The Long-Term Effects of Industrial Policy*

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Abstract

This paper provides causal evidence on the impact of a large-scale industrial policy – South Korea's Heavy and Chemical Industry (HCI) Drive – on firms' long-term performance and quantifies its long-term welfare effects. Using unique historical data on the universe of firm-level subsidies and a natural experiment, we find large and persistent effects of this industrial policy. Subsidized firms grew faster than those never subsidized for 30 years after subsidies ended. We build a quantitative heterogeneous firm model that rationalizes these effects through a combination of learning-by-doing and financial frictions. The model is calibrated to firm-level data, and its key parameters are disciplined with the econometric estimates. The HCI Drive generated larger benefits than costs. If it had not been implemented, South Korea's welfare would have been 13-21% lower, depending on how long-lived are the productivity benefits of learning-by-doing. The large majority of the total welfare impact comes from the long-term benefits of learning-by-doing rather than short-term benefits of relaxing financial constraints.

Keywords: industrial policy, South Korea, HCI Drive, learning-by-doing, financial frictions, welfare
JEL Codes: O14, O25

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1 Introduction

Many countries at different stages of development have engaged in activist industrial policy.[1] Indeed, governments across the political spectrum continue to show a keen interest in shaping the structure of the economy, evident in both the Trump trade war and the Biden administration's objectives of shoring up supply chains in key industries.[2] However, despite their historical and current ubiquity, credible econometric evidence on the long-term effects of industrial policies remains limited, due primarily to lack of systematic and detailed data on these policies. Assessing the long-term effects of industrial policy requires information for the more distant past, making data collection even more challenging.

This paper studies the long-term effects of one of the best-known instances of industrial policy conducted on a national scale: the Heavy and Chemical Industry (HCI) Drive in South Korea between 1973 and 1979. South Korea's experience with industrial policy is important to understand, as it is one of the "growth-miracle" economies of the postwar era, well-known for its rapid transformation from a commodity and light manufacturing producer to a heavy industry powerhouse. It has been argued that government interventions played a central role in this transformation. However, a more complete understanding of the efficacy of South Korea's industrial policy remains elusive.[3]

We make two contributions to the literature. First, we construct a novel historical panel dataset of firm-level industrial policy interventions and balance sheets spanning 40 years. We provide causal evidence of industrial policy's effect on firms' long-term performance by exploiting a natural experiment arising from the historical and institutional context in which the HCI Drive took place. Second, we assess the long-term welfare effects of this industrial policy in a quantitative general equilibrium heterogeneous firm framework.

The main industrial policy tool employed by the Korean government during the HCI Drive was the allocation of foreign credit. Under the Foreign Capital Inducement Act, the Korean government strictly regulated domestic firms' direct financial transactions with foreign firms and only selectively allowed targeted firms to borrow from abroad. Once domestic firms got the approval to obtain credit internationally, the Korean government guaranteed the loan, enabling the targeted firms to borrow at more favorable interest rates than those prevailing domestically. The firms that got the government

[1] See, among many others, Head (1994) for the US steel rail industry, 1885-1915; Irwin (2000a,b) for the late 19th century US iron industry; Krueger and Tuncer (1982) for Turkey during the 1960s; Kalouptsidi (2018) and Barwick et al. (2019) for China's shipbuilding industry; Juhász (2018) for France's cotton industry; Criscuolo et al. (2019) for the UK's Regional Selective Assistance, 1997-2004; Chang (1993), Lee (1996), and Lane (2019) for South Korea's 1970s HCI Drive; Rotemberg (2019) for India during the 2000s.

[2] See `https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf`.

[3] Wade (1990), Westphal (1990), Amsden (1989), and Rodrik (1995) argue that industrial policy played a significant role in shaping South Korea's development. However, many economists have been skeptical of the effectiveness of industrial policy (e.g. Baldwin, 1969; Lee, 1996; Lederman and Maloney, 2012).

approval had to report detailed information on the loan contracts and how they planned to use the allocated credit. These reports are our main data source on subsidized credit at the firm level. The information is hand-collected from the national historical archives and digitized. We combine the loan contract data with firm balance sheet data from various sources. The resulting dataset is representative of the Korean economy and covers the universe of foreign credit allocated to the domestic firms.

Our research design uses two institutional features of the HCI Drive. First, the HCI Drive was suddenly initiated in 1972 and terminated in 1979 by political shocks rather than domestic economic conditions (Lane, 2019). President Nixon proposed to withdraw US forces from South Korea, which relied heavily on the US military presence for its defense against North Korea. In response, President Park started promoting heavy and chemical industries to modernize South Korea's military capabilities and become more self-sufficient in national defense. The HCI Drive ended after the assassination of President Park in 1979. Second, the HCI Drive had pronounced regional variation. It targeted the southeastern part of the country and developed industrial complexes in these regions. Most of the subsidies were allocated to firms in these industrial complexes. Our research design compares the difference between firms in the HCI and non-HCI sectors in the targeted regions to the difference in the non-targeted regions.

Our main empirical finding is that the temporary subsidies had a large and statistically significant effect on firm sales as much as 30 years after subsidies ended. A doubling of the subsidy between 1973 and 1979 led to a 39 percentage points higher sales growth between 1982 and 2009, amounting to a 1.2 percentage point difference in the annual growth rate over this period. This positive effect on sales comes from improvements in firm performance rather than reduced competition. Subsidized firms did not have higher long-run markups, but had higher TFP. In addition, the 1970s' subsidies improved the post-subsidy export performance of these firms. Since South Korea is a small open economy, it is unlikely that these firms' greater success in world markets was driven by higher export markups.

We then quantify the long-term welfare impact of the HCI Drive. We set up a general equilibrium multi-sector small open economy heterogeneous firm model and discipline it using the firm-level data and the econometric estimates. The model rationalizes the reduced-form evidence on persistent effects of industrial policy through a combination of learning-by-doing (LBD) and financial constraints.[4] There are two periods in the model. A firm's second-period productivity increases in its first-period quantity produced. However, in the first period firms are borrowing-constrained. Therefore, they cannot expand to the optimal scale to internalize the dynamic effects of LBD. Government subsidies in the first period relax these constraints, enabling firms to increase first period output, which in

[4] Lucas (1993) argued that LBD played an important role in the growth performance of the East Asian miracle economies.

turn increases productivity in the second period through LBD. The model is tightly connected to the data. The key parameters of the model are pinned down by the reduced-form empirical estimates. The quantitative results imply that had the government not conducted this industrial policy, welfare would have been 13-21% lower, depending on whether we assume that LBD-driven productivity benefits are permanent or temporary. Most of the total welfare effect (87-92%) is due to the long-run impact of subsidies on productivity through LBD.

Related literature This paper contributes to the empirical literature on industrial policy (see, among many others, Weinstein, 1995; Lee, 1996; Irwin, 2000a,b; Nunn and Trefler, 2010; Kline and Moretti, 2014; Aghion et al., 2015; Alder et al., 2016; Juhász, 2018; Criscuolo et al., 2019; Giorcelli, 2019; Lane, 2019; Rotemberg, 2019; Hanlon, 2020; Fan and Zou, 2021; Moretti et al., 2021; Cox, 2022; Giorcelli and Li, 2022). Harrison and Rodríguez-Clare (2010) provide a review of the literature and of the conceptual underpinnings of industrial policy. We use a firm-level dataset that is representative of the national economy and estimate the effect of industrial policy on firms' long-term performance.[5] Lane (2019) studies South Korea's HCI Drive and also finds a persistent effect of this policy. While that paper's analysis is at the sector level, we (i) contribute data on firm-level subsidies and study firm-level outcomes; (ii) additionally exploit regional variation for identification; and (iii) provide a model-based quantification of the HCI Drive's welfare effects. Contemporaneous work by Kim et al. (2021) uses similar firm-level balance sheet data to study the HCI Drive. While these authors focus on the relatively short-run impacts of the HCI Drive on misallocation and the plant size distribution, we estimate and quantify the long-run benefits of this policy. Choi and Shim (2022) use another dataset to study foreign technology adoption by Korean firms in the 1970s. Adoption of foreign technology was one particular channel through which some of the firms targeted by industrial policy grew in the 1970s. While that paper focuses on the 1970s, our analysis examines outcomes in the long run.

We also contribute to the quantitative literature on industrial policy (see, among many others Head, 1994; Gaubert, 2018; Kalouptsidi, 2018; Ossa, 2018; Barwick et al., 2019; Itskhoki and Moll, 2019; Liu, 2019; Bartelme et al., 2020; Lashkaripour and Lugovskyy, 2020; Buera et al., 2021). Our model rationalizes the persistent effect of industrial policy through LBD and financial frictions, and uses microdata to discipline the relevant elasticities.[6] Our work makes tangential contact with the vast literature on place-based policies, reviewed by Neumark and Simpson (2015). Though our identification strategy exploits the geographic dimension, regional disparities are not our focus.

The rest of this paper is organized as follows. Section 2 describes the historical background of South

[5] While we share the focus on firm-level outcomes with Aghion et al. (2015), Criscuolo et al. (2019), and Rotemberg (2019), we contribute causal estimates of the effect of industrial policies on firms' long-term performance. Giorcelli (2019) studies the long-term effect of the government's policy on managerial training.

[6] LBD that is external to firms has been studied in the theoretical trade literature (Arrow, 1962; Krugman, 1987; Young, 1991; Matsuyama, 1992; Melitz, 2005). However, LBD in our model is internal to firms.

Korea's industrial policy between 1973 and 1979 and our data. Section 3 discusses the empirical strategy and identification. Section 4 presents the estimation results. Section 5 builds a quantitative model consistent with the empirical findings and evaluates the welfare effects of the policy. Section 6 concludes.

2 Historical Background and Data

2.1 Background

The South Korean government initiated the HCI Drive in late 1972. The HCI Drive strongly promoted 4 targeted sectors: chemicals, electronics, metals, and machinery. We will refer to these as the HCI sectors. Appendix Table A1 provides a more detailed description of these sectors. The HCI Drive was temporary, ending with the assassination of President Park in 1979. During the HCI Drive, the structure of the Korean economy fundamentally changed. South Korea transformed itself from a commodity and light manufacturing producer into a heavy manufacturing producer. Between 1973 and 1979, the average annual real GDP growth rate of South Korea was 10.3%, and the average export growth rate was around 28%. The HCI sectors increased their share of manufacturing output from 40% to 56% and their share of total exports from 13% to 37%.

Main policy instrument: foreign credit allocation The main industrial policy instrument used by the Korean government was directed foreign credit (Jones and Sakong, 1980; Amsden, 1989; Rodrik, 1995). Through the 1962 Foreign Capital Inducement Act, the Korean government restricted firms' direct foreign financial transactions in order to exercise greater control over the balance of payments. However, once the government granted access to foreign credit to targeted firms, it guaranteed those loans.[7] The government guarantees eliminated the risk of firm default, enabling these firms to borrow at favorable interest rates. The government used its discretionary power to allocate foreign credit to targeted firms in the HCI sectors.

The government-backed foreign credit was valuable to firms because domestic financial markets were quite underdeveloped. The government nationalized the commercial banks from 1961 until the 1980s. In 1961, the Park military government enacted the Law for Dealing with Illicit Wealth Accumulation and ended private ownership of banks, which were deemed a part of accumulated illicit wealth. After that only a small fraction of banks' shares were sold publicly, and controlling stakes – ranging from 35% to 60% during the 1970s – were owned by the government. Through the nationalization of the commercial banks, the government could control the lending practices and decide which industries

[7]Formally, the Korea Development Bank, the Korea Exchange Bank, or the commercial banks controlled by the government guaranteed the foreign credit contracts. For example, Appendix Figure A3 is the first page of the official contract between Hyundai International Inc (a domestic firm) and several foreign banks. It shows that the Korea Development Bank participated in the credit contract as a guarantor.

or firms received credit. See Amsden (1989, p. 72-73) and Jones and Sakong (1980, p. 103). As a result, many firms had to rely on illegal underground markets to access credit.

While in a credit rationing environment interest rates are not necessarily a good indication of (lack of) access to financing, in the 1970s the average deposit rate in domestic banks was around 20%, and the lending rate in the unofficial capital market was 30–40%. The average inflation rate in South Korea over the period of these loans was 14.5%, implying that domestic real interest rates were higher than the roughly 1% real rate the firms paid on the subsidized loans (see Section 2.2 below). Thus, the guaranteed foreign loans constituted a subsidy.[8]

2.2 Data

Our dataset combines firm-level subsidy data, firm balance sheet data, and region- and sector-level variables. The dataset is annual and covers the period 1970 to 2012. There are 55 regions and 9 manufacturing sectors, 4 of which were targeted by the HCI Drive.[9] Data construction is described in further detail in Appendix A.

Foreign credit The Foreign Capital Inducement Act required firms to report details of financial contracts with foreign banks or companies once they received government approval. These reports are our main data source for foreign credit. They contain information on amounts borrowed, the interest rate, the repayment period, and the names of foreign banks for each financial contract made by a domestic firm. The documents are hand-collected from the National Archives of Korea and digitized.[10] The resulting dataset covers the universe of credit allocated to firms between 1967 and 1982, encompassing the HCI Drive period. The foreign credit data are merged with the firm-level balance sheet variables based on firm names.

Firm balance sheets The firm balance sheet data come from two sources. For the 1970-1982 period the information is digitized from the historical Annual Report of Korean Companies published

[8] Financial frictions in the early stage of development of the East Asian countries were further documented by Song et al. (2011), Itskhoki and Moll (2019), and Liu (2019), among others. One episode illustrates the underdevelopment of the financial system in Korea during the 1970s. Many Korean firms heavily relied on the domestic informal loan market to borrow for investment and working capital. In 1971, the collapse of the Bretton Woods system and the end the dollar convertibility into gold resulted in a worldwide economic downturn and a sharp increase in the cost of debt financing of the Korean firms. Instead of allowing financially troubled firms go bankrupt, a Presidential Emergency Decree of August 1972 nullified all the contracts between lenders and borrowers in the informal loan market. The goals of the decree were to bail out firms with large debt burdens and move loans from the informal loan market to the formal loan market. The decree also capped the interest rate on the reported contracts in the informal loan market at 8% and gave an option to lenders to convert their credit into shares of borrowing firms. The decree required firms to report total credit borrowed in the informal loan market. The reported total amount of credit in the informal loan market was 30.1% of the national domestic credit (Cole and Park, 1980).

[9] The 9 manufacturing sectors are chemicals, electronics, metals, machinery, food, textiles, wood, non-metallic mineral, and pharmaceuticals. See Appendix Table A1 for more detail.

[10] Examples of the digitized financial contract documents are reproduced in Appendix Figures A1, A2, and A3.

by the Korea Productivity Center. For the 1982-2012 period the data come from KIS-VALUE, which covers firms with assets above 3 billion Korean Won (2.65mln 2015 USD).[11] We merge the two balance sheet datasets based on firm names. The variables include sales, assets, fixed assets, employment, and locations of establishments. Firms' chaebol status is obtained from Center for Economic Catch-up (2007, 2008). The final firm-level dataset is representative of the national economy. On average, the sum of firms' sales in a sector covers 67% of gross output of the sector according to the Input-Output tables published by Bank of Korea. Appendix Figure A4 reports coverage by sector.

Other regional and sectoral data International trade data come from Feenstra et al. (2005), which covers the 1966-2000 period. South Korea's import tariff data are digitized from Luedde-Neurath (1986). Input-Output tables are obtained from the Bank of Korea.

Descriptive statistics Table 1 reports the descriptive statistics for the loan contracts between 1973 and 1979 digitized from the archives. Between 1973 and 1979, there are 369 contracts in the manufacturing sector. The average size of a foreign loan was $51mln 2015 USD, the average repayment period was 6 years, and the average interest rate was 9%. The loans were denominated in USD. The average US CPI inflation over the period of these loans was about 8%, so the dollar-denominated real interest rate was about 1%. Between 1973 and 1979, the total credit provided this way to the manufacturing firms was about $18.7bln 2015 US dollars, or 17% of the 1972 South Korean real GDP. This implies that the HCI Drive was a large-scale industrial policy at the national level. Table 2 reports the descriptive statistics of the firm balance sheet variables. Columns 1 and 2 report the average sales and employment. Column 3 reports the ratio between allocated credit and sales once a firm reports a positive amount of credit. The total credit received is sizable, about 0.21 times total sales on average. Column 4 reports that about 9% of firms in the dataset ever received credit.

3 Empirical Strategy

3.1 Estimating Equation

To examine the effect of industrial policy on firm outcomes, we estimate the following long-difference regression model:

$$\triangle \ln Sales_f = \beta_1 \text{asinh}(Credit_f) + \beta_2 \ln Sales_{ft_0} + \mathbf{X}'_{ft}\boldsymbol{\beta_3} + \delta_n + \delta_j + \epsilon_f, \tag{3.1}$$

[11] KIS-VALUE covers firms that are either publicly traded or subject to external audit. The 1981 Act on External Audit of Joint-Stock Corporations requires the Korean firms with assets above 3 billion Korean Won to report balance sheet information.

Table 1: Descriptive Statistics of Foreign Credit Contracts, 1973-79

	(1) Loan Size (mln 2015 USD)	(2) Repayment Period (years)	(3) Interest Rate (%)
Mean	50.8	6.1	9.0
Std.	74.2	2.2	2.1

Notes. This table reports the descriptive statistics of approved financial contracts between domestic firms and foreign entities from 1973 to 1979. There are 369 contracts over this period.

Table 2: Descriptive Statistics of Firm Balance Sheet Data, 1973-1979

	(1) Sales (mln 2015 USD)	(2) Employment (thousands)	(3) Credit/Sales |Credit> 0	(4) Ever Received Credit (fraction)
Average	78.74	1.02	0.21	0.09
Std.	256.34	2.01	0.55	

Notes. This table reports the descriptive statistics for the firm-level balance sheet data and credit. The sample is firm-years. "Credit/Sales" is the ratio of credit to sales for firm-year observations with positive amounts of credit. "Ever Received Credit" is the share of firms that ever reported positive amounts of credit between 1973 and 1979.

where f denotes firm, j sector, and n region. The dependent variable $\triangle \ln Sales_f$ is the log change in firm sales, computed for either the 1972-1982, or the 1982-2010 period. The main independent variable, $\text{asinh}(Credit_f)$ is the inverse hyperbolic sine transformation of the sum of the total credit received by firm f between 1973 and 1979:

$$Credit_f = \sum_{\tau=1973}^{1979} Credit_{f\tau}. \tag{3.2}$$

We use the inverse hyperbolic sine transformation as a substitute for logs because a large fraction of firm observations have zero credit. This transformation allows us to include observations with zero credit, while approximating logs for larger values of the credit variable (Burbidge et al., 1988). All specifications include log initial sales ($\ln Sales_{ft_0}$) and region and sector fixed effects δ_n and δ_j that absorb any region and sector common shocks. Some specifications control for additional observables $\mathbf{X}_{ft}$. Long-differences estimation takes out time-invariant firm characteristics. The coefficient of in-

terest is β_1. It captures how much subsidized credit increased firm sales growth. Standard errors are clustered at the regional level throughout.

To use the data more efficiently, we employ overlapping long differences. Because standard errors are clustered at the regional level, this is innocuous. We use two 9-year log-differences for the short-run specification: 1972-1981 and 1973-1982. For the long-run specification, we use 28-year log-differences: 1981-2009 and 1982-2010. The dummies for each set of differences are included in the specifications.

3.2 Identification

OLS estimates of (3.1) may suffer from endogeneity because the government's credit allocation rule may depend on firms' unobservables. If the government selectively allocated foreign credit to firms with differential future productivity growth, credit allocated will be correlated with the firms' unobserved productivity changes in the error term. Our identification strategy relies on combining time series, cross-sectoral, and cross-regional variation. First, the timing of the HCI Drive and the choice sectors to be targeted were driven by external political shocks rather than the economic environment (Lane, 2019). Second, the HCI Drive was a place-based policy that targeted selected regions.

External political shocks The HCI Drive was precipitated by political shocks experienced by South Korea in the late 1960s and early 1970s. The foreign shock was the 1969 Nixon Doctrine, which altered the US foreign and defense policies with respect to the Asian countries. In the doctrine, President Nixon declared that the US would limit its military presence in Asia, and that the Asian countries should assume the primary responsibility for their self-defense instead of relying excessively on the US.[12] In line with the new US foreign policy, Nixon set up a plan for a full withdrawal of the US forces from South Korea. Although the full withdrawal was not implemented, by the early 1971 Nixon removed one-third of US soldiers stationed in South Korea.[13] At the same time, the military tensions between South Korea and communist North Korea were rising.[14] South Korea lagged behind North Korea in the size of the military, necessitating a heavy reliance on the US forces for the national defense against North Korea.[15] The establishment of official diplomatic relations between the US and

[12] In Guam on July 25, 1969, President Nixon said "*...in cases involving other types of aggression, we shall furnish military and economic assistance when requested in accordance with our treaty commitments. But we shall look to the nation directly threatened to assume the primary responsibility of providing the manpower for its defense...*"

[13] Nixon removed a division of 20,000 soldiers, decreasing the total US force levels in South Korea to 42,000.

