences-in-differences models, where the policy shock affects one group and one compares outcomes of the treated group to an unaffected control group in the post-shock period, I invert the pre- and post-treatment periods.[44] In other words, I hypothesize that there are differences in observed outcomes (i.e., startup activity) between two groups (i.e., government- and private-pioneered

[43] Negative trends could indicate anticompetitive behavior or market saturation, although this interpretation may be problematic since the current dataset contains only startup entry and not exit.
[44] Standard approaches to differences-in-differences include Card and Krueger (1994) and Hastings (2004). Similar to this paper's "inverted" approach are Bleakley (2007, 2010), which look at groups with different initial conditions that become similar following policy implementation.

industries) prior to policy reform, and that following the policy shock these observed differences are reduced. If government pioneering of an industry lowered costs to later entrants through subsidized technology imports and capital equipment (or signaled commitment to that industry's development), then startup activity in the selected sector should be higher. Subsequent improvements in the institutional environment and access to financial capital should in turn reduce whatever advantage was conveyed by initial public targeting. Figure 1 illustrates the basic setup of the inverted differences-in-difference model compared to a conventional framework.[45]

[Figure 1 here]

In terms of functional form, the basic model is:

$$y_{it} = \beta_0 + \beta_1 \cdot x_1 + \beta_{2s} \cdot x_{2s} + \beta_{3t} \cdot x_{3t} + \beta_{4st} \cdot x_{4st} + \beta_{5it} \cdot x_{5it} + \varepsilon_{it}, \text{ where}$$

y_{it} = number of startups for three-digit JSIC industry *i* in year *t*

x_1 = government-pioneered industry dummy variable

x_{2s} = policy implementation dummy variable in year *s*

x_{3t} = time *t* trend variable

x_{4st} = interactions of government, policy, and time variables

x_{5it} = other control variables for industry *i* and/or year *t*

ε_{it} = error term

I set as my dependent variable y_{it} the aggregate annual number of startup enterprises in either government- or private-pioneered three-digit industries. The main control variable of interest is the interaction term x_{3s}, which takes the value of zero for all industries in the years prior to the policy shock as well as for private-pioneered sectors in the post-reform period. It takes the value of one for industries that were pioneered by the government in post-reform years, which allows comparison of startup activity trends in both industry series before and after the policy change. Furthermore, when this interaction is combined with a time trend, I can test whether the policy reform had differential effects on the two industry series within and across time periods. Additional control variables such as

[45] This simplified representation assumes no trend differences between treatment and control groups as well as no population-wide policy impacts; these assumptions are relaxed in the analysis.

the share of publicly-listed firms in each industry and the number of financial startup firms each year improve identification of the policy effect, but slightly reduce sample size. With regard to exclusions, I omit the following: establishments in financial industries to focus on latent differences in capital intensity and technology; industries that have only one entrant during the whole of the Meiji Period; and industries that were pioneered after the year of the policy change so as to have a pre- and post-policy comparison.

Results

The descriptive statistics in Table 1 indicate that establishments in public-led industries (224 out of 251) were over-represented in manufacturing compared to private-led industries (336 out of 1971); however, the proportions are nearly reversed for service industries.[46] This corresponds to anecdotal evidence that private entrepreneurs were reluctant to engage in manufacturing due to the scale of investment, technical and organizational difficulty, and technological conservatism.[47] Nevertheless, the number of private-sector startup establishments in heavy industries (234) exceeds that for light industries (186), which appears at odds with the previous result. An explanation for this may lie in the role of financial conglomerates in leading the development of scale-oriented and capital-intensive industries, as well as the dramatic growth of light sectors seeded by the government.[48]

Correlations

Simple pairwise correlations, like summary statistics, provide a useful reference for more rigorous analysis. As shown in the top panel of Table 2, industries pioneered by the public sector are positively correlated with all three industrial series. In particular, between light and heavy industries, the public sector is five times more strongly correlated with the former, which is consistent with the descriptive statistics and suggests the success of government-seeded light industries like textiles that

[46] Note that the figures for service industries may be less reliable than those for manufacturing. This is because establishments providing services probably had fewer capital assets to pass on, and thus may be missing from the genealogies. Given the focus of this paper on industrial development, which was oriented toward manufacturing, possible sample bias does not invalidate the results (especially those using the light and heavy industry group series).
[47] Smith (1974).
[48] Tang (2011).