[14] The South Korean government sent about 326,000 soldiers to the Vietnam war between 1964 and 1973. In exchange for South Korea's support in that war, the Johnson administration provided economic and military support to South Korea. North Korea felt threatened by the tighter bonds between the US and South Korea, increased investments in its military forces, and escalated military provocations against South Korea. For example, in January 1968 North Korea sent a squad of 31 commandos to assassinate President Park. Although the attempt failed, it resulted in 31 casualties and shocked the South Korean government.

[15] South Korea's economic backwardness relative to North Korea limited South Korea's military expenditures. According to the estimates from the Bank of Korea, South Korea's real GNP per capita was below North Korea's until

the People's Republic of China, which fought against South Korea in the Korean War, further raised the South Korean government's level of national security concern (Nixon, 1967).

Faced with the Nixon Doctrine, in the late 1972 the President Park administration decided to pursue a self-reliant defense strategy. Achieving it required a modernization of the weapons capabilities, which necessitated the development of the HCI sectors. Therefore, the government embarked on the HCI Drive.

Place-based policy The HCI Drive was place-based. According to the 1973 Industrial Site Development Promotion Law, 9 southeastern regions of the country were targeted for development (Industrial Sites Development Corporation, 1978, p. 28). In these targeted regions, the government developed industrial complexes and disproportionately subsidized firms in these complexes.[16] Panel A of Figure 1 highlights the regions ex ante targeted by the 1973 Industrial Site Development Promotion Law on the map of South Korea. Panel B of Figure 1 illustrates the geographic distribution of actual allocated foreign credit, and shows substantial though imperfect overlap with the set of targeted regions.

Why these regions were targeted is not explicitly documented, as the government decision process was not transparent during this period. However, narrative evidence suggests that they were chosen based on considerations orthogonal to future productivity growth. Some scholars have conjectured that part of the reason was national security. These southeastern regions are farthest from the North Korean border, and were the last line of defense against the North Korean invasion during the Korean War (Yoo, 1998, p. 267). Another potential reason was political ties to the Park government (Yoo, 1998, p. 243, 291; Kim and Vogel, 2013, p. 298). The president and many core government officers were born in the southeast, and voters in these regions supported the president in the 1971 election.[17] Finally, market access has also been mooted as a potential reason. Many of the targeted regions are close to the main port of Busan. (The two main ports in South Korea are Incheon and Busan. Incheon is located in the northwest close to the border with North Korea, and Busan in the southeast of the country.)

Instrument Our instrument for firm credit is:

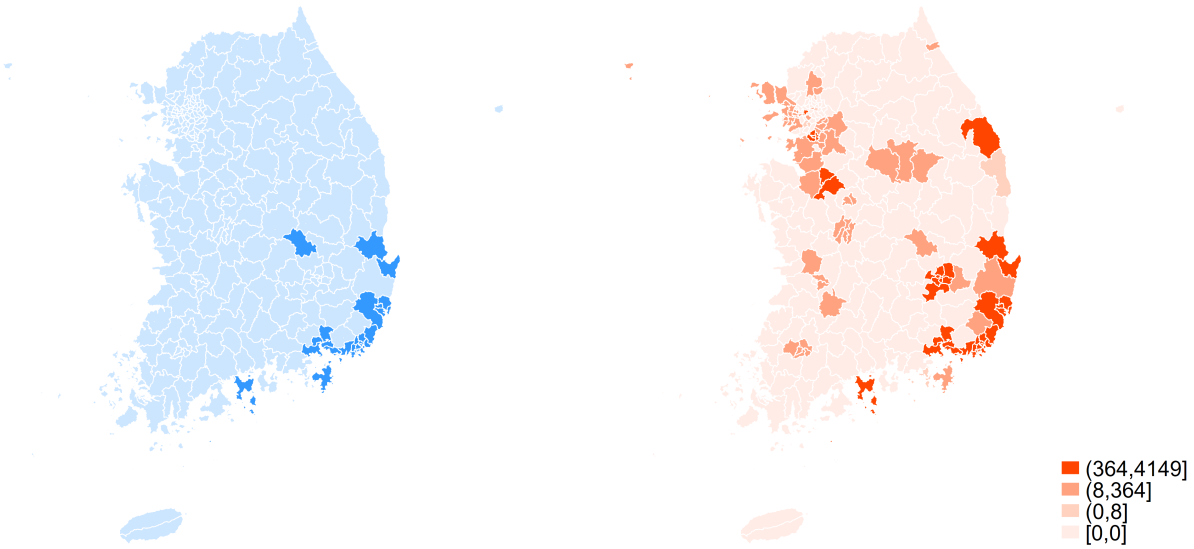
$$D_j^{HCI} \times D_n^{Target}, \tag{3.3}$$

the mid-1970s. In 1972, North Korea's annual military expenditures were about 100% larger than South Korea's (Moon and Lee, 2009). Only in the late 1970s did South Korea's military expenditures surpass North Korea's.

[16] The targeted regions were Busan, Changwon, Guje, Gumi, Jinhae, Masan, Pohang, Ulsan, and Yeosu (Yeocheon). The industrial complexes in Changwon and Guje were newly constructed after 1973. In the other regions, existing industrial infrastructure was expanded (see Enos and Park, 1988, p. 36). Each industrial complex had its specialized sector (Appendix Table A2).

[17] The president himself was born in the inland targeted region, Gumi.

Figure 1. Targeted Regions and Foreign Credit Allocations

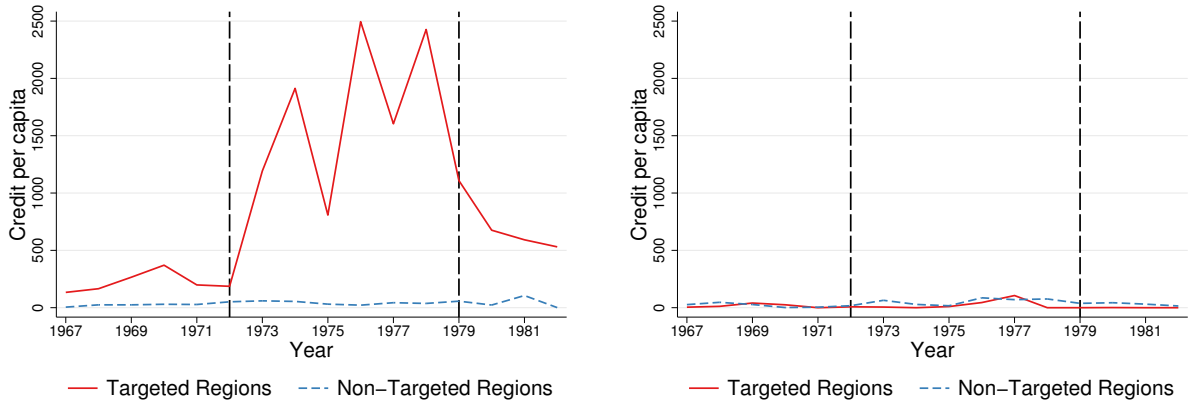


Panel A. Targeted Regions

Panel B. Foreign Credit Allocation, 1973-1979

Notes. Panel A highlights the HCI targeted regions in a darker shade. Panel B illustrates the total credit allocated to each region, in million 2015 USD.

Figure 2. Foreign Credit Allocation by Sector and Region



Panel A. HCI Sectors

Panel B. Non-HCI Sectors

Notes. These figures depict the amount of credit per capita in 2015 US dollars in the HCI sectors (Panel A), and non-HCI sectors (Panel B). The vertical lines represent the start and the end of the HCI Drive industrial policy. The red solid and blue dashed lines represent the targeted and non-targeted regions, respectively.

where D_j^{HCI} is a dummy variable that takes on a value of 1 if a firm is in a sector targeted by the HCI Drive, and D_n^{Target} is a dummy variable for whether the firm is in a targeted region. The identifying assumption is that residual changes in firm unobservables are uncorrelated with the IV. That is, conditional on region and sector fixed effects and the parametric controls, there were no shocks affecting differentially the HCI sector firms in the targeted regions. The exclusion restriction is supported by the historical background detailed above, that suggests that the targeting of sectors and regions was dictated by political and military considerations rather than economic ones.

We stress that our identification assumption is conditional on both sector and region fixed effects throughout (see eq. 3.1). Thus, to the extent that some of the historical features discussed above – such as political support for the Park administration or market access – could have had an independent effect on the growth of all firms in the region, that would be absorbed by the region effects. Ties to the Park administration are also unlikely to be responsible for the long-run results, which pertain to the post-1981 firm growth, whereas president Park was assassinated in 1979. Below we also control for differential sector-level trade exposure of port regions, and the results remain unchanged. Similarly, any effects of the policies that affect sectors as a whole – such as the overall increased demand for military equipment – are absorbed by sector effects.

Another potential source of bias is the sorting of new entrants. After the HCI Drive began, new firms with higher productivity may have systematically entered the targeted regions. This kind of positive sorting of faster-growing firms into the targeted regions may confound the coefficient estimates. Therefore, for both the short-run and the long-run analyses, we restrict our sample of firms to those that were already operating before the HCI Drive started.

Identifying variation Figure 2 plots the distribution of credit across sectors and regions. Panel A shows the per capita credit allocated to the HCI sector firms in the targeted and non-targeted regions. After 1972, the credit going to the HCI sectors in the targeted regions dramatically increased, whereas the credit to HCI sectors in the non-targeted regions stayed constant at near-zero levels. The figure also confirms that the industrial policy was temporary. After 1979, the HCI Drive stopped, and the amounts of credit allocated fell. Panel B plots the non-HCI sectors' credit per capita in the targeted and non-targeted regions. The amounts of credit allocated to non-HCI sector firms were negligible compared to those in the HCI sectors. Also, in the non-HCI sectors there are no differential patterns in credit per capita between targeted and non-targeted regions. Figure 2 illustrates the identifying variation. We will compare the difference between HCI sector firms in the targeted and non-targeted regions and the difference between non-HCI sector firms in the targeted and non-targeted regions.[18]

[18]The HCI sectors in targeted regions received a modestly larger amount of credit per capita prior to 1973. This does not present a threat to identification because we do not compare post- and pre-1973 outcomes. Rather, our strategy exploits differential treatment across sector×locations. The placebo tests in Section 4.2 show that the HCI sectors in the targeted regions did not grow faster than the rest of the Korean economy prior to 1973. This suggests that the

4 Empirical Results

4.1 Baseline Results

Table 3 presents the short-run estimates, in which the outcome variable is sales growth during and immediately after the HCI Drive, 1972-1982. Column 1 reports the OLS results. The coefficient is significantly positive. Column 2 presents the baseline second-stage IV estimates. The Kleibergen-Paap F-statistic of over 20 indicates that the instrument is strong. The coefficients become larger. The IV estimate implies that a one standard deviation increase in asinh($Credit_f$) raises a firm's growth rate between 1973 and 1982 by one standard deviation. Column 3 reports the reduced-form estimate that directly uses the IV as a regressor. The estimated coefficient implies that sales growth of the HCI sector firms in the targeted regions was 98 percentage points higher on average than the firms in the control group.

Table 4 reports the long-run estimates, where the outcome variable is sales growth from 1981 or 1982 (after the HCI Drive ended) to 2009 or 2010.[19] The results show continuing effects in the long run. The IV estimate in column 2 implies that a one standard deviation increase in asinh($Credit_f$) raises firms' sales growth by 2.5 standard deviations. To translate this into cumulative growth, note that a doubling of credit leads to 39 percentage points higher growth between the early 1980s and the late 2000s, equivalent to a 1.2 percentage point higher annual growth rate over this period. Appendix Tables B1 and B2 report the first stage results for the short run and the long run, respectively.

4.2 Robustness

Chaebol status One special feature of the Korean economy is that large business groups – chaebols – account for a large fraction of GDP. A chaebol is a large industrial conglomerate owned and run by a business family.[20] They were inherently different from other medium- or small-sized firms in many dimensions. Chaebols were not only larger but also had a closer connection with the government. In column 4 of Tables 3 and 4, we control for a dummy variable for affiliation with a top 30 chaebol, listed in Appendix A.2. Both short-run and long-run coefficients are similar to the baseline results

impact of pre-1973 credit was limited at most. A positive impact of pre-1973 credit on firm outcomes would also be controlled for by the initial sales included in all specifications.

[19] One may be concerned that if very long-term loan contracts were made, the 2009 or 2010 sales might be affected directly by such long-term loans. However, the average repayment period was 6 years, so after 30 years subsidized loans no longer directly affect sales.

[20] A chaebol is similar to a zaibatsu, a business group in Japan during the pre-WW2 period. The one key difference is whether a business group could run its affiliated banks. The zaibatsu in Japan could run their affiliated banks, which were their main source of capital. However, chaebols in Korea could not own their banks, so foreign credit was an important source of capital for chaebols.

Table 3: Short-Run Effects of Subsidies on Firm Sales Growth

Dep. Var.:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\triangle \ln Sales_f$: 1972-1981 and 1973-1982							
	OLS	IV						
asinh($Credit_f$)	0.06***	0.18***		0.18***	0.19***	0.18***	0.18***	0.19***
	(0.01)	(0.04)		(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
IV			0.98***					
			(0.18)					
$\ln(Sales_{ft_0})$	−0.54***	−0.70***	−0.48***	−0.71***	−0.71***	−0.70***	−0.70***	−0.72***
	(0.04)	(0.06)	(0.04)	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)
$Chaebol_f$				0.12				0.08
				(0.46)				(0.47)
$\triangle Export\ Demand_j \times Port_n$					0.02			0.16*
					(0.06)			(0.08)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						−0.20		−17.65**
						(1.67)		(8.74)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							1.90	44.51**
							(3.15)	(16.82)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		23.00		25.70	23.80	22.27	23.33	24.44
Adj. R^2	0.46		0.40					
Num. Clusters	55	55	55	55	55	55	55	55
N	762	762	762	762	762	762	762	762

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1972 and 1981 or between 1973 and 1982. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Sales_{ft_0})$ is log of initial sales in 1972 or 1973. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table 4: Long-Run Effects of Subsidies on Firm Sales Growth

Dep. Var.:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\triangle \ln Sales_f$: 1981-2009 and 1982-2010							
	OLS	IV						
asinh($Credit_f$)	0.02**	0.58***		0.56***	0.54***	0.57***	0.56***	0.55***
	(0.01)	(0.18)		(0.17)	(0.14)	(0.17)	(0.16)	(0.15)
IV			1.52***					
			(0.20)					
$log(Sales_{ft_0})$	−0.14**	−1.24***	−0.13**	−1.07***	−1.17***	−1.22***	−1.20***	−1.06***
	(0.05)	(0.41)	(0.06)	(0.33)	(0.33)	(0.38)	(0.37)	(0.31)
$Chaebol_f$				−1.80				−1.75
				(1.76)				(1.58)
$\triangle Export\ Demand_j \times Port_n$					−0.23			0.21
					(0.31)			(0.35)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						5.33		−31.10
						(4.88)		(25.91)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							17.12	84.13
							(10.92)	(50.45)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		11.47		11.33	17.17	14.10	14.89	16.66
Adj. R^2	0.15		0.17					
Num. Clusters	53	53	53	53	53	53	53	53
N	739	739	739	739	739	739	739	739

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1981 and 2009 or between 1982 and 2010. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Sales_{ft_0})$ is log of initial sales in 1981 or 1982. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

in column 2.

International trade After President Park started his first term in 1962, South Korea strongly promoted export-oriented development (Westphal, 1990). Economywide changes in the external environment are absorbed by sector fixed effects in estimation. However, since the targeted regions are located near one of the major ports in Korea, trade shocks may have had a differential effect on the targeted regions relative to non-targeted ones, presenting a potential threat to identification. To show that uneven exposure to trade shocks does not drive our results, we additionally control for several trade-related variables.

First, we add an interaction between export demand shocks and the port dummies. The construction of this variable is detailed in Appendix B.2. Second, import tariff changes also may differentially affect the intensity of foreign competition across regions with and without ports. A given import tariff reduction may represent a greater increase in foreign competition in the port regions compared to interior ones, due to within-country trade costs. We thus control for the changes in import tariffs interacted with the port dummies:

$$\triangle \ln(Import\ Tariff_j) \times Port_n.$$

Third, tariffs on imported intermediates may also affect firm performance (Goldberg et al., 2010; Halpern et al., 2015). We control for the interaction between the changes in input tariffs and the port dummies. We construct input tariffs as

$$Input\ Tariff_{jt} = \sum_k \gamma^k_{j,1970} \times Import\ Tariff_{kt}, \tag{4.1}$$

where $\gamma^k_{j,1970}$ is value share of input k in sector j in 1970.

Columns 5, 6, and 7 of Tables 3 and 4 report the results when including these variables one at a time. Column 8 jointly controls for the chaebol status and all three trade-related variables. In both the short-run and the long-run specifications, the coefficients of interest are quite similar to the baseline results in column 2. The estimated coefficients on these additional controls are statistically insignificant.

Placebo Our empirical strategy is based on the assumption that there were no other shocks affecting HCI sectors located in the targeted regions. While this assumption is not testable directly, we could check whether the targeted sectors in the targeted regions already behaved differently prior to the policy, by means of a placebo test. We run the regression (3.1) with the pre-treatment – 1970 to 1973 – sales growth as the dependent variable. If the results were driven by confounding factors correlated with the IV, and those confounding factors were already present prior to 1973, the IV or

Table 5: Robustness. Placebo Test

Dep. Var.:	(1)	(2)	(3)	(4)	(5)	(6)
	$\triangle \ln(Sales)$: 1970 and 1973					
	OLS		Reduced Form		IV	
asinh($Credit_f$)	−0.01	−0.01			−0.04	−0.04
	(0.01)	(0.01)			(0.03)	(0.03)
IV			−0.28	−0.24		
			(0.19)	(0.19)		
Firm Controls	N	Y	N	Y	N	Y
Region FE	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y
KP-F					14.67	10.00
Adj. R^2	−0.01	−0.02	−0.02	−0.03		
Num. Clusters	35	35	35	35	35	35
N	242	242	242	242	242	242

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the placebo results. The dependent variable is the log sales growth rate between 1970 and 1973. Columns 1-2 report the OLS estimates. Columns 3 and 4 report the reduced form, where the main independent variable is the IV defined in (3.3). Columns 2, 4, and 6 control for a dummy variable of Chaebol status and the interaction term between the port dummies and export demand shocks, import tariffs, and input tariffs. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

the allocated credit would be correlated with the 1970-1973 sales growth.

Table 5 reports the results of the placebo test. In columns 1-2 the main independent variable is the 1973-1979 credit, and in columns 3-4 the main independent variable is the IV. Columns 5-6 report the IV estimates. Columns 2, 4, and 6 additionally control for chaebol status and the trade-related variables. Across the specifications, the estimated coefficients on the main independent variables are statistically indistinguishable from zero, supporting our identifying assumption.[21]

[21] Appendix Section B.3 conducts an additional placebo test at the regional level with a different dataset. Using regional information on manufacturing employment shares from the population census, we run a regression of growth in manufacturing employment shares between 1966 and 1970 and between 1970 and 1985 on total credit allocated at the regional level to the HCI sector firms in 1973-79. The results, reported in Appendix Table B5, are consistent with the results in Table 5. We find that the regional total credit is only positively correlated with the growth in manufacturing employment shares between 1970 and 1985, but not with the growth between 1966 and 1970.

Markups and other outcomes One possibility that would substantially affect the interpretation of our results is that firms may have used these subsidies to increase their market power. After 1982 information on firms' variable input expenditures is available, which allows us to estimate firm-level markups based on the production function approach (De Loecker and Warzynski, 2012). Appendix B.4 describes the procedure in detail. We then estimate the baseline empirical model (3.1) with markups as the outcome variable. Table B6 reports the results. The impact of the subsidies on post-1981 markup change is a precisely estimated zero in all specifications. It is thus not the case that the higher sales growth of treated firms is due to markup increases.

Another way to assess whether market power is responsible for our results is to look at exports. Since South Korea is a small open economy, these firms' market power in world markets is unlikely to have been substantially affected by the domestic subsidies. Tables B7-B8 and B9-B10 report the results for a binary indicator for exporting and the inverse hyperbolic sine transformation of export values, respectively. In the short run the effect of subsidies on exports is not significant, suggesting that it took longer than a decade for the treated firms to translate the advantage given to them by the subsidies into export success. However, subsidies significantly increased both the probability of being an exporter and export values in the long run.