formed the foundation of the period's growth. However, like the descriptive statistics, these correlations lack a sense of temporal change. To see if different results obtain for smaller periods of time, I divide the dataset into pre- and post-1893 samples, with the year 1893 chosen because it both occurs near the midpoint of the Meiji Period and was the year when a commercial code for joint stock incorporation was promulgated.[49] Since earlier Japanese governments typically had low regard for property rights and financial note legitimacy, this legal institution arguably eased private access to investment funding and signaled a milestone in financial system development.[50]

[Table 2 here]

The results for the first half of the Meiji Period (Table 2, middle panel) show that sectors pioneered by the government remain positively associated with heavier industries, but this relationship is no longer significant for the second half of the period (Table 2, bottom panel). These findings correspond to the earlier summary statistics that show significant contrasts between startup activity in industries led by either the public or private sectors.

Differences in Industry Type

A major shortcoming of correlation analysis is that it does not include other explanatory influences. Results from the probit analysis, given in Table 3, show positive coefficients for both light and heavy sectors relative to the omitted group of non-manufacturing industries. I interpret this as indicating that higher capital intensity increases the likelihood of being a public-led industry.[51] This makes sense given the relative immaturity of the financial system and risk aversion of private capital for a large part of the period.

[Table 3 here]

[49] Loenholm (1906).

[50] According to Confucian tradition, which the Japanese drew heavily on to justify their class system, merchants were the lowest of the four occupational groups (aristocracy, warriors, craftsmen, merchants) and loan obligations were routinely annulled by government decree; see Hirschmeier and Yui (1975).

[51] That is, the numerator in the capital-labor ratio increases.

To account for variation in labor supply and market demand across prefectures, I include population density and its interaction with industry type as additional control variables. Interestingly, higher population density lowers the relative probability of a generic light or heavy industry being pioneered by the government (column 3), shown by the negative coefficient on the variable. When limited to the subset of industries considered modern, however, the cumulative probability of government-led entry into heavy industries becomes negative (column 4). This may imply the government's interest in developing regions that had less access to investment capital or infrastructure, but with an emphasis on lighter sectors.

In addition to including fixed effects for year and prefecture in all four specifications and both natural resource and geography indicator variables in the last three, I cluster the standard errors by three-digit industry to allow for correlation in errors within industries, and report Eicker-White standard error estimates that are robust to data heteroskedasticity.

Differences in Entry

To better understand the relationship between public sector leadership and an industry's revealed ease of entry, I test the hypothesis that industries pioneered by the government see greater entry than those led by the private sector. If public-led industries have greater startup activity, this is consistent with the premise of capital market failure and the need for public intervention to overcome initial investment costs and technological risks. In addition, greater entry in public-led sectors also suggests profit potential and the implicit long-term support of the government in its viability. I also examine whether the difference between the average number of startup establishments for both public-led versus private-led industries is stable over time. If a difference exists, it may indicate technological entry barriers.[52] That is, when two series begin with different rates of entry that converge over time, there may be decreasing costs to entry. Conversely, divergent entry rates may indicate monopolistic or predatory behavior by incumbents or other persistent entry barriers. Stable rates suggest the absence of differential technological impediments between the two sectors.

[52] I use the average number of startup establishments per three-digit industry instead of total number of startups to reduce distortions from industry outliers.

To test these hypotheses, I first compare the means and trends between public-led and private-led industry startups using a two-sample t-test of significance. If one series has a larger mean for the average number of startups per industry in a given year compared to the other, then the former is revealed to have fewer barriers to entry. I then use standard unit root tests to determine if either series has a dynamic trend, and if so, test for cointegration to see if the two series share a long-term relationship. Table 4 has the overall means and standard deviations, which indicate statistically significant differences in mean entry rates across different industry groups. For both modern and light industries, the positive difference means indicate greater entry rates in public-led sectors, which may reflect lower risk aversion. Surprisingly, the opposite result obtains among heavy sectors, despite these having a greater probability of being pioneered by the government.

[Table 4 here]

Geographic Differences

This study also examines differences in geographic establishment, with spatial distribution serving as a gauge of industry promotion and market integration. On this premise, it appears that public-led industries were less widespread than private-led ones, the former being found in 35 of the 47 prefectures compared to the private sector in 45. In particular, for both the modern and heavy industry series, startups in government-led sectors were on average in ten or eleven fewer prefectures compared to private-led sectors, as shown in the top panel of Table 5. On the other hand, they were slightly better represented in light sectors by an average of three prefectures.

[Table 5 here]

Alternatively, one can use population density to assess economic integration of underserved areas. Earlier correlations already indicated that population density decreases the likelihood for public sector entry, which suggests that the government may have wanted to encourage development in the periphery. Based on average population density of prefectures, government-led industries indeed tended to be in less densely populated areas for both modern and heavy sectors. Thus, although

government-led industries may have tended to locate in fewer areas, these locations were less urban and presumably in greater need of industrial development.

Impact of policy changes

Period-wide differences notwithstanding, considerable institutional and economic changes occurred in the intervening years and it may be useful to observe whether they amplified or weakened the initial selection of industries. As mentioned above, one important policy reform that the central government implemented toward the end of the century was the 1893 Commercial Code, which codified commercial entity establishments and joint-stock ownership.[53] Linear regression estimates suggest that both initial government targeting of industries as well as the commercial code affected startup activity, with the former inciting entrepreneurship and the latter reducing the selection effect. This can be seen in the different specifications in Table 6, where positive coefficients indicate an increase in the annual number of startup establishments (aggregated to the three-digit industry classification level). In the most basic specification, the inclusion of the 1893 Commercial Code variable has no independent significance (column 1), but interacting it and other control variables with a time trend variable changes the results (column 2). Moreover, for this and other specifications, I fail to reject the hypothesis that the coefficients on the time trend and its interactions are singly and jointly equal to zero at 5 percent statistical significance.

Adding industry and year fixed effects (column 3) suggests that government-pioneering is associated with a greater number of startups (69.7) per sector over the whole of the period, but this advantage is substantially reduced (-133.7) following the commercial reform. Using a Wald test of parameter significance, the two coefficients on the time trend variables for government- and private-led startup series fail at the 5 percent level to be statistically different. An interpretation of this result is that whatever advantage in startup activity was conveyed by government targeting was effectively neutralized with the passage of the Commercial Code and contemporaneous reforms, a nuance not visible in earlier results for the period as a whole. These results are qualitatively shown in Figure 2.

[53] This commercial code significantly revised an existing law promulgated in 1890, and included provisions for unlimited and limited partnerships as well as joint-stock companies; see Loenholm (1906), Morikawa (1992), p. 43, and Taira (1997), p. 254.

[Table 6 and Figure 2 here]

To better understand what type of advantage government selection may confer, I include two additional control variables for financial development (column 4). One typical feature of late developing countries is financial sector immaturity and limited access to investment funding, which can impede the acquisition of technology and capital equipment during the early drive toward industrialization. I use both the share of firms that were publicly listed out of all firms in the three-digit industry as well as total number of financial sector startups in the given year as measures of financial access.[54] Allowing for greater financial intermediation over time and variation between industries is likely to reduce the effect of government selection of certain sectors and earlier in the period. Indeed, this appears to be the case as controlling for these variables renders the previous specification's results statistically insignificant.

Nevertheless, given the numerous changes occurring both preceding and following the 1893 Commercial Code, one may reasonably suspect alternative explanations for changes in entrepreneurial activity. As an alternative policy reform, I use the adoption of the gold standard in 1897 since it may have had similar effects on enterprise via lower borrowing costs, expanded foreign markets, and improved access to international investors. Results in Table 7 suggest that adoption of the gold standard did had a comparable effect on startup activity and reduced the initial boost from government selection (column 1).[55] Including financial development variables (column 2) also reduces statistical significance from all pre-adoption variables, but there continues to be a post-adoption difference. When both policy reforms are in the same specification (column 3), neither reform has much of an effect either individually or as part of an interaction. However, the coefficient on initial government selection remains positive, consistent with the earlier period-wide comparisons.

[Table 7 here]

[54] While the 1893 Commercial Code clarified company ownership and liability, public exchanges and company listings were available since the 1880s, albeit to a much smaller degree.
[55] For analytical consistency, with the gold standard adoption specifications I expand the set of industries to include those pioneered before 1897.

It would be heroic to attribute a causal relationship based on these results, however, given the non-standard framework and potential confounding factors. The methodology, while mimicking the differences-in-differences model, is unusual because of inherent industry differences that would persist even following policy change; ergo, the reason why the sectors were selected at the outset. A more appropriate interpretation would simply observe a narrowing of differences between the series that coincide with the passage of wide-ranging institutional reforms around the turn of the century. Furthermore, the comparability of two different reforms in close timing to each other suggests caution in over-interpreting theboth sets of results or attributing causality to specific policies or timing simply because of statistical significance. It is likely that the data are highly sensitive to any given year and that many factors are involved in industrial activity during this period, which individual institutions are unlikely to adequately capture and may happen only to coincide with changes in trends. Rather, these results can be used to complement macroeconomic evidence of a growing industrial base and private sector activity over the course of the Meiji Period.