We next estimate the empirical model with alternative dependent variables: firm employment and TFP. TFP is computed assuming a value-added Cobb-Douglas production function and using the method proposed by Ackerberg et al. (2015).[22] Firm value added is calculated as firm sales multiplied with value-added shares obtained from IO tables. The results are reported in Appendix Tables B11-B12 for employment and B13-B14 for TFP. Subsidies increased both employment and TFP of these firms, with the employment effects most pronounced in the short run, and TFP effects largest in the long run.

Additional robustness To examine whether the particular choice of years is driving our long-run results, Appendix Figure B2 reports the yearly estimates for the differential sales growth between 1982 and year $t = 1983 - 2011$. The estimated coefficients increase as time passes, up to 2009. Instead of using the inverse hyperbolic sine transformation, we also use a dummy variable that equals one if a firm was ever allocated foreign credit between 1973 and 1979 and log of one plus credit. Appendix Tables B15-B16 report the results for the positive credit dummy, and Appendix Tables B17-B18 report the results for log one plus credit. Instead of using the overlapping log differences, the results when using only a single log difference are reported in Appendix Tables B19-B20. All specifications

[22] Applying the Ackerberg et al. (2015) method requires information on material inputs. Between 1970 and 1982 the material input information is not available. Therefore, we first estimate the production function for the sample between 1982 and 1990 and obtain the labor and capital elasticities. Using these estimated coefficients, we obtain TFP measures as the residuals for the sample between 1970 and 1982. The results are robust to applying different production function estimation methods.

include the log of initial sales. This is our preferred approach because it additionally controls for any other channels that potentially affect firms' long-run performance through initial size. The estimates without controlling for the initial sales are reported in Appendix Tables B21-B22. The results are robust to omitting the initial size control.

Omitted policies Even if the instrumental variable is uncorrelated with omitted productivity or demand shocks, the exclusion restriction may not hold if other policies favored firms in the targeted sectors and regions. Although sector and region fixed effects may mitigate this concern by absorbing common policy components within a sector or region, given the limited availability of other policy data we cannot completely rule out this possibility. However, narrative evidence suggests that this is not a major concern because the other policies were conditioned on getting approvals for foreign credit. For example, under the Foreign Capital Inducement Act, tax privileges such as exemptions from acquisition or property taxes were only granted to imported foreign capital or raw materials purchased using the approved foreign credit.[23] In this case, our IV estimates would in effect capture the combined effect of subsidies *per se* and the accompanying policies that affected only the targeted sector-region cells.

5 Quantitative Framework

Our main empirical finding is that subsidized credit during the HCI Drive increased firm sales as much as 30 years after the credit stopped. We interpret this as evidence that this temporary policy had persistent long-run effects. We now develop a theoretical framework that captures this pattern and use it to quantify the long-run welfare benefits of the policy. The main mechanism in the model is learning-by-doing (LBD) within the firm: a firm's current production quantity increases its future productivity (Arrow, 1962; Krugman, 1987; Young, 1991; Matsuyama, 1992; Lucas, 1993). Firms are also borrowing-constrained. Thus, they cannot expand in the short run to internalize the future benefits of producing more today. These features are consistent with both the formal econometric, as well as narrative historical evidence. In this environment, industrial policy has a role. Government subsidies relax firms' borrowing constraints and increase output in the first period, leading to productivity gains from LBD. We discipline the model by deriving the estimating equations used in the empirical analysis, allowing the key parameters of the model to be recovered from the econometric estimates.

5.1 Model

Preliminaries A small open economy, labeled Home, trades with the rest of the world labeled Foreign. There are two periods with time indexed by $t = 1, 2$. Each period should be viewed as

[23] See Lee (1980) and Enos and Park (1988, p. 35).

10 years or more. There are $\mathcal{J}$ sectors indexed by j and k, partitioned into $\mathcal{J}_M$ manufacturing sectors and $\mathcal{J}_{NM}$ non-manufacturing sectors. Firms in the manufacturing sectors are monopolistically competitive and heterogeneous in productivity. The non-manufacturing sectors include commodities and services and are perfectly competitive.

Households The representative household supplies H_t units of labor inelastically and maximizes:

$$\begin{aligned} \max \quad & \sum_{t=1,2} \beta^{t-1} \ln \left(\prod_{j \in \mathcal{J}} C_{jt}^{\alpha^j} \right) \\ s.t. & \\ \sum_{j \in \mathcal{J}} P_{jt} C_{jt} \quad &= \quad w_t H_t + \Pi_t + T_t \qquad t = 1, 2, \end{aligned}$$

where β is the discount factor, C_{jt} is the sector j consumption bundle, and P_{jt} is the sector j price index at time t. Households' total income comprises of the labor income $w_t H_t$, the aggregate firm profits Π_t, and government lump-sum transfers T_t. We assume that trade is balanced each period, so total consumption expenditure equals total income.

Sectors The manufacturing sectors $j \in \mathcal{J}_M$ are populated by firms indexed by $f \in \mathcal{F}_j$. Home sector j output is a CES aggregate of Home firm outputs:

$$Q_{jt}^H = \left[\sum_{f \in \mathcal{F}_j} q_{fjt}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}},$$

where q_{fjt} is the quantity of firm f output and σ is the elasticity of substitution across firms within a sector. The price of Home's sectoral output is

$$P_{jt}^H = \left[\sum_{f \in \mathcal{F}_j} p_{fjt}^{1-\sigma} \right]^{\frac{1}{1-\sigma}},$$

where p_{fjt} is firm f's price. For the perfectly competitive non-manufacturing sectors $j \in \mathcal{J}_{NM}$, a representative firm prices at marginal cost, and the price of Home sectoral output is equal to the representative firm's price: $P_{jt}^H = p_{fjt}$ for $j \in \mathcal{J}_{NM}$.

The sector j output used by Home for final consumption and intermediate use is a CES aggregate of Home and Foreign sector j outputs:

$$Q_{jt} = \left[(Q_{jt}^H)^{\frac{\rho-1}{\rho}} + (Q_{jt}^F)^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}},$$

where Q_{jt}^F is the quantity of Foreign sector j output demanded by Home and ρ is the elasticity of substitution between Home and Foreign sectoral outputs. The sectoral price index is

$$P_{jt} = \left[(P_{jt}^H)^{1-\rho} + (P_{jt}^F)^{1-\rho} \right]^{\frac{1}{1-\rho}},$$

where P_{jt}^F is the Foreign sector j price that Home takes as exogenous. The share of imports in total sector j Home expenditure is $\pi_{jt}^F = (P_{jt}^F/P_{jt})^{1-\rho}$. The Home sector j faces foreign demand for its output given by $Q_{jt}^X = (P_{jt}^H)^{-\rho} D_{jt}^F$, where D_{jt}^F is an exogenous foreign demand shifter that also includes iceberg trade costs. The Home sector j total export revenues are $EX_{jt} = (P_{jt}^H)^{1-\rho} D_{jt}^F$.

Firms Firms in each sector produce with a constant returns to scale Cobb-Douglas production function:

$$q_{fjt} = A_{fjt} H_{fjt}^{\gamma_j^H} \prod_{k \in \mathcal{J}} (M_{fjt}^k)^{\gamma_j^k}, \qquad \gamma_j^H + \sum_{k \in \mathcal{J}} \gamma_j^k = 1,$$

where A_{fjt} is firm-specific productivity, H_{fjt} is its labor input, and M_{fjt}^k are sector k intermediate inputs used by firm f. The parameters γ_j^H and γ_j^k are common across firms within a sector. Cost minimization implies the cost of the input bundle equal to

$$c_{jt} = \left(\frac{w_t}{\gamma_j^H} \right)^{\gamma_j^H} \prod_{k \in \mathcal{J}} \left(\frac{P_{kt}}{\gamma_j^k} \right)^{\gamma_j^k}.$$

A firm in the manufacturing sector faces a downward-sloping demand curve. When a firm charges price p_{fjt}, its sales X_{fjt} are

$$X_{fjt} = \left(\frac{p_{fjt}}{P_{jt}^H} \right)^{1-\sigma} X_{jt} = \pi_{fjt} X_{jt},$$

where X_{jt} is Home sector j's total sales, and π_{fjt} is firm f's share in sectoral sales.

Only firms in the manufacturing sectors are subject to LBD. In particular, firm f's productivities at $t = 1$ and $t = 2$ are:

$$A_{fj1} = \phi_{fj1}, \qquad A_{fj2} = \phi_{fj2} q_{fj1}^{\xi},$$

where the ϕ_{fjt} are exogenous. The second period A_{fj2} is increasing in the first period quantity produced with elasticity ξ. If $\xi = 0$, there is no LBD and the model collapses to the standard static multi-sector heterogeneous firm model with two periods. The value of ξ will be inferred from the econometric estimates in Section 4, as discussed below.

Industrial policy in the model is a proportional subsidy on firm purchases of input bundles, denoted by $\kappa_{fj1} \leq 1$. (That is, the government pays for a fraction $1 - \kappa_{fj1}$ of the firm's input expenditures.) Firms face borrowing constraints in the first period. Before production occurs, firms have to borrow

for working capital to pay their total input expenditures subject to the following constraint:

$$\kappa_{fj1}(w_1 H_{fj1} + \sum_k P_{k1} M^k_{fj1}) \leq \tilde{\lambda}_{j1} A^{\sigma-1}_{fj1}, \qquad \tilde{\lambda}_{j1} = \lambda_{j1} \left(\frac{\sigma}{\sigma-1}\right)^{-\sigma} c_{j1}^{1-\sigma} (P^H_{j1})^{\sigma-1} X_{j1}, \tag{5.1}$$

where the left-hand side of the inequality is total input costs inclusive of subsidies and the right-hand side is the borrowing limit. Borrowing constraint tightness $\tilde{\lambda}_{j1}$ is proportional to market size $(P^H_{j1})^{\sigma-1} X_{j1}$, unit cost c_{j1} and an exogenous industry-specific parameter λ_{j1}. Expressing the borrowing constraint as in (5.1) is analytically convenient, and reflects the notion that when firms face bad economic conditions such as increased unit costs or decreased market size, it becomes more difficult for them to borrow. Firms with higher productivity A_{fj1} can borrow more.[24] The subsidy κ_{fj1} increases a firm's sales directly by reducing input expenditures and indirectly by relaxing the borrowing constraints.

A firm's profit maximization problem is dynamic because of LBD. An unconstrained firm will increase its $t = 1$ quantity produced and lower its price relative to the static profit-maximizing levels in order to benefit from LBD. Appendix C.1 lays out the details of the unconstrained firm problem. At the same time, financial constraints imply that firms cannot increase to the optimal size. The ratio between the exogenous constraint parameter and the firm-specific subsidy $\lambda_{j1}/\kappa_{fj1}$ determines the tightness of the borrowing constraint. When $\lambda_{j1}/\kappa_{fj1} \to \infty$, the borrowing constraints are not binding and firms set the dynamically optimal price that internalizes LBD. When $\lambda_{j1}/\kappa_{fj1} \leq 1$, the firm's price is higher than the static profit-maximizing level:

$$p^{Friction}_{fj1} = \frac{\sigma}{\sigma-1} \left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{-\frac{1}{\sigma}} \frac{c_{j1}}{A_{fj1}},$$

and its output and profits are lower. Appendix C.2 shows this formally and discusses the relationships between the severity of the borrowing constraints, and the unconstrained, statically optimal, and constrained prices. In what follows, we assume that at $t = 1$ $\lambda_{j1}/\kappa_{fj1} \leq 1$ holds for all firms. When firms charge $p^{Friction}_{fj1}$, their revenues are

$$X_{fj1} = \left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{\frac{\sigma-1}{\sigma}} \left(\frac{\sigma}{\sigma-1} \frac{c_{j1}}{A_{fj1}}\right)^{1-\sigma} (P^H_{j1})^{\sigma-1} X_{j1}, \tag{5.2}$$

and input expenditures are

$$c_{j1} m_{fj1} = \left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{\frac{1}{\sigma}} \frac{\sigma-1}{\sigma} X_{fj1}.$$

[24] Firm sales scale with $A^{\sigma-1}_{fj1}$, thus this borrowing constraint formulation amounts to assuming that the firms can pledge a fraction of its sales.

The total post-subsidy input costs are $\kappa_{fj1}c_{j1}m_{fj1}$. First period profits equal sales minus total costs

$$\Pi_{fj1} = \left[1 - \kappa_{fj1}\left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)\right]X_{fj1}.$$

Equilibrium A monopolistically competitive equilibrium is a set of prices w, $\left\{P_{jt}^H\right\}_{j\in\mathcal{J}}$, $\{p_{fjt}\}_{f\in\mathcal{F}_j,j\in\mathcal{J}}$ and factor allocations $\left\{Q_{jt}^H\right\}_{j\in\mathcal{J}}$, $\{q_{fjt}\}_{f\in\mathcal{F}_j,j\in\mathcal{J}}$ such that at $t=1,2$, (i) consumers maximize utility; (ii) firms maximize profits, (iii) all goods and factor markets clear, (iv) the government budget is balanced; and (v) trade is balanced.

We will assume that at $t=1$, firms face financial constraints and some firms receive subsidies. At $t=2$, there are no financial constraints or subsidies, so the model collapses to a textbook small open economy with monopolistically competitive firms. Sectoral sales, input expenditures, and profits sum across all firms' in the sector: $X_{jt} = \sum_{f\in\mathcal{F}_j} X_{fjt}$, $c_{jt}m_{jt} = c_{jt}\sum_{f\in\mathcal{F}_j} m_{fjt}$, and $\Pi_{jt} = \sum_{f\in\mathcal{F}_j}\Pi_{fjt}$, $\forall j,t$. Goods market clearing is

$$X_{jt} = (1-\pi_{jt}^F)\left[\alpha^j\left(w_tH_t + \Pi_t + T_t\right) + \sum_{k\in\mathcal{J}}\gamma_k^j c_{kt}m_{kt}\right] + EX_{jt} \quad \forall j,$$

where the aggregate profits are:

$$\Pi_t = \sum_{j\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_j}\Pi_{fjt},$$

and the lump-sum taxes used to pay for the subsidies are:

$$T_t = \sum_{j\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_j}(\kappa_{fjt}-1)c_{j1}m_{fjt}. \tag{5.3}$$

Because there are no subsidies in the second period, $T_2 = 0$. Labor market clearing implies that

$$w_tH_t = \sum_{j\in\mathcal{J}}\gamma_j^H c_{jt}m_{jt}.$$

The prices of Home sectoral output in manufacturing at $t=1,2$ are

$$P_{j1}^H = \left[\sum_{f\in\mathcal{F}_j}\left(\left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{-\frac{1}{\sigma}}\frac{\sigma}{\sigma-1}\frac{c_{j1}}{A_{fj1}}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}, \qquad P_{j2}^H = \left[\sum_{f\in\mathcal{F}_j}\left(\frac{\sigma}{\sigma-1}\frac{c_{j2}}{A_{fj2}}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}},$$

and the Home non-manufacturing output prices are $P_{jt}^H = c_{jt}/A_{jt}$ for $t=1,2$. The ideal consumption

price index is

$$P_t = \prod_{j \in \mathcal{J}} \left(\frac{P_{jt}}{\alpha^j} \right)^{\alpha^j}.$$

5.2 Counterfactuals

We are interested in the long-term aggregate welfare effects of industrial policy. Thus, our main counterfactual exercise computes the welfare change in the world in which the Korean government had not conducted industrial policy. In our model, this corresponds to setting $\kappa_{fj1} = 1, \forall f$.

To perform counterfactuals, we utilize a modification of the Dekle et al. (2008) exact hat algebra. Appendix C.4 describes the procedure in detail. For any outcome x, let the subscript c stand for the counterfactual equilibrium allocation, and $\hat{x}_1^S = x_{c,1}/x_1$ denote the gross proportional difference between the counterfactual and the baseline at $t = 1$. Denote by $\hat{x}_2^L = x_2/x_1$ the changes between the first and second periods in the baseline. Finally, let $\hat{x}_{c,2}^L = x_{c,2}/x_{c,1}$ denote the changes between the first and second periods in the counterfactual.

Under log utility, the welfare levels in the baseline initial equilibrium and the counterfactual equilibrium can be expressed as:

$$U = \left(\frac{y_1}{P_1}\right)\left(\frac{y_2}{P_2}\right)^{\beta} = \left(\frac{y_1}{P_1}\right)\left(\frac{\hat{y}_2^L}{\hat{P}_2^L}\frac{y_1}{P_1}\right)^{\beta}, \qquad U_c = \left(\frac{y_{c,1}}{P_{c,1}}\right)\left(\frac{y_{c,2}}{P_{c,2}}\right)^{\beta} = \left(\frac{y_{c,1}}{P_{c,1}}\right)\left(\frac{\hat{y}_{c,2}^L}{\hat{P}_{c,2}^L}\frac{y_{c,1}}{P_{c,1}}\right)^{\beta},$$

where y is the per capita income.[25] The counterfactual welfare change relative to the baseline equilibrium is

$$\frac{U_c}{U} = \underbrace{\left(\frac{\hat{y}_1^S}{\hat{P}_1^S}\right)}_{\substack{\text{Short-run} \\ \text{Welfare Change}}} \times \underbrace{\left(\frac{\tilde{y}_2^L}{\tilde{P}_2^L}\frac{\hat{y}_1^S}{\hat{P}_1^S}\right)^{\beta}}_{\substack{\text{Long-run} \\ \text{Welfare Change}}} \qquad \text{where} \qquad \frac{\tilde{y}_2^L}{\tilde{P}_2^L} = \frac{\hat{y}_{c,2}^L}{\hat{P}_{c,2}^L} \Big/ \frac{\hat{y}_2^L}{\hat{P}_2^L}, \tag{5.4}$$

with $\tilde{x}$ denoting the ratio of long-run changes between the counterfactual and the baseline equilibrium.[26] The overall welfare change U_c/U is thus composed of the short- and the long-run components.

In our setting, changes in subsidies $\hat{\kappa}_{fj1}$ affect the $t = 1$ allocation directly, and the $t = 2$ allocation indirectly through LBD. The computation of the counterfactual proceeds in three steps. First we obtain the $t = 1$ counterfactual changes via the standard hat algebra. Second, we obtain the coun-

[25] Per capita income in the first period is: $y_1 = \frac{w_1 H_1 + \Pi_1 + T_1}{H_1}$. In the second period, there are no taxes/transfers ($T_2 = 0$) and the economy is unconstrained, so that total profits are a constant fraction of the wage bill. Thus the second-period per capita welfare is proportional to the real wage.

[26] Caliendo et al. (2019) adopt a similar approach. By computing the ratio of changes, one can compute the counterfactual change without knowing the levels of the shocks. In our application, we do not require information on the initial level of each firm's quantities produced in the first period, which is used to compute long-run productivity changes.

terfactual $t = 2$ productivity changes, which are endogenous outcomes affected by the $t = 1$ quantity produced through LBD. In particular, suppose we know a firm's long-run *factual* productivity change (Section 5.3 details the procedure for inferring it from the data). According to the model, this productivity change equals $\hat{A}^L_{fj2} = A_{fj2}/A_{fj1} = \phi_{fj2}q^{\xi}_{fj1}/\phi_{fj1}$. The counterfactual long-run productivity change is then computed as

$$\hat{A}^L_{c,fj2} = \frac{\phi_{fj2}q^{\xi}_{c,fj1}}{\phi_{fj1}} = \underbrace{\frac{\phi_{fj2}q^{\xi}_{fj1}}{\phi_{fj1}}}_{=\hat{A}^L_{fj2}\text{ : Data}} \times \underbrace{\left(\frac{q_{c,fj1}}{q_{fj1}}\right)^{\xi}}_{=\hat{q}^S_{fj1}\text{ : Short-run hat algebra}},$$

where changes of each firm's quantity produced $\hat{q}^S_{fj1} = q^c_{fj1}/q_{fj1}$ come from the short-run hat algebra in the first step. In the last step, we feed in $\hat{A}^L_{c,fj2}$ and $\hat{A}^L_{fj2}$ and apply the long-run hat algebra to the counterfactual and baseline $t = 1$ equilibria to obtain $\hat{y}^L_{c,2}/\hat{P}^L_{c,2}$ and $\hat{y}^L_2/\hat{P}^L_2$. From these long-run changes, we compute relative changes $\tilde{y}^L_2/\tilde{P}^L_2$ in (5.4). For the long-run hat algebra, we also feed in changes in the population $\hat{H}^L_2$.

5.3 Taking the Model to the Data

To implement the counterfactual, we need the LBD elasticity ξ, the values of the subsidy shocks $\{\hat{\kappa}_{fj1}\}$, the long-run productivity shocks in the observed equilibrium $\{\hat{A}^L_{fj2}\}$, the sectoral constraint tightness $\{\lambda_{j1}\}$, the long-run foreign demand and import price shocks $\{\hat{P}^{F,L}_{jt}\}$ and $\{\hat{D}^{F,L}_{jt}\}$, and the structural parameters β, σ, and ρ. Because each firm is an object in the model, we also need the firm-specific market shares in the initial equilibrium, which we take directly from the data. Table 6 summarizes the calibration.

The LBD parameter Using the short-run and long-run econometric estimates of (3.1), we back out the key parameter of the model: the LBD elasticity ξ. Log first period firm sales are (see 5.2):

$$\ln X_{fj1} = -\frac{\sigma - 1}{\sigma}\ln \kappa_{fj1} + \tilde{\delta}_{j1} + (\sigma - 1)\ln \phi_{fj1} \tag{5.5}$$

where $\tilde{\delta}_{j1}$ absorbs industry common components. We assume that the subsidy κ_{fj1} takes the following form:

$$\kappa_{fj1} = exp\big(-\eta \times \text{asinh}(Credit_{fj1})\big). \tag{5.6}$$

Combining (5.5) and (5.6) we derive the following estimable short-run regression model:

$$\ln X_{fj1} = \underbrace{\beta^S_1}_{=\frac{\sigma-1}{\sigma}\eta} \times \text{asinh}(Credit_{fj1}) + \delta_{n1} + \delta_{j1} + (\sigma - 1)\ln \phi_{fj1}, \tag{5.7}$$

Table 6: Calibration

Param.	Value	Description	Moment	Source
Intertemporal Discount Factor				
β	1.62	Permanent Δproductivity		
β	0.90	Temporary Δproductivity		
Elasticities				
η	0.12	Effective subsidy from credit	IV Estimates	Data
ξ	1.05	Learning-by-doing	IV Estimates	Data
σ	3	Elast. of subst. varieties		Broda and Weinstein (2006)
ρ	2	Elast. of subst. Home vs. Foreign		Boehm et al. (2020)
Shocks				
λ_{j1}		Financial frictions	IV Estimates	Data
$\{\hat{\kappa}^S_{f1}\}$		Subsidy shocks	IV Estimates	Data
$\{\hat{A}^L_{fj2}\}$		Long-run productivity shocks	Sales, PPI	Data, OECD STAN
$\{\hat{D}^{F,L}_{j2}\}$		Long-run Foreign demand shocks	Exports	IO table
$\{\hat{P}^{F,L}_{j2}\}$		Long-run Foreign import price shocks	Import shares	IO table
Production & Consumption				
$\{\alpha^j\}$		Final consumption shares	IO table	IO table
$\{\gamma^H_j, \gamma^k_j\}$		Labor & intermediate shares	IO table	IO table

Notes. The table summarizes the calibrated values used for the quantitative analysis.

where any region or sector common variables are absorbed by region-time fixed effects δ_{n1} and sector-time fixed effects δ_{j1}.[27] Unobservable firm productivity in the first period $\ln \phi_{fj1}$ orthogonalized with respect to the fixed effects and other controls is a structural residual. Time-differencing, we can derive the short-run regression model as in Equation (3.1).[28] With the estimated $\hat{\beta}^S_1$ and a value of σ, we can obtain a value of η that connects the credit observed in the data to the subsidy rate in the model.

Second period firm sales can be written as:

$$\ln X_{fj2} = (\sigma - 1)\xi \ln \kappa_{fj1} + \delta_{n2} + \delta_{j2} + \sigma \ln \phi_{fj1} + (\sigma - 1) \ln \phi_{fj2}, \tag{5.8}$$

[27] Sector-time fixed effects absorb variables that are common within a sector: sectoral constraint $\frac{\sigma-1}{\sigma} \ln \lambda_{j1}$, costs of input bundles c_{j1}, and market size $(P^H_{j1})^{\sigma-1} X_{j1}$. Although regions are not explicitly modeled in our quantitative framework, δ_{n1} absorbs factors that are common within region.

[28] Strictly speaking, of course, the model only has one first period. To take the short-run time difference inside the model, we can think of period 1 as consisting of several sub-periods identical in every way except for credit given to firms, such that we can take the time difference in sales and credit between the later and the earlier sub-periods.

where δ_{n2} and δ_{j2} are region and industry common components.[29] Because of LBD, subsidies κ_{fj1} and exogenous productivity in the first period $\ln \phi_{fj1}$ appear in the second period sales. Substituting (5.6) into (5.8) yields the following estimable regression model:

$$\ln X_{fj2} = \underbrace{\beta_1^L}_{=(\sigma-1)\xi\eta} \times \text{asinh}(Credit_{fj1}) + \delta_{n2} + \delta_{j2} + \sigma \ln \phi_{fj1} + (\sigma - 1) \ln \phi_{fj2}, \tag{5.9}$$

where region and sector fixed effects capture similar objects as in Equation (5.7). Subtracting initial period sales from both sides yields the long-run regression specification (3.1). Since firm sales are proportional to firm productivity, initial sales also control for the initial productivity $\ln \phi_{fj1}$. Combining the short-run and long-run estimates from (5.7) and (5.9) and a value of σ, we can obtain a value of ξ as follows:

$$\sigma\xi = \frac{\beta_1^L}{\beta_1^S} \iff \xi = \frac{1}{\sigma}\frac{\beta_1^L}{\beta_1^S}. \tag{5.10}$$

Thus, we can infer the LBD parameter ξ from the ratio of the long-run to the short-run responses of firm sales to a subsidy. Intuitively, the short-run regression coefficients in Table 3 pick up the mechanical effect of subsidies on output: giving money to firms to produce naturally increases their sales. The short-run estimates are useful for translating the amount of credit firms received into the effective subsidy rate in the model κ_{fj1}, pinning down η in (5.6). Then, the long-run coefficients in Table 4 contain information on the strength of LBD, as they compare the post-subsidy sales of subsidized and non-subsidized firms.

The ratio β_1^L/β_1^S is about 3. A common elasticity of substitution σ of 3 (Broda and Weinstein, 2006) yields a value of $\xi \approx 1$. This is at the high end, but within range, of previous estimates. For instance, Irwin and Klenow (1994) report values of 0.3–0.5 for the semiconductor industry in the US and Japan, Benkard (2000) of 0.5–1.0 for US passenger aircraft, Thompson (2001) of 0.3–0.5 for US WWII shipbuilding, and Levitt et al. (2013) of 0.3 for US auto assembly. It is sensible that our value is at the high end of this range. First, all of these studies are based on a substantially shorter time horizon. At the extreme, Levitt et al. (2013) work with a single year of data, and their estimate of 0.3 is of the *daily* speed of learning. Second, the above studies consider industries at the technological frontier and located in the most advanced economies. In the 1970s South Korea was a developing country well inside the world productivity frontier, which we conjecture would have made learning easier. Thus, we view our implied values of ξ to be broadly consistent with existing evidence.

Subsidies and financial constraints Given the value of η backed out from the short-run estimates, the firm-specific subsidies κ_{fj1} are obtained from (5.6). We winsorize the 5% highest subsidy

[29] δ_{j2} is proportional to $\prod_{h=0}^{1}\left[\left(\frac{\sigma}{(\sigma-1)}c_{j,t-2}\right)^{(1-\sigma)(\sigma\xi)^h} \times ((P_{j,2-h}^H)^{\sigma-1}X_{j,2-h})^{(\xi(\sigma-1))^h}\right]$.

rates to make the results robust to outliers.[30]

The degree of sectoral financial frictions λ_{j1} is set to:

$$\lambda_{j1} = \min_{f \in \mathcal{F}_j} \{\kappa_{fj1}\},$$

which ensures that even the firm that received the largest subsidy rate (or the lowest input cost) still charges the static profit maximizing price and cannot optimally increase output to take advantage of LBD. We view this as a conservative value, because even lower values of λ_{j1} would imply firms are more constrained and therefore experience larger gains from the industrial policy. Also, this assumption simplifies the counterfactual hat algebra, as it removes the forward-looking component from the $t = 1$ firm decisions. When all firms are constrained, they do not set prices to maximize the profits from future LBD-driven productivity. If firm price-setting decisions at $t = 1$ were instead forward-looking, we would have to find a fixed point between all the firms' $t = 1$ pricing decisions and the $t = 2$ equilibrium, and thus the short-run hat algebra would not be separable from the long-run hat algebra.

Calibration of the remaining parameters and data inputs Firm market shares π_{fj1} are calculated as follows. We directly observe the 1982 firm-level sales in our main dataset. For some firms we impute missing sales using assets.[31] After summing the observed firm-level sales, we calculate the residual of the sectoral gross output by subtracting the sum of sales in the firm-level data from the gross output in the 1983 IO table. We treat the residual output as a separate firm. In this way, the model matches perfectly the output in each sector and time period. This procedure also implies that post-1982 firm entry is absorbed into the residual firm.[32] Firm-level shares are then obtained by dividing firm sales by the gross sectoral output from the IO table. Import shares π^F_{j1} and export values EX_{j1} are obtained from the 1983 IO table.

The long-run productivity changes, foreign demand shifters, and import price changes are jointly calibrated. The sales growth and changes in subsidies of firm f relative to a reference firm f_0 in the

[30] Our model quantification assumes that the subsidies κ_{fj1} entailed a direct fiscal cost (eq. 5.3). However, the actual policy was a government loan guarantee. The full fiscal cost of these government guarantees is not transparent. In some cases these guarantees entailed directly observable fiscal costs to the government. For example, the 1979 Second Oil Crisis created difficulties for some of the treated firms, and in 1981 the Bank of Korea had to set up a special fund in the amount of 1899 billion Korean Won ($688.5mln 2015 USD) for bailing out these firms (The National Archives of Korea, 1981, p. 78). More broadly, these government guarantees could have entailed other costs that would not be easy to quantify, such as increased sovereign spreads. Our approach of assuming the full taxpayer-borne cost of these subsidies is conservative. To the extent the guarantees did not entail the full fiscal cost, the welfare gains from these policies are even higher than what we report below.

[31] There are some firms without information on sales, but all firms have information on assets. Appendix C.5 describes the imputation procedure in detail.

[32] In the quantitative analysis, the total number of firms in each sector is the total number of firms in the firm-level data that were operating in 1982 plus 1. The residuals are the sum of sales of small-sized firms that are not in our dataset.

same sector gives us the relative long-run factual productivity changes:

$$\frac{\hat{A}^L_{fj2}}{\hat{A}^L_{f_0j2}} = \left(\frac{\widehat{X}^L_{fj2}}{\widehat{X}^L_{f_0j2}}\right)^{\frac{1}{\sigma-1}} \left(\frac{\widehat{\kappa}^L_{fj2}}{\widehat{\kappa}^L_{f_0j2}}\right)^{\frac{1}{\sigma}}, \tag{5.11}$$

where the firm-level sales X_{fjt} come from the data and the baseline subsidies κ_{fjt} are backed out above. Then, we pin down the long-run productivity growth of the reference firm $\hat{A}^L_{f_0j2}$, the foreign demand $\hat{D}^{F,L}_{j2}$, and the import price changes $\hat{P}^{F,L}_{j2}$ by matching the changes in the producer price index, the export values, and the import shares exactly to the data between 1982 and 2010. See Appendix C.7 for more detail.

The model has 2 periods, so we must take some care to set an appropriate value of β between the first and the second period. The first period corresponds roughly to the decade between 1973 and 1982. The second period is the future. In order to discount the future to the present, we must take a stand on how quickly the LBD benefits materialize, and how long they last. The LBD benefits appear to build slowly (Appendix Figure B2), and our regression estimates reflect the total productivity increment after about 30 years. To be conservative, we assume that the productivity benefits accrue 15 years into the future. Then, we make two alternative assumptions on how long the productivity benefits last. The first is that they are permanent. Assuming an annual discount rate of 0.96, the decadal discount rate is $0.96^{10} = 0.66$. If the productivity increase comes 15 years into the future and is permanent, then $\beta = 0.66^{1.5}/(1 - 0.66) = 1.62$. Alternatively, to be even more conservative we assume that the productivity benefit starts 15 years in the future and persists for only one more decade. This would be the case, for example, if there is some forgetting, or if the technologies about which LBD took place become obsolete. In that case, $\beta = 0.66^{1.5} + 0.66^{2.5} = 0.90$.

Finally, we set the elasticities of substitution σ and ρ to 3 and 2 following Broda and Weinstein (2006) and Boehm et al. (2020), respectively.

5.4 Welfare Results

We compute the welfare change in the counterfactual world in which the Korean government did not conduct the industrial policy ($\kappa_{c,fj1} = 1$ for all firms). Table 7 reports the results. When there is no subsidy in the first period, and the productivity benefits of the policy are permanent, the overall welfare decreases by 21.32%. In this total, 1.67% is the short-run welfare decrease, and 19.65%, or about 92%, is the long-run welfare decrease. The short-run welfare changes come from exacerbated financial frictions in the first period, while the long-run welfare changes are due to lower second-period productivity as a result of less LBD. The industrial policy has quantitatively sizable impacts in the long run, consistent with the empirical finding that subsidies had persistent effects on firms' long-term performance. When we assume the productivity benefits are temporary, the short-run welfare

Table 7: Counterfactual: No Subsidy

Welfare change (%):	(1) Total	(2) Short-run	(3) Long-run
Productivity change:			
Permanent ($\beta = 1.62$)	−21.32	−1.67	−19.65
Temporary ($\beta = 0.90$)	−12.59	−1.67	−10.92

Notes. The table reports the welfare effects under the counterfactual in which the Korean government did not conduct the industrial policy.

impact is unchanged, but the long-run welfare decrease is 10.92%. Still, the long run accounts for 87% of the total 12.59% welfare impact.

The welfare analysis above uses actual subsidies received by each firm. Our instrument varies at the sector-region level, and variation in actual subsidy takeup across firms within a sector-region is endogenous. While by construction the counterfactual in which the HCI Drive never happened and no one receives a subsidy is still well-conceived, an interesting question is what would have happened if there was no endogeneity in who received the subsidy. Do get a sense of this, we perform an alternative counterfactual in which we assume that subsidies were applied evenly to all firms within the same sector-region. This exercise mimics perfect exogenous assignment of subsidies to treated and non-treated region-sectors. We keep the total fiscal cost of the subsidy the same as in the baseline to keep the results comparable. Appendix C.9 describes the procedure in detail, and Appendix Table C1 reports the results. The welfare effects are similar but slightly larger under this alternative.

Appendix Table C2 reports the results under different values of substitution elasticities σ and ρ. Both the short- and the long-run gains from the subsidies decrease in σ and increase in ρ. Since the LBD parameter is identified up to the value of σ, changing σ also entails a change in ξ (see eq. 5.10). Higher σ implies lower values of ξ, and thus leads to lower long-run productivity benefits of subsidies. With higher ρ, the positive terms of trade effects of removing subsidies and of lower productivity are weaker, and thus it is more costly for the Home country to have low domestic production in the short run (due to removing subsidies) and in the long run (through lower productivity).

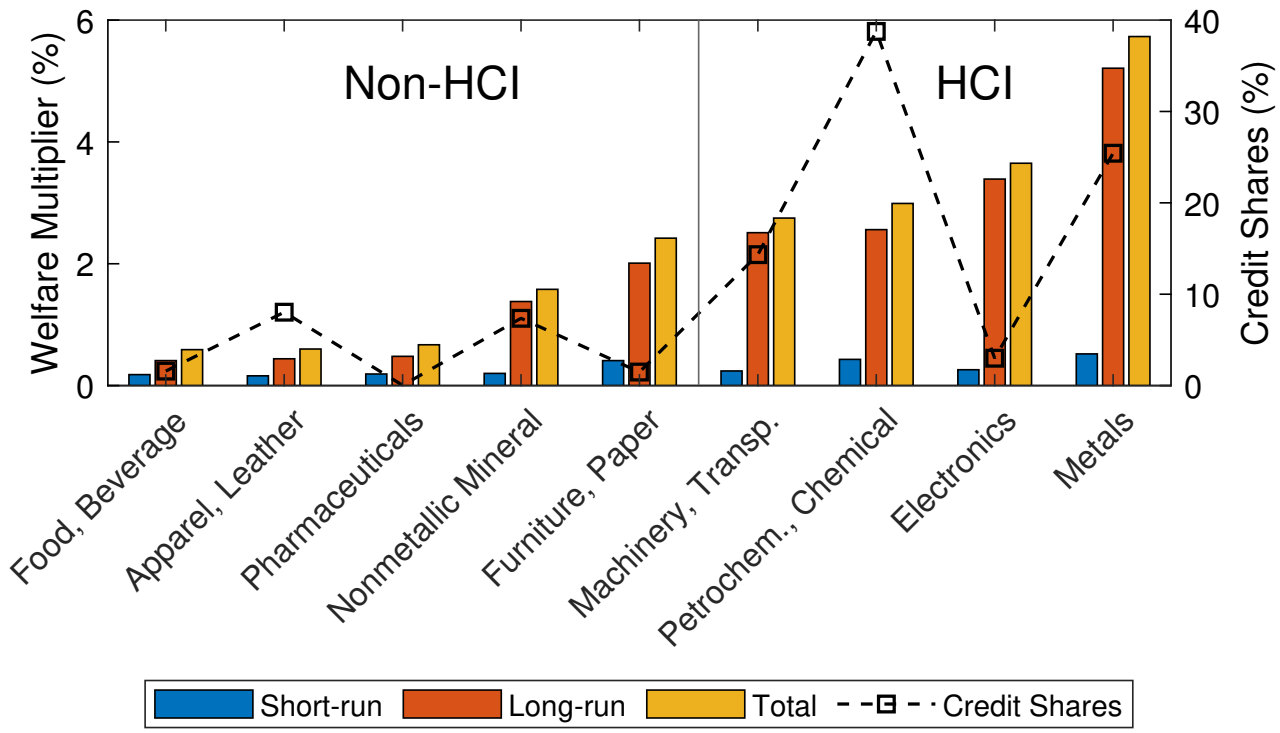
Distortionary taxation The baseline model assumes that the government levies a lump-sum tax to raise money for subsidies. However, it could be that the government only has access to distortionary tax instruments. In that case, in an attempt to fix one distortion, the policymaker would have to exacerbate another. To capture this possibility, we extend the model to allow for variable labor supply and a tax levied on labor income instead of lump-sum. The combination of these two assumptions makes taxation distortionary: taxing labor income discourages workers from supplying labor. The details of the model are laid out in Appendix C.11, and the welfare results are reported in Appendix Table C3. Indeed, in the short run introducing distortionary taxation leads to smaller real consumption gains from the subsidy. But the long-run benefits are similar to the baseline. There are two opposing effects of introducing flexible labor supply and distortionary taxation. On the one hand when taxes discourage labor, the subsidy increases output by less in the short run, the LBD effects are weaker, and thus the $t = 2$ productivity is lower. On the other hand, at $t = 2$ a given increase in productivity leads to higher output when labor is flexible. These two effects appear to largely cancel out.

Were the right sectors targeted? The central objective of our quantitative exercise is to evaluate the welfare effects of the actual industrial policy undertaken by South Korea. A related and equally important question is what would have been the optimal industrial policy? A full treatment of this question would require more theoretical structure and data than we currently have. On the theory side, we would need to be precise on potential non-linearities in the effects of the subsidies, in order to establish at which subsidy levels the costs begin to outweigh the benefits. We do not have the data to impose sufficient discipline on these non-linearities. In addition, for a credible treatment of optimal subsidies it would be desirable to pin sector-specific LBD parameters as well as sector-specific σ's, since our estimation procedure does not pin down ξ separately from σ. Estimating both by sector is challenging, and we do not have sufficient data to do it in our setting. Thus, tackling the optimality of industrial policy remains a fruitful avenue for future research (for some recent work on this, see, e.g. Liu, 2019; Bartelme et al., 2020).

Nonetheless, we can answer a more limited question, namely, did the actual policy appear to target broadly the right sectors? To do this we apply the same subsidy, in the amount of 1% of the initial South Korean GDP, one-by-one to each of the manufacturing sectors and compute the resulting welfare change. We assume that all firms in the sector receive the same subsidy. This exercise in effect computes sector-specific "welfare multipliers" of the industrial policy. Figure 3 plots the short-run, long-run, and total welfare benefits from subsidizing each sector sorted in ascending order of the multiplier. We also display the share of the aggregate credit received by each sector. Appendix Table C4 reports the numbers.