Discussion and Conclusion

How well did the government succeed in its modernization program? Generally speaking, the results show that the government was more likely to invest in more capital-intensive industries than the private sector, which may indicate capital market failure for manufacturing investments early in the Meiji Period. Within major industry type, the government-led sectors also retained an advantage in the entry rates of startups. Since these entry rates are compared within broad industry groups, this suggests that as opposed to financial entry barriers, risk aversion among private entrepreneurs may have delayed adoption of new technologies not endorsed by the government. The government also succeeded in spreading the effects of industrialization across the country to more sparsely populated areas. Finally, regression results for differences in startup activity corroborate a positive selection effect almost to the turn of the century, with the implication that government intervention may have aided the expansion of targeted sectors until institutional changes caught up. Whatever the metric, these broad-based policies appeared to have paid off, with per capita GDP increasing 5.1 percent annually between 1875 and 1912, over twice the rate of the United States in the same period.[56]

[56] Japan Statistical Association (1987).

To extend this line of research, one may look at international factors like foreign policy and trade and technology flows. Japan repeatedly demonstrated its martial prowess over its neighbors, thereby convincing western powers to relinquish extraterritorial rights and to return tariff autonomy by 1911. As mentioned earlier, the country's adoption of technology and heavy industrial growth benefited considerably from military demand. Thus, it may be of interest to study to what extent investment (public or private) in military goods stimulated the domestic economy. Notwithstanding the availability of public expenditure data on military budgets, the current dataset of firm establishment may provide an alternative perspective by tracing the expansion of commerce and manufacturing in Japanese colonies.

The government also actively encouraged international trade to acquire technology and capital. As shown in Table 8, exports increased more rapidly than imports, easing the burden of capital goods imports and underwriting the development of domestic industries to substitute for foreign production. Less clear is how trade impacted small independent firms and domestic market integration. An extension of this paper could link industry-level trade flows with entrepreneurial activity in the same sectors. One may also assess how non-tradable goods and services were affected by foreign technology and infrastructural improvements induced by foreign commerce by comparing industrial growth between regions as well to examine the extent to which Japan transferred technology (as embodied in firm activity within more advanced industries) to surrounding nations that were even less developed (e.g., those in the Greater East Asia Co-Prosperity Sphere).

[Table 8 here]

International factors, however, should not overshadow the importance of domestic ones in discussing Japanese industrialization. While exports helped to finance Japan's modernization program, the ports, ships, and merchandise were the issue of deliberate policymaking and ever-improving institutions. Within this broader framework, even the privatizations of failed public enterprises in the 1880s can be viewed as a sign of progress that the private sector was ready to take the reins of economic growth.

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Table 1: Descriptive Statistics			
	Total	**Public-Led**	**Private-Led**
Number of Establishments	2,231	259	1,972
Ownership identifier	1,877	228	1,649
Location identifier	1,009	189	820
By sector[a]			
Primary	66	22	44
Secondary	560	224	336
Tertiary	1,605	13	1,602
By product class			
Modern[b]	632	209	423
Light[c]	352	166	186
Heavy[d]	298	58	234
By ownership			
Government	56	18	38
Publicly traded	1,513	146	1,367
Unlisted	308	44	264
By population density[e]			
Urban	392	77	315
Rural	617	112	505

[a]Based on three-digit JSIC code

[b]Includes textiles, chemicals, metals, machinery, utilities, and transport; cf. Rosovsky (1961)

[c]Includes processed food, textiles, wood products, glass/ceramics, and unclassified manufacturing; ibid.

[d]Includes chemicals, metal processing, machinery, and utilities; ibid.

[e]Urban is defined as over 386 people per square kilometer.

Source: see text

Table 2: Correlations

	Public	Modern	Light	Heavy
Meiji Period (1868-1912)				
Modern industry	0.419*	1.000		
Light industry	0.493*	0.203*	1.000	
Heavy industry	0.100*	0.617*	-0.165*	1.000
Population density	-0.012	0.161*	0.021	0.219*
Pre-Commercial Code (1868-1892)				
Modern industry	0.496*	1.000		
Light industry	0.414*	0.255*	1.000	
Heavy industry	0.257*	0.548*	-0.188*	1.000
Population density	0.051	0.155*	0.100	0.163*
Post-Commercial Code (1893-1912)				
Modern industry	0.388*	1.000		
Light industry	0.531*	0.179*	1.000	
Heavy industry	0.037	0.644*	-0.155*	1.000
Population density	-0.010	0.163*	0.004	0.232*

Significance level: *5 percent
Source: see text

Table 3: Probit Results for Government Pioneering

DV: Government-led sector	[1-All]	[2-All]	[3-All]	[4-Modern]
Light	1.998***	2.537***	2.998***	4.380***
	(0.593)	(0.583)	(0.650)	(0.873)
Heavy	1.235***	1.468***	2.397***	1.377**
	(0.449)	(0.449)	(0.529)	(0.617)
Pop den	-0.366*	-0.457	0.760	2.109***
	(0.204)	(0.467)	(0.522)	(0.784)
Popden*Light			-1.041**	-1.791***
			(0.475)	(0.691)
Popden*Heavy			-1.934***	-1.497***
			(0.589)	(0.421)
Resource fixed effects[a]		included	included	included
Observations	995	829	829	341
Pseudo R-squared	0.281	0.441	0.451	0.596

Significance levels: *10% **5% ***1%; robust standard errors in parentheses, clustered by three-digit JSIC industries.
[a]See text for complete variable list. All specifications include year and prefecture fixed effects.
Source: see text

Table 4: Average Annual Startups per Industry

	Public-led [A]	Private-led [B]	Difference [A-B]
Modern industries	2.111	1.627	0.484***
	(1.604)	(0.713)	
Light industries	2.554	1.358	1.196***
	(1.986)	(0.468)	
Heavy industries	1.349	1.519	-0.171*
	(0.432)	(0.557)	

Significance levels: *10% **5% ***1% for null hypothesis that mean difference does not equal zero.
Standard deviation in parentheses.
Source: see text

Table 5: Geographic Representation

	Public-led [A]	Private-led [B]	Difference [A-B]
Average number of prefectures			
Modern industries	9.373	20.995	-11.622***
	(7.114)	(14.497)	
Light industries	10.337	7.441	2.896***
	(8.865)	(4.904)	
Heavy industries	3.828	14.504	-10.677***
	(2.637)	(10.279)	
Average population density			
Modern industries	403.195	528.224	-125.029***
	(317.147)	(408.828)	
Light industries	418.298	426.037	-7.738
	(330.405)	(362.947)	
Heavy industries	367.670	627.643	-259.973***
	(242.517)	(418.828)	

Significance levels: *10% **5% ***1% for null hypothesis that mean difference does not equal zero.
Standard deviation in parentheses.
Source: see text

Table 6: OLS Results for Startup Activity				
DV: Number of Annual Startups	**[1]**	**[2]**	**[3]**	**[4]**
Time trend (t)	0.017***	-0.007	0.048***	0.041**
	(0.005)	(0.012)	(0.018)	(0.019)
Government-led industry	-0.057	22.845	69.688***	dropped
	(0.093)	(27.666)	(25.981)	
Commercial Code (t ≥ 1893)	-0.141	-44.084	dropped	dropped
	(0.146)	(35.584)		
Govt-led * Com. Code	0.117	-97.252**	-133.691***	-70.421
	(0.130)	(41.825)	(37.773)	(42.944)
Govt-led*Time		-0.012	-0.039***	-0.006
		(0.015)	(0.014)	(0.018)
Time*Com. Code		0.023	-0.0008*	-0.0003
		(0.019)	(0.0005)	(0.0006)
Govt-led*Time*Com. Code		0.051**	0.071***	0.037
		(0.022)	(0.020)	(0.023)
Financial development controls[a]				included
Industry and year fixed effects			included	included
Observations	1,416	1,416	1,416	1,288
R-squared	0.022	0.053	0.351	0.373

Significance levels: *10% **5% ***1%; standard errors in parentheses.

[a]See text for complete variable list. All significant coefficients of control variables shown.