Remarkably, it appears that along the sectoral dimension the Korean industrial policy got it broadly

Figure 3. Welfare Multiplier across Sectors



Notes. This figure plots the changes in welfare in the short run (blue bars), long run (red bars), and in total (orange bars) from giving each sector a subsidy in the amount of 1% of the initial GDP (left axis), and the share of the aggregate credit received by each sector (dashed line, right axis).

right. The HCI sectors have strictly larger welfare multipliers than the non-HCI sectors, and the welfare multiplier is correlated with actual credit, albeit imperfectly. In our parsimonious model all sectors, including non-HCI, have the same LBD parameter ξ and substitution elasticities σ and ρ. Thus, the sectoral heterogeneity in the welfare multiplier is driven by the position of these sectors in the input network, a notion explored in detail by Liu (2019).

6 Conclusion

This paper estimates the effects of South Korea's 1973-79 HCI Drive on firms' long-term performance. We show that subsidized credit distributed to firms had a persistent positive impact on firm sales, that is evident as much as 30 years after the subsidies themselves stopped. To rationalize this empirical finding and quantify its importance, we build a quantitative heterogeneous firm framework with learning-by-doing and financial frictions. In this environment, if the industrial policy had not been implemented, South Korea's welfare would have been noticeably lower.

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ONLINE APPENDIX

(NOT FOR PUBLICATION)

Appendix A Data

A.1 Data Construction

Foreign credit Information on foreign credit allocated by the government was hand-collected and digitized from the national historical archives. Key variables are the total amount borrowed, interest rate, and repayment period for each financial contract.

Figures A1, A2, and A3 display the examples of the financial contract documents of Hyundai International Inc., which borrowed from seven foreign banks or companies.[33] Hyundai International Inc. borrowed $44M at interest rate 8.375%. Figure A3 is the first page of the formal contract document between Hyundai International Inc. and the foreign banks. Importantly, it shows that the Korea Development Bank, the state-owned policy development bank that was in charge of financing industrial policies conducted by the government, guaranteed the repayment of this contract.

Firm balance sheets For the sample period between 1970 and 1982, firm balance sheet data are digitized from the historical Annual Report of Korean Companies published by the Korea Productivity Center. The annual reports have information on assets, capital, employment, export, fixed assets, and sales. For the sample between 1980 and 2011, firm balance sheet data comes from KIS-VALUE. The two separate datasets are then merged based on firm names.

The coverage of the Annual Report of Korean Companies is broader than KIS-VALUE. KIS-VALUE covers firms with assets above 3 billion Korean Won. In contrast, the Annual Report of Korean Companies (1973-1983) covers firms with capital larger than 50 million Korean Won, including more small and medium-sized firms. Therefore, in the main dataset, we restrict our sample to the firms appearing in both KIS-VALUE and Annual Report of Korean Companies.

Foreign credit data and firm-balance sheet data are merged based on firm names.

Input-Output table Input-Output tables are obtained from the Bank of Korea. Based on the descriptions of the products, we convert the reported codes into ISIC Rev.3. From the Input-Output table, we obtain value-added shares and intermediate input shares.

Trade and import tariffs Trade data between 1972 and 2000 come from Feenstra et al. (2005), which reports it in the 4-digit Standard International Trade Classification (SITC) classification. We convert SITC into ISIC Rev 3. Import tariffs data are digitized from Luedde-Neurath (1986). These come in the Customs Co-operation Council Nomenclature (CCCN). We convert CCCN into 4-digit

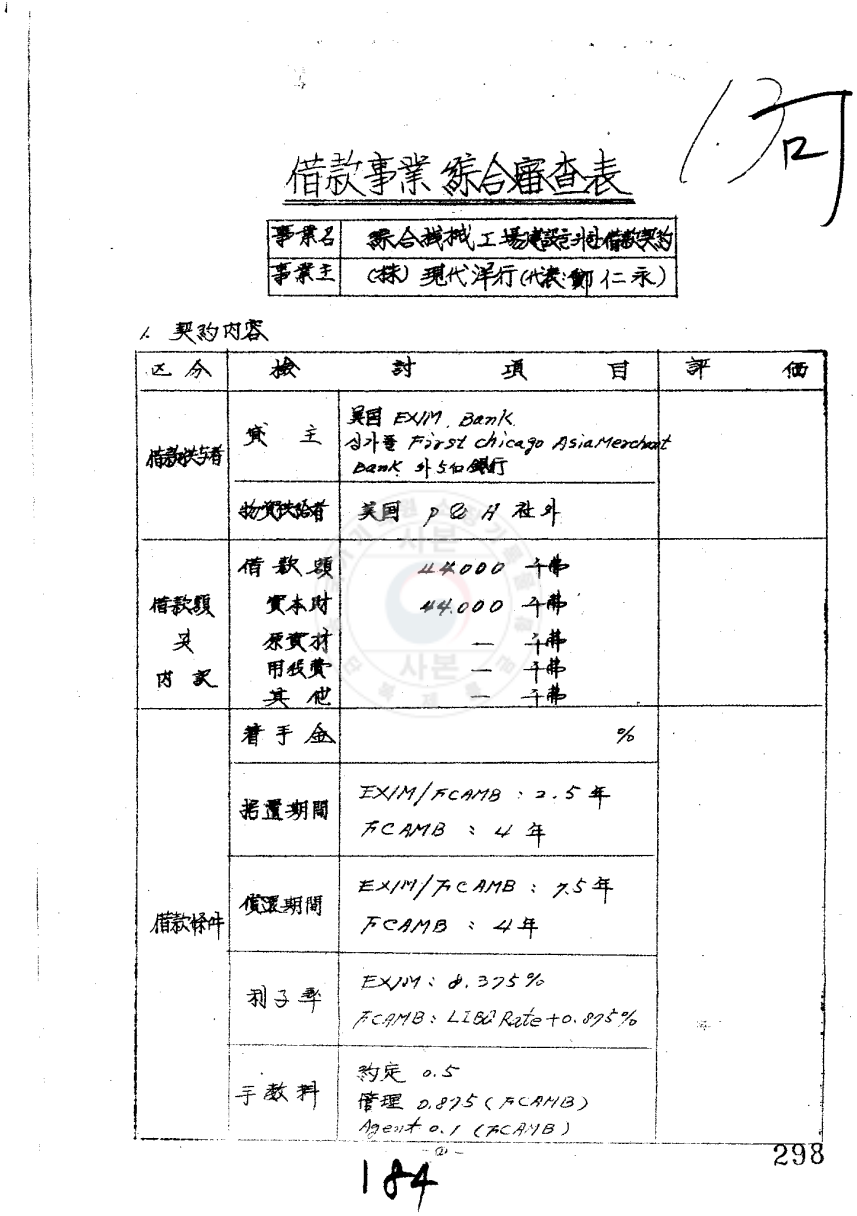
[33] These were First Chicago Hong Kong Ltd., Bank Bumiputra Malaysia Berhad, Credit Lyonnais Hong Kong (Finance) Ltd., Nippon Credit International (HK) Ltd., Toronto Dominion Investments (HK) Ltd., Export-Import Bank of the United States (EXIM), and First Chicago Asia Merchant Bank Ltd..

ISIC Rev 3. The average import tariffs are obtained as the averaged import tariffs across 4-digit ISIC sectors, weighted by import values.

A.2 List of Chaebol Groups (English and Corresponding Korean Names)

Geumho (금호), Kia (기아), Daerim (대림), Daewoo (대우), Taihan Electric Wire (대한전선), Daehan Shipbuilding (대한조선), Dongbu (동부), Dong Ah (동아), Doosan (두산), Lucky (럭키), Lotte (롯데), Miwon (미원), Sammi (삼미), Samsung (삼성), Samhwan (삼환), Sunkyung (선경), Shindongah (신동아), Ssangyong (쌍용), Jinyang (진양), Kolon (코오롱), Taekwang (태광), Hanwha (한국화약), Hanbo (한보주택), Hanyang (한양주택), Hanil Synthetic Fiber (한일합섬), Hanjin (한진), Hyundai (현대), Hyosung (효성).

Figure A1. An Example of a Financial Contract Digitized from the Historical Archive



借款事業綜合審查表

事業名	綜合機械工場建設所用借款契約
事業主	(株) 現代洋行(代表: 鄭仁永)

1. 契約內容

区分	検討項目		評価
借款契約者	貸主	美国 EXIM, Bank 싱가폴 First Chicago AsiaMerchant Bank 外5社銀行	
	物資供給者	美国 PQH 社外	
借款額及内訳	借款額	44000 千弗	
	資本財	44.000 千弗	
	原資材	— 千弗	
	用役費	— 千弗	
	其他	— 千弗	
借款條件	着手金	%	
	据置期間	EXIM/FCAMB : 2.5年 FCAMB : 4年	
	償還期間	EXIM/FCAMB : 7.5年 FCAMB : 4年	
	利子率	EXIM : 8.375% FCAMB : LIBO Rate+0.875%	
	手数料	約定 0.5 管理 0.875 (FCAMB) Agent 0.1 (FCAMB)	

298

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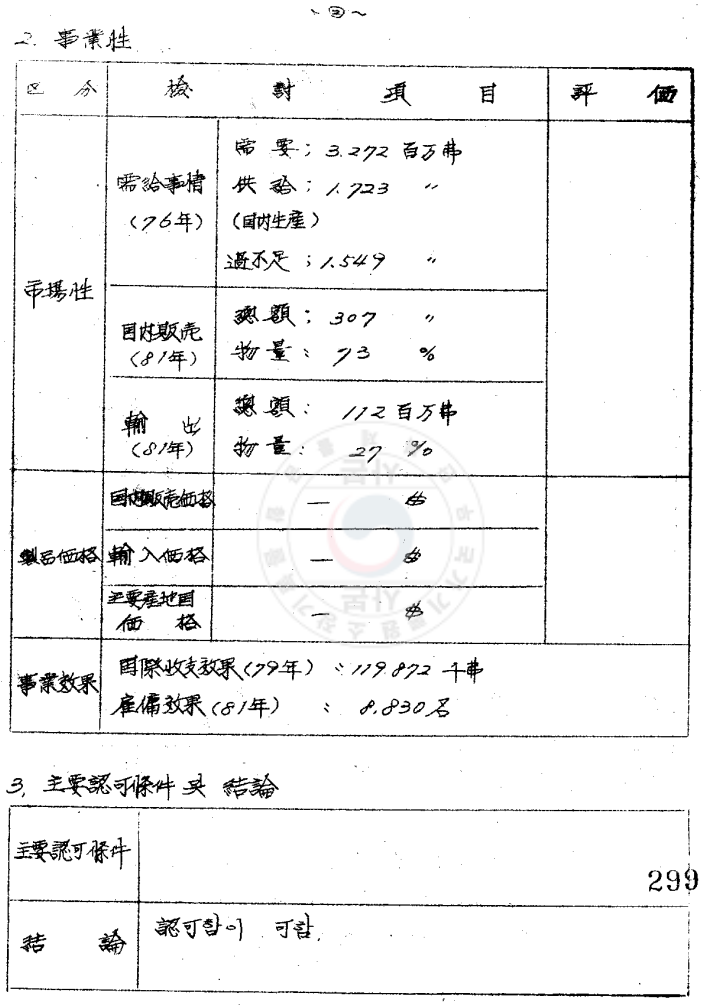
Figure A2. An Example of a Financial Contract Digitized from the Historical Archive-cont'd



-3-

2. 事業性

区分	検討項目		評価
市場性	需給事情（76年）	需要；3.272 百万㌧ 供給；1.723 〃 （国内生産） 過不足；1.549 〃	
	国内販売（81年）	総額；307 〃 物量；73 %	
	輸出（81年）	総額；112 百万㌦ 物量；27 %	
製品価格	国内販売価格	— ㌦	
	輸入価格	— ㌦	
	主要産地国価格	— ㌦	
事業効果	国際収支効果（79年）；119.872 千㌦ 雇傭効果（81年）；8.830名		

3. 主要認可條件 및 結論

主要認可條件	
結論	認可함이 可함.

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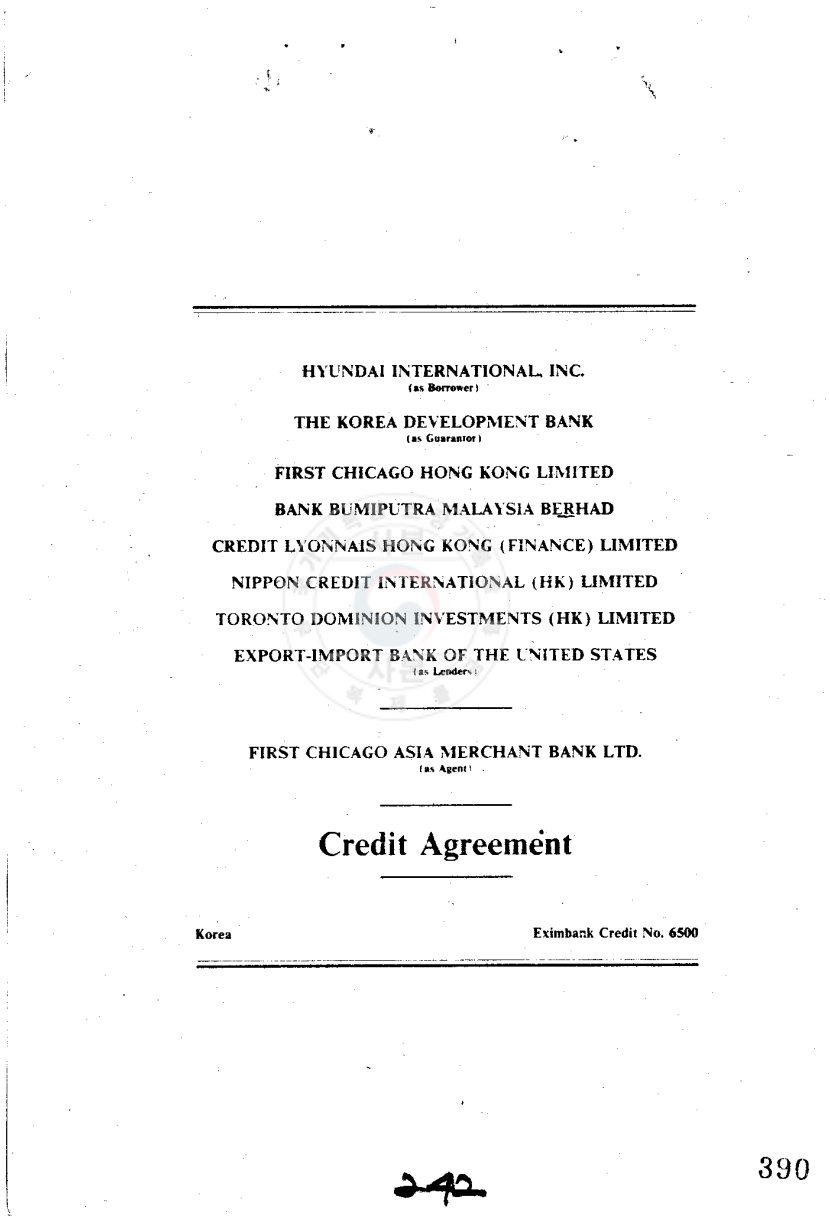
Figure A3. An Example of a Financial Contract Digitized from the Historical Archive-cont'd



HYUNDAI INTERNATIONAL, INC.
(as Borrower)

THE KOREA DEVELOPMENT BANK
(as Guarantor)

FIRST CHICAGO HONG KONG LIMITED

BANK BUMIPUTRA MALAYSIA BERHAD

CREDIT LYONNAIS HONG KONG (FINANCE) LIMITED

NIPPON CREDIT INTERNATIONAL (HK) LIMITED

TORONTO DOMINION INVESTMENTS (HK) LIMITED

EXPORT-IMPORT BANK OF THE UNITED STATES
(as Lenders)

FIRST CHICAGO ASIA MERCHANT BANK LTD.
(as Agent)

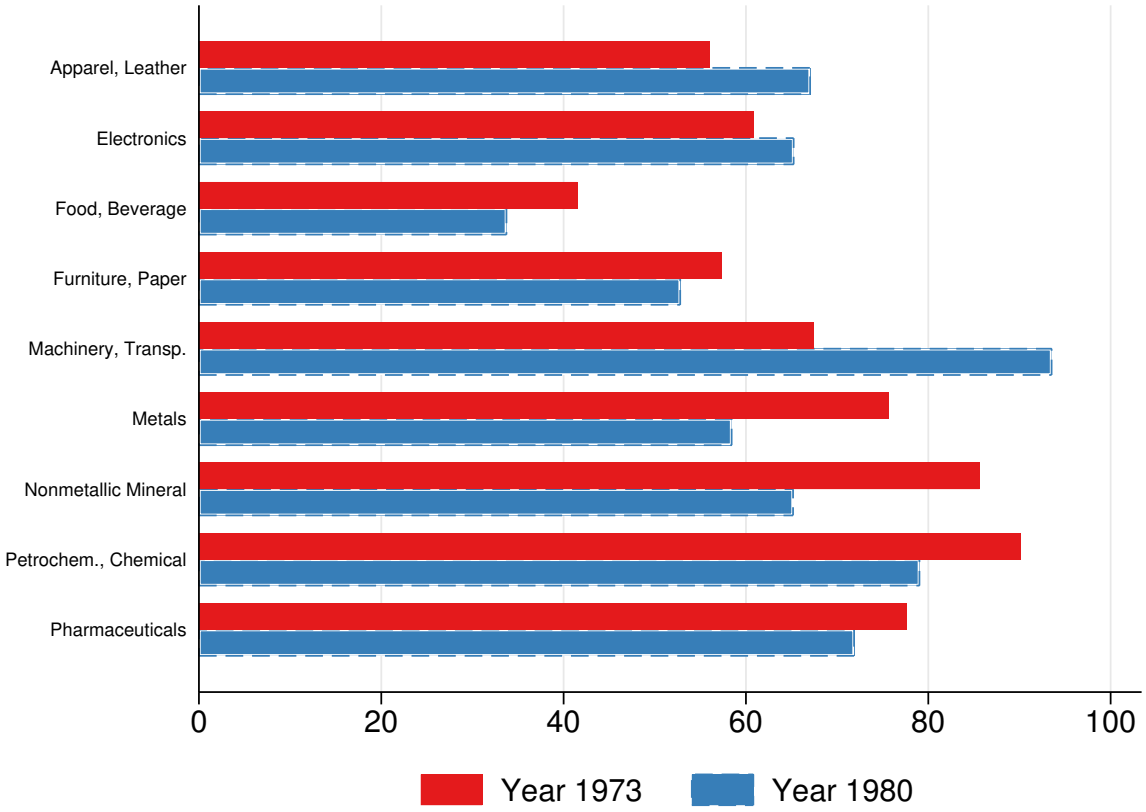
Credit Agreement

Korea — Eximbank Credit No. 6500

242

390

Figure A4. Coverage of the Dataset (%)



Notes. This figure depicts the fraction of total sales in each sector that is covered by the firms in the dataset. Total sales in each sector come from the Input-Output tables.

Table A1: Sector Classification

HCI	Aggregated Industry	Industry
HCI	Chemicals, Petrochemicals, and Rubber and Plastic Products	Coke oven products (231) Refined petroleum products (232) Basic chemicals (241) Other chemical products (242) Man-made fibres (243) except for pharmaceuticals and medicine chemicals (2423) Rubber products (251) Plastic products (252)
	Electrical Equipment	Office, accounting and computing machinery (30) Electrical machinery and apparatus n.e.c. (31) Ratio, television and communication equipment and apparatus (32) Medical, precision, and optical instruments, watches and clocks (33)
	Basic and Fabricated Metals	Basic metals (27) Fabricated metals (28)
	Machinery and Transport Equipment	Machinery and equipment n.e.c. (29) Motor vehicles, trailers and semi trailers (34) Building and repairing of ships and boats (351) Railway and tramway locomotives and rolling stock (352) Aircraft and spacecraft (353) Transport equipment n.e.c. (359)
Non-HCI	Food, Beverages, and Tobacco	Food products and beverages (15) Tobacco products (16)
	Textiles, Apparel, Leather	Textiles (17) Apparel (18) Leather, luggage, handbags, saddlery, harness, and footwear (19) Manufacturing n.e.c. (369)
	Wood, Paper, Printing, and Furniture	Wood and of products, cork (20) Paper and paper products (21) Publishing and printing (22) Furniture (361)
	Pharmaceuticals and Medicine Chemicals	pharmaceuticals and medicine chemicals (2423)
	Other Non-Metallic Mineral Products	Glass and glass products (261) Non-metallic mineral products n.e.c. (269)

Table A2: Targeted Regions

Region name	Specialized Sectors	Start Year of Industrial Complex
Busan	Rubber, Shipbuilding	No industrial complex
Changwon, Jinhae	Machinery	1975
Guje (Jukdo, Okpo)	Shipbuilding	1974
Gumi	Electronics	1973
Masan	Synthetic fibre	1970
Pohang	Metals, Steel	1967
Ulsan	Chemicals, Motor Vehicles, Petrochemicals, and Shipbuilding	1962
Yeosu, Yeocheon	Chemicals, Petrochemicals	1967

Appendix B Estimation Results Appendix

B.1 Baseline First Stage

Table B1: First Stage. Short-Run Effects of Subsidies on Firms' Sales Growth

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:			asinh($Credit_f$)			
IV	5.30***	5.26***	5.44***	5.30***	5.33***	5.25***
	(1.11)	(1.04)	(1.12)	(1.12)	(1.10)	(1.06)
$\ln(Sales_{ft_0})$	1.24***	1.04***	1.25***	1.24***	1.24***	1.08***
	(0.19)	(0.21)	(0.19)	(0.19)	(0.19)	(0.20)
$Chaebol_f$		3.97*				3.94**
		(2.01)				(1.93)
$\triangle Export\ Demand_j \times Port_n$			0.51			0.21
			(0.43)			(0.44)
$\triangle \ln(Import\ Tariff_j) \times Port_n$				−0.07		77.92*
				(9.14)		(46.39)
$\triangle \ln(Input\ Tariff_j) \times Port_n$					−13.70	−170.63*
					(16.34)	(86.11)
Adj. R^2	0.26	0.29	0.26	0.26	0.26	0.30
Num. Clusters	55	55	55	55	55	55
N	762	762	762	762	762	762

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the first stage results of the short-run IV regression (3.1). The dependent variable is the inverse hyperbolic sine transformation of credit as in (3.2). The IV is defined in (3.3). Chaebol is a dummy variable that equals one if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in Equation (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in Equation (4.1). $\ln(Sales_{t_0})$ is log of initial sales in 1972 or 1973. All specifications include region and sector fixed effects.

Table B2: First Stage. Long-Run Effects of Subsidies on Firms' Sales Growth

Dep. Var.:	asinh($Credit$)					
	(1)	(2)	(3)	(4)	(5)	(6)
IV	2.61***	2.76***	2.93***	2.68***	2.73***	2.91***
	(0.77)	(0.82)	(0.71)	(0.71)	(0.71)	(0.71)
$\ln(Sales_{t_0})$	1.90***	1.59***	1.91***	1.90***	1.90***	1.58***
	(0.32)	(0.27)	(0.32)	(0.32)	(0.32)	(0.27)
$Chaebol_f$		4.56**				4.50**
		(2.24)				(2.21)
$\triangle Export\ Demand_j \times Port_n$			0.74			0.02
			(0.54)			(0.57)
$\triangle \ln(Import\ Tariff_j) \times Port_n$				−14.31**		37.15
				(6.22)		(51.91)
$\triangle \ln(Input\ Tariff_j) \times Port_n$					−38.89**	−106.69
					(16.01)	(111.57)
Adj. R^2	0.33	0.35	0.33	0.33	0.33	0.35
Num. Clusters	53	53	53	53	53	53
N	739	739	739	739	739	739

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the first stage results of the short-run IV regression (3.1). The dependent variable is the inverse hyperbolic sine transformation of credits defined in (3.2). The IV is defined in (3.3). $Chaebol_f$ is a dummy variable which equals one if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in Equation (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in Equation (4.1). $\ln(Sales_{t_0})$ is log of initial sales in 1981 or 1982. All specifications include region and sector fixed effects.

B.2 Construction of the World Demand Control

Consider the following variable that captures changes in South Korea's export opportunities:

$$\frac{\triangle EX_{jt}^{KOR}}{GO_{j,1970}^{KOR}} \times Port_n, \tag{B.1}$$

where $Port_n$ is a dummy that equals one if a region has its own port, $\triangle EX_{jt}^{KOR}$ is the change in South Korea's sector j exports to the world between 1973 and 1979, and $GO_{j,1970}^{KOR}$ is sector j's gross output in 1970.[34] Changes of export intensity $\triangle EX_{jt}^{KOR}/GO_{j,1970}^{KOR}$ capture the world demand shocks for South Korea's sector j goods. The interaction term captures the possibly heterogeneous effect of the world demand shocks across regions with and without ports. However, $\triangle EX_{jt}^{KOR}$ contains not only world demand shocks but also South Korea's supply shock of sector j, which can be correlated with unobservable productivity shocks in the error term in Equation (3.1). Therefore, instead of using EX_{jt}^{KOR}, in Tables 3 and 4 we control for

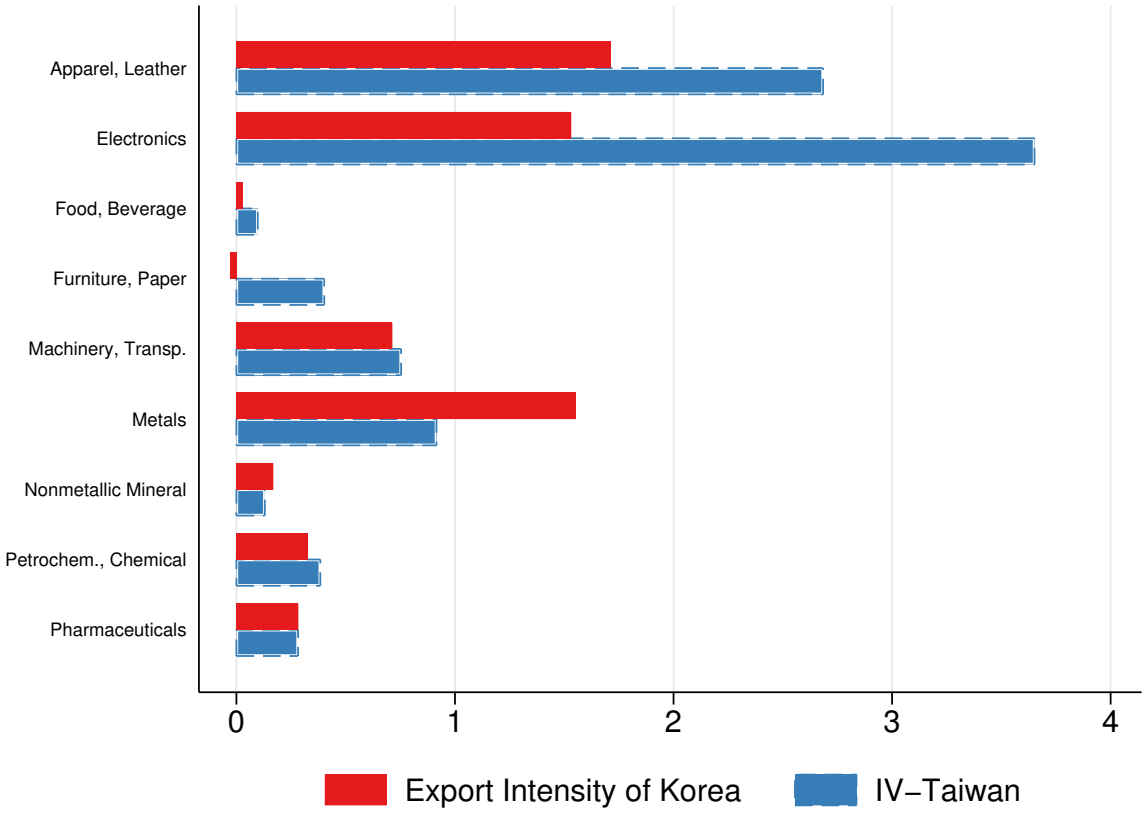
$$\frac{\triangle EX_{jt}^{TWN}}{GO_{j,1970}^{KOR}} \times Port_n, \tag{B.2}$$

where $\triangle EX_{jt}^{TWN}$ is the change in Taiwan's exports to the world other than Korea. This amounts to controlling for the exogenous component of (B.1) as a reduced form. Appendix Figure B1 graphically illustrates that changes in the export intensity of Korea $\triangle EX_{jt}^{KOR}/GO_{j,1970}^{KOR}$ and export intensity of Taiwan $\triangle EX_{jt}^{TWN}/GO_{j,1970}^{KOR}$ are highly correlated. The export shock (B.2) does not suffer from the endogeneity problem if Taiwan's supply shocks are uncorrelated with the error term in the second-stage regression.

Appendix Tables B3 and B4 report the IV estimates where (B.1) is the regressor instrumented with (B.2). In some specifications, the F-statistics are lower than 10, implying possibly weak instruments. However, the estimated coefficients are similar to those reported in Tables 3 and 4.

[34] Busan, Changwon, Guje, Goonsan, Incheon, Masan, Mokpo, Pohang, Ulsan, and Yeosu (Yeocheon) are defined to have a port.

Figure B1. Changes in Export Intensity of Korea and Export Intensity as Measured by Exports of Taiwan



Notes. The figure plots the log-difference in South Korea's export intensity (B.1) (red bar) and the instrumental variable for the log-difference in South Korea's export intensity (B.2) (blue bar).

Table B3: Robustness. Instrumenting Export Demand. Short-Run Effects of Subsidies on Firm Sales Growth

Dep. Var.:	$\triangle \ln Sales_f$: 1972-1981 and 1973-1982	
	(1)	(2)
asinh($Credit_f$)	0.18^{***}	0.18^{***}
	(0.04)	(0.04)
$\triangle Export\ Demand_j^{KOR} \times Port_n$	0.04	0.04
	(0.12)	(0.12)
$\ln(Sales_{ft_0})$	-0.70^{***}	-0.71^{***}
	(0.06)	(0.05)
$Chaebol_f$		0.12
		(0.46)
Region FE	Y	Y
Sector FE	Y	Y
KP-F	12.12	13.47
SW-$F1$	25.05	28.17
SW-$F2$	340.78	444.09
Num. Clusters	55	55
N	762	762

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the IV estimates of (3.1). The dependent variable is sales growth between 1972 and 1981 or between 1973 and 1982. asinh($Credit_f$) and $\triangle Export\ Demand_j^{KOR} \times Port_n$ are instrumented by IV's in (3.3) and (B.2), where $\triangle Export\ Demand_n^{KOR} \times Port_n$ is the interaction between the port dummies and the changes in the world demand for Korea's exports. $Chaebol_f$ is a dummy variable that equals one if a firm is affiliated with a top 30 Chaebol group. $\ln(Sales_{ft_0})$ is log of initial sales in 1972 or 1973. All specifications include region and sector fixed effects. KP-F is the Kleibergen-Paap F-statistics. SW-$F1$ and SW-$F2$ are Sanderson and Windmeijer (2016) F-statistics for asinh($Credit_f$) and $\triangle Export\ Demand_j^{KOR} \times Port_n$ respectively.

Table B4: Robustness. Instrumenting Exports Demand. Long-Run Effects of Subsidies on Firm Sales Growth

Dep. Var.:	$\triangle \ln Sales_f$: 1981-2009 and 1982-2010	
	(1)	(2)
asinh($Credit_f$)	0.58^{***}	0.56^{***}
	(0.17)	(0.17)
$\triangle Export\ Demand_j^{KOR} \times Port_n$	-0.50	-0.36
	(0.71)	(0.56)
$\ln(Sales_{ft_0})$	-1.23^{***}	-1.07^{***}
	(0.39)	(0.32)
$Chaebol_f$		-1.77
		(1.68)
Region FE	Y	Y
Sector FE	Y	Y
KP-F	7.04	7.05
SW-$F1$	14.62	14.71
SW-$F2$	16.67	28.78
Num. Clusters	53	53
N	739	739

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the IV estimates of (3.1). The dependent variable is sales growth between 1981 and 2009 or between 1982 and 2010. asinh($Credit_f$) and $\triangle Export\ Demand_j^{KOR} \times Port_n$ are instrumented by IV's in (3.3) and (B.2), where $\triangle Export\ Demand_j^{KOR} \times Port_n$ is the interaction between the port dummies and the changes in the world demand for Korea's exports. $Chaebol_f$ is a dummy variable that equals one if a firm is affiliated with a top 30 Chaebol group. $\ln(Sales_{ft_0})$ is log of initial sales in 1981 or 1982. All specifications include region and sector fixed effects. KP-F is the Kleibergen-Paap F-statistics. SW-$F1$ and SW-$F2$ are Sanderson and Windmeijer (2016) F-statistics for asinh($Credit_f$) and $\triangle Export\ Demand_j^{KOR} \times Port_n$ respectively.

B.3 Alternative Placebo Test

This section provides an alternative placebo test, based on data at the regional level. Using population census downloaded from Statistics Korea, we construct manufacturing shares of employment and regional population for each region in 1966, 1970, and 1985. We estimate the following specification:

$$\triangle \ln \text{Mfg. Emp. Share}_n = \beta_1 \text{asinh}(\text{HCI Credit}_n) + \beta_2 X_n + \epsilon_n \tag{B.3}$$

where $\triangle \ln \text{Mfg. Emp. Share}_n$ is growth of manufacturing employment shares between 1966 and 1970 and between 1970 and 1985. The right-hand side is the inverse hyperbolic sine transformation of the sum of credits of all HCI sector firms located in region n between 1973 and 1979:

$$\text{HCI Credit}_n = \sum_{f \in \mathcal{F}_{n,HCI}} \sum_{\tau=1973}^{1979} Credit_{f\tau},$$

where $\mathcal{F}_{n,HCI}$ is the set of HCI sector firms located in region n. X_n is a vector of additional controls. By taking the time difference, any time-invariant regional unobservables are differenced out. Robust standard errors are used for inference.

Under our exclusion restriction, we should expect that asinh(HCI Credit$_n$) is uncorrelated with the growth of manufacturing employment shares between 1966 and 1970. Suppose the Korean government predicted the productivity growth of HCI sectors in the targeted regions. In that case, our estimates may be driven by the productivity growth in the residual rather than by the effects of subsidies. If the productivity growth of HCI sectors is persistent, the change in the manufacturing employment share between 1966 and 1970 may be positively correlated with the sum of all credits of HCI sectors allocated between 1973 and 1979. One caveat of this dataset is that we only observe overall manufacturing shares but not employment shares of sub-sectors within the manufacturing sector. Given that the dependent variables are overall manufacturing share growth, if unobservable productivity of non-HCI sector evolved so that it exactly cancels out HCI sector productivity growth, then overall manufacturing shares may remain stable despite productivity growth of HCI sectors. However, setting knife-edge cases aside, as long as changes in unobservable productivity of HCI sectors affect regional manufacturing shares, the falsification test in (B.3) provides additional support for our identifying assumption.

The results are reported in Table B5. In columns 1 and 2, the dependent variables are manufacturing employment share growth between 1966 and 1970, and in columns 3 and 4, the dependent variables are manufacturing employment share growth between 1970 and 1985. In columns 2 and 4, we additionally control for the log of the total population of 1966. In columns 1 and 2, we find no

Table B5: Placebo Test at the Regional Level

Dep. Var.:	△ ln Mfg. Share: 1966-1970		△ ln Mfg. Share: 1970-1985	
	(1)	(2)	(3)	(4)
asinh(Regional HCI Loan)	0.01	0.01	0.03***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
log of population in 1966		−0.08		−0.17**
		(0.07)		(0.08)
N	61	61	61	61

Notes. Robust standard errors are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS estimates of Equation (B.3). In columns 1 and 2, the dependent variable is the log change in the regional manufacturing share between 1966 and 1970. In columns 3 and 4, the dependent variable is the log change in the regional manufacturing share between 1970 and 1985.

statistically significant correlation between total credit and manufacturing share growth, supporting our identifying assumption. By contrast, in columns 3 and 4, they are positively correlated, with the coefficient significant at the 5% level.

B.4 Markups

If the allocated credit systematically increased firms' markups, the long-term effects of credit on firms' sales may come from increased markups rather than increased productivity. In this subsection, we provide empirical evidence that is subsidized credit was not associated with higher markups. This evidence supports our interpretation of the long-term effects as due to LBD in our quantitative framework.

Following De Loecker and Warzynski (2012) and De Loecker et al. (2020), we use information on firms' inputs and output to measure firm-level markups based on the production function approach. This approach utilizes firms' minimization of variable input costs that can be freely adjusted each period. Consider firm f with the following production function:

$$Q_{ft} = Q_{ft}(A_{ft}, V_{ft}, K_{ft}),$$

where A_{ft} is productivity, V_{ft} are variable inputs such as labor or intermediate inputs that can be freely adjusted each period, and K_{ft} is the capital stock, which can only be adjusted with some lag. The Lagrangian of firm f's cost minimization problem is as follows:

$$\mathcal{L}(V_{ft}, K_{ft}, \lambda_{ft}) = P_{ft}^{V} V_{ft} + r_{ft} K_{ft} + \lambda_{ft}(Q_{ft}(A_{ft}, V_{ft}, K_{ft}) - \bar{Q}_{ft}),$$

where P_{ft}^{V} is the price of the variable input, r_{ft} is the user cost of capital, $\bar{Q}_{ft}$ is a scalar, and λ_{ft} is the Lagrange multiplier. The first-order condition with respect to V_{ft} is expressed as:

$$\frac{\partial \mathcal{L}_{ft}(\cdot)}{\partial V_{ft}} = P_{ft}^{V} - \lambda_{ft} \frac{\partial Q_{ft}(\cdot)}{\partial V_{ft}} = 0.$$

After multiplying both terms by V_{ft}/Q_{ft} and rearranging the terms, we can obtain that

$$\theta_{ft}^{V} \equiv \frac{\partial Q(\cdot)}{\partial V_{ft}} \frac{V_{ft}}{Q_{ft}} = \frac{1}{\lambda_{ft}} \frac{P_{ft}^{V} V_{ft}}{Q_{ft}},$$

where θ_{ft}^{V} is the output elasticity of the variable input. The Lagrange multiplier is a direct measure for the marginal cost c_{ft}. The markup is the ratio of the output price to the marginal cost: $\mu_{ft} \equiv P_{ft}/c_{ft}$. Then, rearranging the term yields

$$\mu_{ft} = \theta_{ft}^{V} \frac{P_{ft} Q_{ft}}{P_{ft}^{V} V_{ft}}.$$

Once we have the estimate of the output elasticity θ_{ft}^{V} and the revenue share of the variable input $\frac{P_{ft}Q_{ft}}{P_{ft}^{V}V_{ft}}$, we can calculate firm-level markups.

The structure of our firm-level data resembles Compustat. Therefore, we closely follow De Loecker et

al. (2020) for estimating θ^V_{ft} and calculating $\frac{P_{ft}Q_{ft}}{P^V_{ft}V_{ft}}$. Similar to Compustat, our dataset has information on sales, costs of goods sold (COGS), and fixed assets, but has a limitation that only a small number of firms report wage bills. Therefore, we use COGS as the variable input expenditure variable and fixed assets as a measure for capital stock.

For each sector, we assume the Cobb-Douglas production function:

$$y_{ft} = \theta^V v_{ft} + \theta^K k_{ft} + a_{ft} + \epsilon_{ft},$$

where lowercase letters denote logs, $y_{ft} \equiv \ln(Q_{ft} exp(\epsilon_{ft}))$ is measured output, and ϵ_{ft} is measurement error in output. There are two main concerns with estimating this production function. The first is simultaneity bias which arises from firms endogenously choosing their variable inputs based on their productivity unobservable to the econometrician. We deal with this problem using the control function approach. By inverting input demands, we can write a_{ft} as a function of firms' state variables and a control variable:

$$a_{ft} = w(h_{ft}, k_{ft}, z_{ft}),$$

where h_{ft} is a control variable, and z_{ft} captures input and output market factors that generate variation in factor market demands conditional on k_{ft} and a_{ft}. We use v_{ft} (COGS) as a static control: $h_{ft} = v_{ft}$.

Our estimation proceeds in two steps. In the first step, after plugging in the control function, we nonparametrically estimate the following function:

$$y_{ft} = \phi(\nu_{ft}, k_{ft}, z_{ft}) + \epsilon_{ft}.$$

From this step, we can soak out measurement error ϵ_{ft} and obtain $\hat{\phi}_{ft}$.

In the second step, we assume that the productivity follows first-order Markov process: $a_{ft} = g(a_{i,t-1}) + u_{ft}$ and that firms can adjust their variable inputs after observing a_{ft}, but capital stock cannot be adjusted contemporaneously. With the assumed productivity process and the timing structure, we can construct the following moment conditions:

$$\mathbb{E}_t\left(u_{ft}(\theta^V, \theta^K) \begin{bmatrix} v_{i,t-1} \\ k_{ft} \end{bmatrix} \right),$$

where u_{ft} is obtained by projecting $\hat{a}_{ft}$ on $\hat{a}_{ft-1}$. While projecting $\hat{a}_{ft}$ on $\hat{a}_{ft-1}$, we use polynomial expansion of $\hat{a}_{ft-1}$ up to the third order.