Source: see text

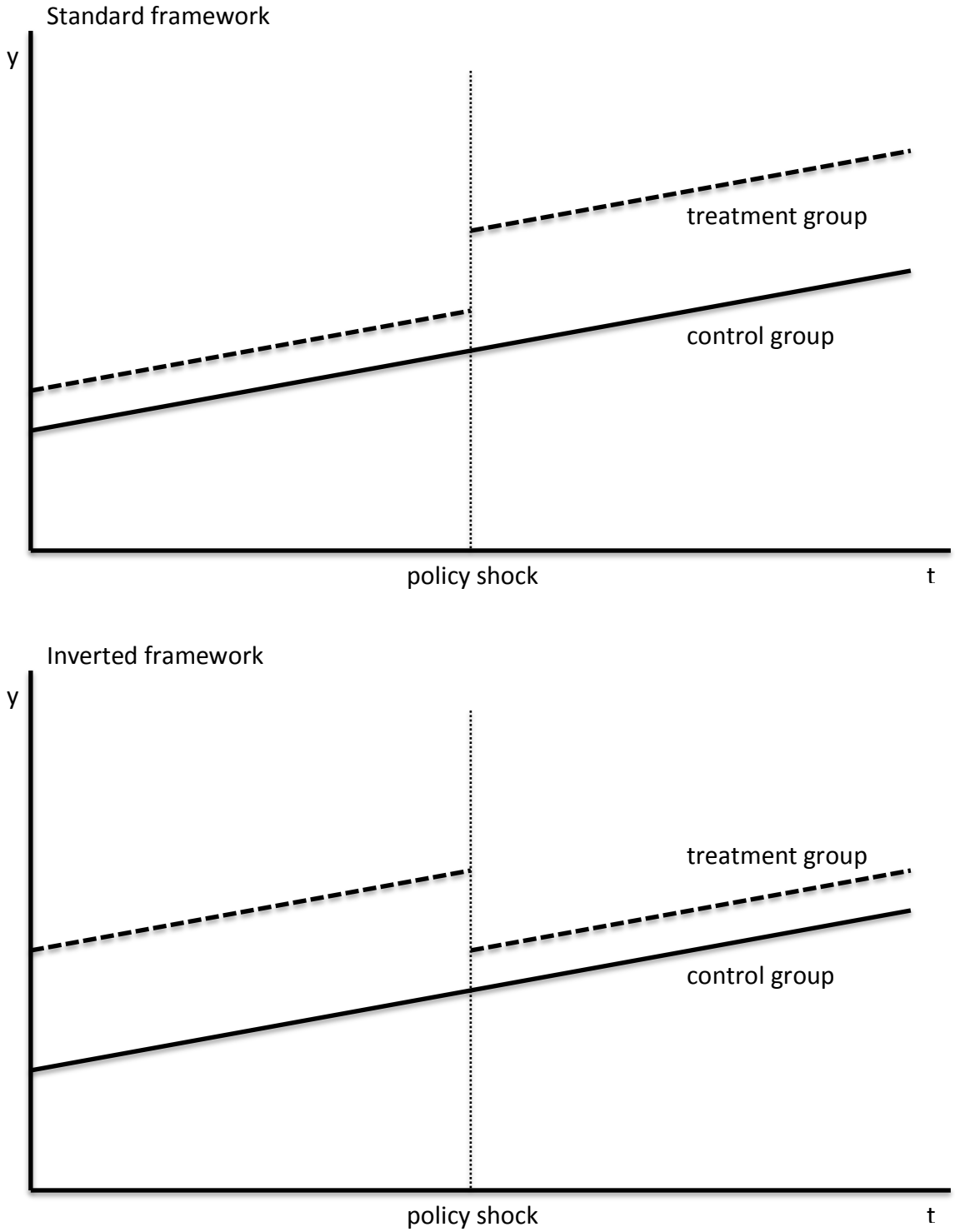
Table 7: OLS Robustness Checks for Startup Activity				
DV: Number of Annual Startups	**[1]**	**[2]**	**[3]**	**[4]**
Time trend (t)	0.012	-0.008	-0.021	-0.043
	(0.024)	(0.036)	(0.028)	(0.043)
Government-led industry	60.199***	dropped	69.690***	dropped
	(20.010)		(25.993)	
Gold Standard (t ≥ 1897)	dropped	dropped	dropped	dropped
Govt-led*Gold	-137.485***	-98.719**	-241.179	-287.857
	(43.903)	(46.450)	(272.793)	(280.227)
Govt-led*Time	-0.034***	-0.009	-0.039***	-0.006
	(0.011)	(0.013)	(0.014)	(0.018)
Time*Gold	0.0000	0.0002	0.0003	0.0004
	(0.0003)	(0.0004)	(0.0003)	(0.0004)
Govt-led*Time*Gold	0.073***	0.052**	0.127	0.152
	(0.023)	(0.024)	(0.144)	(0.148)
Commercial Code (t ≥ 1893)			dropped	dropped
Govt-led*Com. Code			94.123	194.355
			(271.241)	(279.357)
Time*Com. Code			0.0005***	0.0005***
			(0.0002)	(0.0002)
Govt-led*Time*Com. Code			-0.050	-0.103
			(0.143)	(0.147)
Financial development controls[a]		included		included
Industry and year fixed effects	included	included	included	included
Observations	1,416	1,288	1,416	1,288
R-squared	0.346	0.374	0.352	0.374

Significance levels: *10% **5% ***1%; standard errors in parentheses.
[a]See text for complete variable list. All significant coefficients of control variables shown.
Source: see text

Table 8: Annual Trade Growth		
Period	**Exports (%Δ)**	**Imports (%Δ)**
1868-1912	9.9	12.3
(a) 1868-1880	6.7	15.4
(b) 1881-1895	10.5	11.8
(c) 1896-1912	11.7	10.3

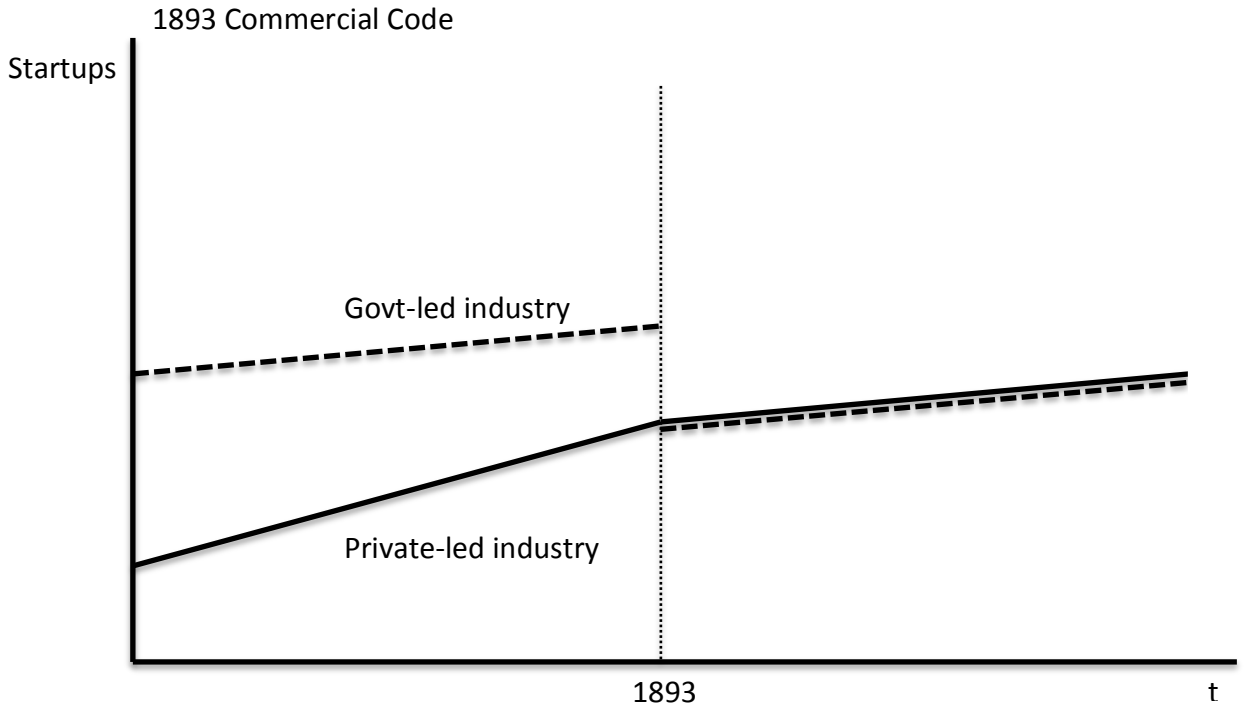
Source: see text

Figure 1: Standard versus Inverted Differences-in-Differences Model



Source: see text

Figure 2: Startup Activity Trends in Government- versus Private-Led Industries



Source: author's calculations based on Table 6, column 3 estimates