The second issue is that only firms' input expenditures and revenues are observed rather than physical quantities of input use and output. The use of revenues and expenditures induces bias due to

unobserved input and output prices and thus implies the following structural error term:

$$\omega_{ft} + p_{ft} - \theta^V P^V_{ft} - \theta^K r_{ft},$$

where P_{ft} is the price of the output, P^V_{ft} is the price of the variable input, and r_{ft} is the user cost of capital. P_{ft}, P^V_{ft}, and r_{ft} may vary across firms.

Following De Loecker et al. (2016) and De Loecker et al. (2020), we model the price wedge between the output and input prices as a function of demand shifters and productivity differences. The productivity differences are captured by the control function. We control for the demand shifters by controlling for market shares as z_{ft} in the first stage regression. De Loecker et al. (2016) shows that when the demand system is a nested logit, market shares are be an exact control conditional on productivity differences.

With the estimated $\hat{\theta}^V$ and $\hat{\theta}^K$, we compute markups as

$$\mu_{ft} = \theta^V \frac{exp(\ln(Sales_{ft} - \hat{\epsilon}_{ft}))}{\text{COGS}_{ft}},$$

where we adjust for the measurement error obtained from the first-stage regression as $\ln(Sales_{ft}) - \hat{\phi}(\nu_{ft}, k_{ft}, z_{ft})$. We trim the 1% tails of $\frac{exp(\ln(Sales_{ft} - \hat{\epsilon}_{ft}))}{\text{COGS}_{ft}}$ of each sector-year. The average of the estimated $\hat{\theta}^V$ across sectors is 0.84 and the mean of the estimated markups is 1.08. These numbers are comparable to 0.88 and 1.4–1.5 which are the average of the estimates of θ^V and markups from De Loecker et al. (2020) calculated based on the US Compustat data.

We estimate the long-run specification in Equation (3.1) using estimated markups as a new dependent variable. Table B6 reports the results. The estimated coefficients are statistically insignificant and close to zero across different specifications.

Table B6: Long-Run Effects of Subsidies on Firms' Markup Growth

Dep. Var.:	$\triangle \ln \text{Markup}_f$: 1981-2009 and 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	−0.001	−0.003		−0.003	−0.002	−0.003	−0.003	−0.002
	(0.001)	(0.005)		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
IV			−0.012					
			(0.019)					
$\ln(Sales_{ft_0})$	0.001	0.004	−0.001	0.005	0.003	0.004	0.004	0.003
	(0.007)	(0.011)	(0.006)	(0.009)	(0.010)	(0.011)	(0.010)	(0.008)
$Chaebol_f$				−0.002				−0.011
				(0.029)				(0.028)
$\triangle Export\ Demand_j \times Port_n$					0.012			0.017
					(0.015)			(0.011)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						−0.006		0.823
						(0.291)		(0.679)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							−0.224	−1.208
							(0.676)	(1.409)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		16.09		21.68	15.82	17.62	18.14	26.09
Adj. R^2	0.36		0.36					
Num. Clusters	46	46	46	46	46	46	46	46
N	467	467	467	467	467	467	467	467

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is changes in markups between 1981 and 2009 or between 1982 and 2010. Markups are estimated following the production approach developed by De Loecker and Warzynski (2012). The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8, where the IV is defined in Equation (3.3). In column 3, the reduced form estimates of the IV are reported. $Chaebol_f$ is a dummy variable that equals one if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand defined in Equation (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in Equation (4.1). Across all specifications, region and sector fixed effects and initial dependent variables are included. KP-F is the Kleibergen-Paap F-statistics.

B.5 Additional Robustness Tables

Table B7: Short-Run Effects of Subsidies on Firms' Export Status

Dep. Var.:	$\triangle\mathbb{1}[\text{Export}_{ft} > 0]$: 1972-1981 and 1973-1982							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.00	−0.01		−0.01	−0.01	−0.01	−0.01	−0.00
	(0.00)	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
IV			−0.05					
			(0.08)					
$\mathbb{1}[\text{Export}_{ft_0}]$	−0.88***	−0.85***	−0.87***	−0.85***	−0.85***	−0.85***	−0.85***	−0.86***
	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
$Chaebol_f$				−0.01				−0.02
				(0.09)				(0.09)
$\triangle Export\ Demand_j \times Port_n$					0.02			0.06
					(0.03)			(0.05)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						0.08		−2.97
						(0.50)		(1.99)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							0.49	8.80*
							(1.08)	(4.57)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		23.03		24.58	24.86	23.55	24.26	24.53
Adj. R^2	0.43		0.42					
Num. Clusters	55	55	55	55	55	55	55	55
N	787	787	787	787	787	787	787	787

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is the change in export status between 1972 and 1981 or between 1973 and 1982. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\mathbb{1}[\text{Export}_{ft_0}]$ is the initial export status in 1972 or 1973. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B8: Long-Run Effects of Subsidies on Firms' Export Status

Dep. Var.:	$\triangle \mathbb{1}[\text{Export}_{ft} > 0]$: 1981-2009 and 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.01***	0.07***		0.07***	0.06***	0.06***	0.06***	0.06***
	(0.00)	(0.02)		(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
IV			0.35***					
			(0.09)					
$\mathbb{1}[\text{Export}_{ft_0}]$	−0.91***	−0.93***	−0.90***	−0.94***	−0.93***	−0.93***	−0.93***	−0.93***
	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)
$Chaebol_f$				−0.42				−0.37
				(0.28)				(0.22)
$\triangle Export\ Demand_j \times Port_n$					−0.09**			−0.07
					(0.04)			(0.04)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						1.27		−3.05
						(0.84)		(5.46)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							3.49	6.95
							(2.11)	(13.09)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		26.92		25.84	27.82	27.28	26.81	28.96
Adj. R^2	0.56		0.56					
Num. Clusters	53	53	53	53	53	53	53	53
N	748	748	748	748	748	748	748	748

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is the change in export status between 1981 and 2009 or between 1982 and 2010. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\mathbb{1}[\text{Export}_{ft_0}]$ is the initial export status in 1981 or 1982. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B9: Short-Run Effects of Subsidies on Firms' Exports

Dep. Var.:	$\triangle$asinh(Export$_f$): 1972-1981 and 1973-1982							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.08	−0.03		−0.03	−0.01	−0.03	−0.03	0.02
	(0.06)	(0.22)		(0.23)	(0.22)	(0.22)	(0.22)	(0.22)
IV			−0.17					
			(1.36)					
asinh(Export$_{ft_0}$)	−0.83***	−0.81***	−0.81***	−0.81***	−0.81***	−0.81***	−0.81***	−0.82***
	(0.06)	(0.07)	(0.05)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
$Chaebol_f$				−0.20				−0.44
				(1.60)				(1.57)
$\triangle Export\ Demand_j \times Port_n$					0.36			1.19
					(0.63)			(0.95)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						−0.44		−61.90
						(8.86)		(38.32)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							5.85	176.40**
							(19.92)	(78.86)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		21.16		22.78	23.06	21.93	22.60	22.90
Adj. R^2	0.36		0.36					
Num. Clusters	55	55	55	55	55	55	55	55
N	787	787	787	787	787	787	787	787

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is the inverse hyperbolic sine transformation of export values between 1972 and 1981 or between 1973 and 1982. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). asinh(Export$_{ft_0}$) is the inverse hyperbolic sine of initial exports in 1972 or 1973. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B10: Long-Run Effects of Subsidies on Firms' Exports

Dep. Var.:	$\triangle$asinh(Export$_f$): 1981-2009 and 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.24***	1.30***		1.38***	1.17***	1.28***	1.27***	1.25***
	(0.06)	(0.34)		(0.44)	(0.28)	(0.31)	(0.29)	(0.36)
IV			6.84***					
			(1.56)					
asinh(Export$_{ft_0}$)	−0.90***	−0.95***	−0.89***	−0.94***	−0.94***	−0.94***	−0.94***	−0.94***
	(0.03)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
$Chaebol_f$				−7.42				−6.43
				(5.01)				(4.08)
$\triangle Export\ Demand_j \times Port_n$					−1.55*			−1.24
					(0.82)			(0.78)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						19.45		−62.53
						(16.45)		(97.89)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							56.89	133.05
							(41.69)	(236.83)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		27.01		25.31	28.11	27.44	26.99	28.45
Adj. R^2	0.54		0.53					
Num. Clusters	53	53	53	53	53	53	53	53
N	748	748	748	748	748	748	748	748

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is the inverse hyperbolic sine transformation of export values between 1981 and 2009 or between 1982 and 2010. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). asinh(Export$_{ft_0}$) is the inverse hyperbolic sine of initial exports in 1981 or 1982. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B11: Short-Run Effects of Subsidies on Firm Employment Growth

Dep. Var.:	$\triangle \ln Emp_f$: 1972-1981 and 1973-1982							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.02***	0.15***		0.15***	0.15***	0.15***	0.15***	0.16***
	(0.01)	(0.05)		(0.05)	(0.05)	(0.05)	(0.05)	(0.06)
IV			0.72***					
			(0.12)					
$\ln(Emp_{ft_0})$	−0.28***	−0.51***	−0.24***	−0.51***	−0.52***	−0.52***	−0.52***	−0.53***
	(0.04)	(0.10)	(0.03)	(0.08)	(0.10)	(0.09)	(0.09)	(0.09)
$Chaebol_f$				−0.05				−0.08
				(0.43)				(0.47)
$\triangle Export\ Demand_j \times Port_n$					0.07*			0.05
					(0.04)			(0.14)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						−2.33		−7.43
						(1.71)		(8.96)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							−4.12	13.08
							(4.48)	(26.63)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		12.22		12.96	12.85	12.56	12.50	11.80
Adj. R^2	0.16		0.15					
Num. Clusters	52	52	52	52	52	52	52	52
N	872	872	872	872	872	872	872	872

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is employment growth between 1972 and 1981 or between 1973 and 1982. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Emp_{ft_0})$ is log of initial employment in 1972 or 1973. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B12: Long-Run Effects of Subsidies on Firm Employment Growth

Dep. Var.:	$\triangle \ln Emp_f$: 1981-2009 and 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.04***	0.10		0.11*	0.11*	0.10*	0.10	0.13**
	(0.01)	(0.07)		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
IV			0.47					
			(0.30)					
$log(Emp_{ft_0})$	−0.57***	−0.66***	−0.53***	−0.68***	−0.67***	−0.66***	−0.65***	−0.70***
	(0.05)	(0.14)	(0.06)	(0.08)	(0.12)	(0.13)	(0.13)	(0.08)
$Chaebol_f$				0.26				0.12
				(0.82)				(0.83)
$\triangle Export\ Demand_j \times Port_n$					0.07			0.33**
					(0.16)			(0.13)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						0.28		−14.29*
						(3.09)		(7.92)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							2.45	43.29**
							(6.33)	(16.90)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		26.58		22.68	32.11	32.35	30.72	23.19
Adj. R^2	0.36		0.34					
Num. Clusters	53	53	53	53	53	53	53	53
N	854	854	854	854	854	854	854	854

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is employment growth between 1981 and 2009 or between 1982 and 2010. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Emp_{ft_0})$ is log of initial employment in 1981 or 1982. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B13: Short-Run Effects of Subsidies on Firm TFP Growth

Dep. Var.:	$\triangle TFP_f$: 1972-1981 and 1973-1982							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	−0.00	0.03**		0.03*	0.03**	0.03**	0.03**	0.03**
	(0.01)	(0.01)		(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
IV			0.19**					
			(0.09)					
ln(TFP_{ft_0})	−0.85***	−0.84***	−0.85***	−0.83***	−0.83***	−0.84***	−0.84***	−0.83***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
$Chaebol_f$				0.08				0.08
				(0.14)				(0.13)
$\triangle Export\ Demand_j \times Port_n$					0.01			−0.01
					(0.05)			(0.05)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						−0.35		0.28
						(1.04)		(5.21)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							−0.79	−1.70
							(2.14)	(10.90)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		19.11		21.37	20.26	17.56	18.53	23.42
Adj. R^2	0.60		0.60					
Num. Clusters	50	50	50	50	50	50	50	50
N	562	562	562	562	562	562	562	562

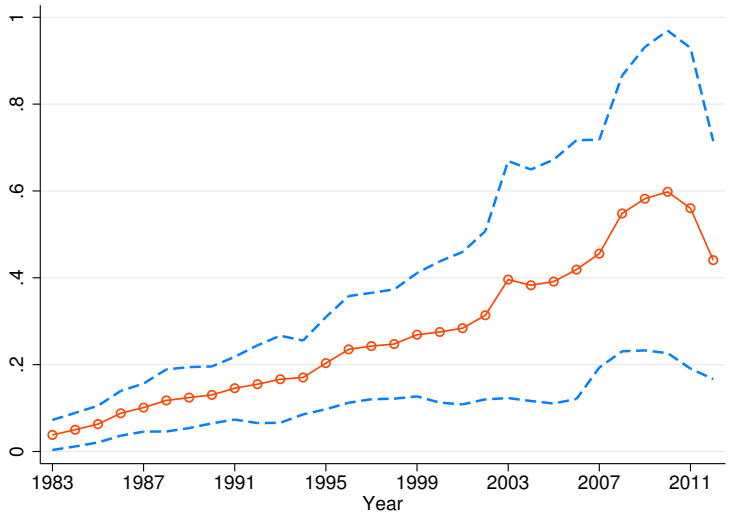
Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is TFP growth between 1972 and 1981 or between 1973 and 1982, where TFP is obtained by applying the production function estimation method developed by Ackerberg et al. (2015). The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). ln(TFP_{ft_0}) is log of initial TFP in 1972 or 1973. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B14: Long-Run Effects of Subsidies on Firm TFP Growth

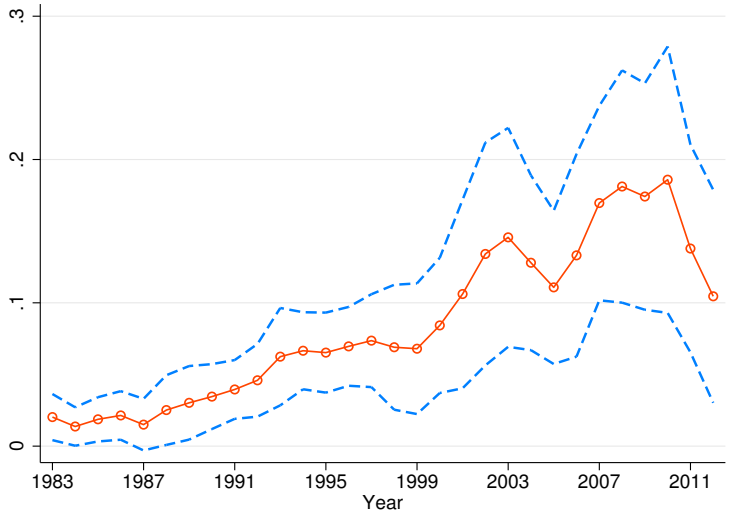
Dep. Var.:	$\triangle \ln TFP_f$: 1981-2009 and 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.01**	0.17***		0.18***	0.17***	0.18***	0.17***	0.18***
	(0.01)	(0.04)		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
IV			0.99***					
			(0.11)					
$log(TFP_{ft_0})$	−0.72***	−0.73***	−0.74***	−0.74***	−0.73***	−0.73***	−0.73***	−0.73***
	(0.10)	(0.16)	(0.09)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
$Chaebol_f$				−0.81				−0.79
				(0.57)				(0.54)
$\triangle Export\ Demand_j \times Port_n$					−0.08			−0.05
					(0.17)			(0.19)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						−1.13		−21.06
						(2.30)		(15.90)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							1.86	41.38
							(4.66)	(30.11)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		24.85		23.68	23.89	24.97	23.47	28.33
Adj. R^2	0.45		0.46					
Num. Clusters	53	53	53	53	53	53	53	53
N	663	663	663	663	663	663	663	663

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is TFP growth between 1981 and 2009 or between 1982 and 2010, where TFP is obtained by applying the production function estimation method developed by Ackerberg et al. (2015). The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(TFP_{ft_0})$ is log of initial TFP in 1981 or 1982. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Figure B2. Yearly Long-Run Estimates



Panel A. log(Sales)



Panel B. TFP

Notes. This figure plots the yearly estimated coefficients from estimating Equation (3.1). In Panel A, the dependent variable is the sales growth between 1982 and the year on the x-axis. In Panel B, the dependent variable is the TFP growth between 1982 and the year on the x-axis, where TFP is obtained by applying the production function estimation method developed by Ackerberg et al. (2015). The blue dashed lines represent the 95% confidence intervals, using standard errors clustered by region.

Table B15: Robustness: Alternative Transformation of Credit. Short-Run Effects of Subsidies on Firm Sales Growth

Dep. Var.:	$\triangle \ln Sales_f$: 1972-1981 and 1973-1982							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$1[Credit_f > 0]$	1.00***	3.49***		3.48***	3.51***	3.49***	3.47***	3.65***
	(0.20)	(0.77)		(0.77)	(0.78)	(0.79)	(0.77)	(0.82)
IV			0.98***					
			(0.18)					
$log(Sales_{ft_0})$	−0.53***	−0.70***	−0.48***	−0.71***	−0.70***	−0.70***	−0.70***	−0.72***
	(0.04)	(0.05)	(0.04)	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)
$Chaebol_f$				0.16				0.13
				(0.46)				(0.47)
$\triangle Export\ Demand_j \times Port_n$					0.02			0.16*
					(0.06)			(0.09)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						−0.16		−16.30*
						(1.79)		(8.76)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							1.78	41.37**
							(3.35)	(16.61)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		26.01		29.42	26.43	25.14	26.23	27.78
Adj. R^2	0.45		0.40					
Num. Clusters	55	55	55	55	55	55	55	55
N	762	762	762	762	762	762	762	762

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1972 and 1981 or between 1973 and 1982. The independent variable $1[Credit_f > 0]$ is the binary indicator for whether the firm received credit between 1973 and 1979. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Sales_{ft_0})$ is log of initial sales in 1972 or 1973. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B16: Robustness: Alternative Transformation of Credit. Long-Run Effects of Subsidies on Firms' Sales Growth

Dep. Var.:	$\triangle \ln Sales_f$: 1981-2009 and 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$1[Credit_f > 0]$	0.38**	10.28***		9.95***	9.62***	10.10***	9.95***	9.85***
	(0.19)	(3.08)		(3.00)	(2.57)	(2.93)	(2.88)	(2.72)
IV			1.52***					
			(0.20)					
$log(Sales_{ft_0})$	−0.13**	−1.14***	−0.13**	−1.01***	−1.08***	−1.13***	−1.11***	−1.00***
	(0.05)	(0.36)	(0.06)	(0.30)	(0.29)	(0.34)	(0.33)	(0.29)
$Chaebol_f$				−1.44				−1.39
				(1.59)				(1.43)
$\triangle Export\ Demand_j \times Port_n$					−0.23			0.17
					(0.29)			(0.36)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						5.66		−23.67
						(4.87)		(25.89)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							16.51	67.74
							(10.19)	(49.98)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		12.70		12.35	17.80	15.03	15.46	17.62
Adj. R^2	0.15		0.17					
Num. Clusters	53	53	53	53	53	53	53	53
N	739	739	739	739	739	739	739	739

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1981 and 2009 or between 1982 and 2010. The independent variable $1[Credit_f > 0]$ is the binary indicator for whether the firm received credit between 1973 and 1979. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Sales_{ft_0})$ is log of initial sales in 1981 or 1982. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B17: Robustness: Alternative Transformation of Credit. Short-Run Effects of Subsidies on Firms' Sales Growth

Dep. Var.:	$\triangle \ln Sales_f$: 1972-1981 and 1973-1982							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(1+Credit_f)$	0.06***	0.19***		0.19***	0.19***	0.19***	0.19***	0.20***
	(0.01)	(0.05)		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
IV			0.98***					
			(0.18)					
$\ln(Sales_{ft_0})$	−0.54***	−0.70***	−0.48***	−0.71***	−0.71***	−0.70***	−0.70***	−0.72***
	(0.04)	(0.06)	(0.04)	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)
$Chaebol_f$				0.12				0.08
				(0.46)				(0.47)
$\triangle Export\ Demand_j \times Port_n$					0.02			0.16*
					(0.06)			(0.08)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						−0.20		−17.70**
						(1.67)		(8.74)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							1.91	44.63**
							(3.15)	(16.83)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		22.89		25.56	23.70	22.16	23.22	24.32
Adj. R^2	0.46		0.40					
Num. Clusters	55	55	55	55	55	55	55	55
N	762	762	762	762	762	762	762	762

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1972 and 1981 or between 1973 and 1982. The independent variable is log of 1 plus the credit received by the firm between 1973 and 1979. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Sales_{ft_0})$ is log of initial sales in 1972 or 1973. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B18: Robustness: Alternative Transformation of Credit. Long-Run Effects of Subsidies on Firms' Sales Growth

Dep. Var.:	$\triangle \ln Sales_f$: 1981-2009 and 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(1+Credit_f)$	0.02**	0.61***		0.58***	0.57***	0.60***	0.59***	0.58***
	(0.01)	(0.19)		(0.18)	(0.15)	(0.17)	(0.17)	(0.16)
IV			1.52***					
			(0.20)					
$log(Sales_{ft_0})$	−0.14**	−1.24***	−0.13**	−1.07***	−1.17***	−1.22***	−1.20***	−1.06***
	(0.05)	(0.41)	(0.06)	(0.33)	(0.33)	(0.39)	(0.37)	(0.31)
$Chaebol_f$				−1.81				−1.76
				(1.77)				(1.58)
$\triangle Export\ Demand_j \times Port_n$					−0.23			0.21
					(0.31)			(0.35)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						5.32		−31.40
						(4.89)		(25.93)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							17.14	84.79*
							(10.95)	(50.50)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		11.42		11.28	17.12	14.04	14.84	16.59
Adj. R^2	0.15		0.17					
Num. Clusters	53	53	53	53	53	53	53	53
N	739	739	739	739	739	739	739	739

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1981 and 2009 or between 1982 and 2010. The independent variable is log of 1 plus the credit received by the firm between 1973 and 1979. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Sales_{ft_0})$ is log of initial sales in 1981 or 1982. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B19: Robustness: Single Long Difference. Short-Run Effects of Subsidies on Firms' Sales Growth

Dep. Var.:	$\triangle \ln Sales_f$: 1973-1982							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.06***	0.19***		0.19***	0.19***	0.19***	0.19***	0.20***
	(0.01)	(0.04)		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
IV			1.01***					
			(0.19)					
$\ln(Sales_{ft_0})$	−0.56***	−0.72***	−0.50***	−0.73***	−0.73***	−0.72***	−0.72***	−0.75***
	(0.05)	(0.06)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)
$Chaebol_f$				0.16				0.11
				(0.48)				(0.48)
$\triangle Export\ Demand_j \times Port_n$					0.04			0.28**
					(0.08)			(0.13)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						0.95		−14.84*
						(1.55)		(7.63)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							3.93	44.17***
							(3.29)	(14.28)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		35.42		38.97	37.48	35.05	36.33	42.11
Adj. R^2	0.47		0.42					
Num. Clusters	44	44	44	44	44	44	44	44
N	397	397	397	397	397	397	397	397

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1973 and 1982. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Sales_{ft_0})$ is log of initial sales in 1973. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B20: Robustness: Single Long Difference. Long-Run Effects of Subsidies on Firms' Sales Growth

Dep. Var.:	$\triangle \ln Sales_f$: 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.02*	0.53***		0.53***	0.50***	0.53***	0.52***	0.54***
	(0.01)	(0.16)		(0.18)	(0.14)	(0.16)	(0.15)	(0.16)
IV			1.40***					
			(0.21)					
$\ln(Sales_{ft_0})$	−0.13**	−1.11***	−0.12	−1.00***	−1.07***	−1.12***	−1.10***	−1.02***
	(0.06)	(0.38)	(0.07)	(0.32)	(0.33)	(0.36)	(0.34)	(0.31)
$Chaebol_f$				−1.69				−1.72
				(1.86)				(1.71)
$\triangle Export\ Demand_j \times Port_n$					−0.17			0.36
					(0.27)			(0.32)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						6.34		−28.32
						(5.04)		(25.97)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							18.25*	84.66*
							(10.39)	(48.81)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		10.75		10.76	13.57	12.71	13.20	15.86
Adj. R^2	0.08		0.09					
Num. Clusters	46	46	46	46	46	46	46	46
N	403	403	403	403	403	403	403	403

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1982 and 2010. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). $\ln(Sales_{ft_0})$ is log of initial sales in 1982. All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Table B21: Robustness: No Initial Sales Control. Short-Run Effects of Subsidies on Firms' Sales Growth

Dep.	$\triangle \ln Sales_f$: 1972-1981 and 1973-1982							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.02*	0.10**		0.10**	0.11**	0.10**	0.10**	0.11**
	(0.01)	(0.04)		(0.05)	(0.04)	(0.04)	(0.04)	(0.05)
IV			0.63**					
			(0.24)					
$Chaebol_f$				−0.29				−0.34
				(0.37)				(0.41)
$\triangle Export\ Demand_j \times Port_n$					0.10			0.29**
					(0.06)			(0.13)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						1.92		4.34
						(2.11)		(8.15)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							2.94	3.44
							(4.20)	(19.43)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		27.33		29.02	27.84	27.06	27.78	28.41
Adj. R^2	0.09		0.09					
Num. Clusters	55	55	55	55	55	55	55	55
N	762	762	762	762	762	762	762	762

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1972 and 1981 or between 1973 and 1982. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8, where the IV is defined in Equation (3.3). In column 3, the reduced form estimates of the IV are reported. $Chaebol_f$ is a dummy variable which equals one if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in Equation (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in Equation (4.1). Across all specifications, region and sector fixed effects are controlled. KP-F is the Kleibergen-Paap F-statistics.

Table B22: Robustness: No Initial Sales Control. Long-Run Effects of Subsidies on Firms' Sales Growth

Dep.	$\triangle \ln Sales_f$: 1981-2009 and 1982-2010							
	OLS	IV						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
asinh($Credit_f$)	0.01	0.25***		0.27***	0.25***	0.25***	0.25***	0.28***
	(0.01)	(0.06)		(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
IV			1.33***					
			(0.18)					
$Chaebol_f$				−1.30				−1.40
				(1.03)				(1.08)
$\triangle Export\ Demand_j \times Port_n$					0.02			0.37*
					(0.17)			(0.19)
$\triangle \ln(Import\ Tariff_j) \times Port_n$						1.22		−24.39*
						(4.18)		(13.78)
$\triangle \ln(Input\ Tariff_j) \times Port_n$							6.44	67.14**
							(8.36)	(25.91)
Region FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
KP-F		27.14		24.64	27.93	27.89	27.40	27.56
Adj. R^2	0.15		0.16					
Num. Clusters	53	53	53	53	53	53	53	53
N	739	739	739	739	739	739	739	739

Notes. Standard errors clustered at the region level are in parentheses. *: p<0.1; **: p<0.05; ***: p<0.01. The table reports the OLS and IV estimates of Equation (3.1). The dependent variable is sales growth between 1981 and 2009 or between 1982 and 2010. The OLS estimates are reported in column 1. The IV estimates are reported in columns 2 and 4-8. The IV is defined in (3.3). Column 3 reports the reduced form estimates. $Chaebol_f$ is a dummy variable that equals 1 if a firm is affiliated with a top 30 Chaebol group. $\triangle Export\ Demand_j \times Port_n$ is the interaction between the port dummies and the changes in the world demand shock defined in (B.2). $\triangle \ln(Import\ Tariff_j) \times Port_n$ is the interaction between changes in import tariffs and the port dummy variable. $\triangle \ln(Input\ Tariff_j) \times Port_n$ is the interaction between changes in input tariffs and the port dummy variable, where the input tariffs are defined in (4.1). All specifications include region and sector fixed effects. KP-F are the Kleibergen-Paap F-statistics.

Appendix C Theory and Quantification

C.1 Profit Maximization When Firms are Not Constrained

Given downward sloping demand and LBD, a firm maximizes discounted profits:

$$\max_{\{p_{fjt}\}_{t=1,2}} \left\{ \underbrace{\left(p_{fj1}q_{fj1} - \kappa_{fj1}\frac{c_{j1}}{A_{fj1}}q_{fj1} \right)}_{=\Pi_{fj1}(p_{fj1})} + \beta \underbrace{\left(p_{fj2}q_{fj2} - \frac{c_{j2}}{A_{fj2}}q_{fj2} \right)}_{=\Pi_{fj2}(p_{fj1},p_{fj2})} \right\}$$
$$\text{subject to} \quad q_{fjt} = p_{fjt}^{-\sigma}(P_{jt}^H)^{\sigma-1}X_{jt}, \quad A_{fj2} = A_{fj1}(q_{fj1})^{\xi}, \quad \text{(C.1)}$$

where κ_{fj1} is a subsidy provided by the government in the first period and there is no subsidy in the second period.[35] $\Pi_{fj1}(p_{fj1})$ and $\Pi_{fj2}(p_{fj1}, p_{fj2})$ are profits in the first and the second periods.In the second period the firm's maximization problem is static. The firm charges the standard constant mark-up over marginal cost:

$$p_{fj2} = \frac{\sigma}{\sigma-1}\frac{c_{j2}}{A_{fj2}},$$

and its sales are

$$X_{fj2} = \left(\frac{\sigma}{\sigma-1}\frac{c_{j2}}{A_{j2}} \right)^{1-\sigma} (P_{j2}^H)^{\sigma-1}X_{j2}.$$

Second period profits and input expenditures are $\frac{1}{\sigma}X_{fj2}$ and $\frac{\sigma-1}{\sigma}X_{fj2}$ respectively.

Given the pricing decision in the second period, a firm's maximization problem in the first period can be rewritten as

$$\Pi_{fj} = \max_{p_{fj1}} \left\{ \Pi_{fj1}(p_{fj1}) + \beta\tilde{\Pi}_{fj2}(p_{fj1}) \right\},$$

where

$$\tilde{\Pi}_{fj2}(p_{fj1}) = \frac{1}{\sigma}\left(\frac{c_{j2}}{\phi_{fj2}} \right)^{1-\sigma} (P_{j2}^H)^{\sigma-1}X_{j2} \times (p_{fj1}^{-\sigma}(P_{j1}^H)X_{j1})^{\xi(\sigma-1)}.$$

The firm's optimal price in the first period p_{fj1}^{LBD} is the price that satisfies the first order condition of the above maximization problem: $\partial\Pi_{fj}/\partial p_{fj1} = 0$. This first-order condition is:

$$0 = (1-\sigma)p_{fj1}^{-\sigma}(P_{j1}^H)^{\sigma-1}X_{j1} + \sigma\frac{c_{j1}}{\phi_{fj1}}p_{fj1}^{-\sigma-1}(P_{j1}^H)^{\sigma-1}X_{j1}$$
$$- \beta\sigma\xi(\sigma-1)\left[p_{fj1}^{-\sigma\xi(\sigma-1)-1}\left((P_{j1}^H)^{\sigma-1}X_{j1} \right)^{\xi(\sigma-1)} \right]\frac{1}{\sigma}\left(\frac{c_{j2}}{\phi_{fj2}} \right)(P_{j2}^H)^{\sigma-1}X_{j2},$$

It collapses to the first order condition that maximizes the static profit in the first period when $\xi = 0$.

[35] Because households own the firms, firms apply the same discount factor as the households.

Denote the price that maximizes the first period static profits by p_{fj1}^{Static}:

$$p_{fj1}^{Static} = \frac{\sigma}{\sigma - 1} \frac{\kappa_{fj1} c_{j1}}{A_{fj1}}. \tag{C.2}$$

This is the price charged by firms in the first period when there is no LBD. Firms always set $p_{fj1}^{LBD} < p_{fj1}^{Static}$ because by dropping the price below p_{fj1}^{Static}, firms internalize LBD by increasing quantity in the first period, which in turn increases productivity in the second period.

C.2 Equilibrium in the First Period When Firms are Constrained

This section derives expressions for firm-level variables when all firms are constrained in the first period, that is, $\lambda_{j1}/\kappa_{fj1} \leq 1, \forall f$. We first formally show that when $\lambda_{j1}/\kappa_{fj1} \leq 1$, a firm produces at most the quantity that maximizes static profits and charges at most the price that maximizes static profits.

Proposition C.1. *When $\lambda_{j1}/\kappa_{fj1} \leq 1$, firms are constrained, $q_{fj1}^{Friction} \leq q_{fj1}^{Static}$, and $p_{fj1}^{Friction} \geq p_{fj1}^{Static}$, where q_{fj1}^{Static} and p_{fj1}^{Static} are the quantity and price that maximize the static profits.*

Proof. The static profit-maximizing price is

$$p_{fj1}^{Static} = \frac{\sigma}{\sigma - 1} \frac{c_{j1}}{A_{fj1}}$$

and $q_{fj1}^{Static} = (p_{fj1}^{Static})^{-\sigma} (P_{j1}^{H})^{\sigma - 1} X_{j1}$. Firms are constrained when

$$\kappa_{fj1} c_{j1} m_{j1} \leq \tilde{\lambda}_{j1} A_{fj1}^{\sigma - 1} \tag{C.3}$$

binds with equality. When charging p_{fj1}^{Static}, total input costs are

$$\begin{aligned} \kappa_{fj1} c_{j1} m_{fj1} &= \kappa_{fj1} c_{j1} \times \frac{1}{A_{fj1}} (q_{fj1}^{Static}) = \frac{c_{j1}}{A_{fj1}} (p_{fj1}^{Static})^{-\sigma} (P_{j1}^{H})^{\sigma - 1} X_{j1} \\ &= \kappa_{fj1} \left(\frac{\sigma}{\sigma - 1} \right)^{-\sigma} c_{j1}^{1-\sigma} A_{fj1}^{\sigma - 1} (P_{j1}^{H})^{\sigma - 1} X_{j1}. \end{aligned} \tag{C.4}$$

Substituting (C.4) into (C.3) binding with equality, we can establish that when $\kappa_{fj1}/\lambda_{j1} \leq 1$, firms

are constrained. When firms are constrained, their prices are pinned down by the constraints:

$$\begin{aligned}\kappa_{fj1}c_{j1}m_{fj1} &= \kappa_{fj1}\frac{c_{j1}}{A_{fj1}}q_{fj1}^{Friction} \\ &= \kappa_{fj1}\frac{c_{j1}}{A_{fj1}}(p_{fj1}^{Friction})^{-\sigma}(P_{j1}^{H})^{\sigma-1}X_{j1} \\ &= \lambda_{j1}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}c_{j1}^{1-\sigma}A_{fj1}^{\sigma-1}(P_{j1}^{H})^{\sigma-1}X_{j1},\end{aligned}$$

which gives

$$p_{fj1}^{Friction} = \frac{\sigma}{\sigma-1}\left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{-\frac{1}{\sigma}}\frac{c_{j1}}{A_{fj1}}$$

and

$$q_{fj1}^{Friction} = (p_{fj1}^{Friction})^{-\sigma}(P_{j1}^{H})^{\sigma-1}X_{j1}.$$

Because $\lambda_{j1}/\kappa_{fj1} \leq 1$, $p_{fj1}^{Friction} \geq p_{fj1}^{Static}$ and $q_{fjq}^{friction} \leq q_{fj1}^{Static}$ hold. □

We next derive equilibrium allocation when all firms are constrained.

Prices and sales By Proposition C.1

$$p_{fj1}^{Friction} = \frac{\sigma}{\sigma-1}\frac{c_{j1}}{A_{fj1}}\left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{-\frac{1}{\sigma}}. \tag{C.5}$$

Demand for firm f's output is $p_{fj1}^{-\sigma}(P_{j1}^{H})^{\sigma-1}X_{j1}$. After substituting firm price in (C.5) into firm sales $X_{fj1} = p_{fj1}q_{fj1}$, we obtain

$$X_{fj1} = \left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{\frac{\sigma-1}{\sigma}}\left(\frac{\sigma}{\sigma-1}\frac{c_{j1}}{A_{fj1}}\right)^{1-\sigma}(P_{j1}^{H})^{\sigma-1}X_{j1}.$$

Input expenditures and total input costs A firm's input expenditures are expressed as

$$\begin{aligned}&\left(w_t H_{fj1} + \sum_k P_{k1}M_{fk1}\right) = c_{j1}m_{fj1} = c_{j1}\frac{q_{fj1}}{A_{fj1}} \\ &= \left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{-1}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}\left(\frac{c_{j1}}{A_{fj1}}\right)^{1-\sigma}(P_{j1}^{H})^{\sigma-1}X_{j1} = \left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{\frac{1}{\sigma}}\frac{\sigma-1}{\sigma}X_{fj1}.\end{aligned}$$

The first equality comes from a firm's cost minimization such that $w_t H_{fj1} + \sum_k P_{k1}M_{fk1}$ is equal to $c_{j1}m_{fj1}$ where c_{j1} is the price of the input bundle and m_{fj1} is the total quantity of input bundles used by firm f. The second equality comes from a firm's production function. The third equality is derived from the demand curve and prices charged under constraints in (C.5). Input expenditures

on each intermediate input and on labor are

$$\gamma_j^l \left(\frac{\lambda_{j1}}{\kappa_{fj1}} \right)^{\frac{1}{\sigma}} \frac{\sigma - 1}{\sigma} X_{fj1}, \qquad l = 1, \ldots, J, \quad H.$$

A firm's total costs on inputs inclusive of subsidies are obtained as

$$\kappa_{fj1} c_{j1} m_{fj1} = \kappa_{fj1} \left(\frac{\lambda_{j1}}{\kappa_{fj1}} \right)^{\frac{1}{\sigma}} \frac{\sigma - 1}{\sigma} X_{fj1}.$$

Profits A firm's profits are obtained as sales net of total input costs:

$$\Pi_{fj1} = \left[1 - \kappa_{fj1} \left(\frac{\lambda_{j1}}{\kappa_{fj1}} \right)^{\frac{1}{\sigma}} \left(\frac{\sigma - 1}{\sigma} \right) \right] X_{fj1}.$$

C.3 Equilibrium in the Second Period

There is no subsidy and constraint in the second period, so firms maximize their static profits. The firm charges a constant mark-up over marginal cost:

$$p_{fj2} = \frac{\sigma}{\sigma - 1} \frac{c_{j1}}{A_{fj2}},$$

and its sales are

$$X_{fj2} = \left(\frac{\sigma}{\sigma - 1} \frac{c_{j2}}{A_{j2}} \right)^{1-\sigma} (P_{j2}^H)^{\sigma - 1} X_{j2}.$$

Because $A_{fj2} = \phi_{fj2} q_{fj1}^{\xi}$ and $q_{fj1} = p_{fj1}^{-\sigma} (P_{j1}^H)^{\sigma-1} X_1$, after substituting the firm's first period price (C.5), we can rewrite the second period sales as

$$X_{fj2} = \left(\frac{\lambda_{j1}}{\kappa_{fj1}} \right)^{(\sigma-1)\xi} \prod_{h=0}^{1} \left[\left(\frac{\sigma}{\sigma - 1} \frac{c_{j,2-h}}{\phi_{fj,2-h}} \right)^{(1-\sigma)(\sigma\xi)^h} \times \left((P_{j,2-h}^H)^{\sigma-1} X_{j,2-h} \right)^{(\xi(\sigma-1))^h} \right].$$

Because there is no subsidy, the total input expenditures and total input costs are identical in the second period. They are expressed as

$$c_{j2} m_{fj2} = \frac{\sigma - 1}{\sigma} X_{fj2}$$

Profits Profits in the second period are

$$\Pi_{fj2} = \frac{1}{\sigma} X_{fj2}.$$

C.4 A Shock Formulation of the Model

This section presents the shock formulation of the model. We express the equilibrium conditions in terms of gross changes $\hat{x} = x^c/x$ where x^c and x are the counterfactual and pre-shock allocations. In the short-run hat algebra, the shocks are $\hat{\kappa}_{fj1}$, and in the long-run hat algebra, the shocks are $\hat{A}^L_{fj2}$.

The short run In the short-run counterfactual, λ_{j1}, P^F_{j1}, D^F_{j1}, and ϕ_{fj1} remain constant, but only κ_{fj1} are changed. We set $\hat{\lambda}^S_{j1} = 1$, $\hat{A}^S_{fj1} = 1$, $\hat{P}^{F,S}_{j1} = 1$, $\hat{D}^{F,S}_{j1} = 1$, $\hat{H}^S_1 = 1$, and $\hat{\kappa}^S_{fj1} = \kappa_{c,fj1}/\kappa_{fj1}$, where $\kappa_{c,fj1} = 1$.

A firm's price changes are written as

$$\hat{p}^S_{fj1} = \left(\frac{\hat{\lambda}^S_{j1}}{\hat{\kappa}^S_{fj1}}\right)^{-\frac{1}{\sigma}} \frac{\hat{c}^S_{j1}}{\hat{A}^S_{fj1}}. \tag{C.6}$$

Changes of Home sectoral price indices are

$$(\hat{P}^{H,S}_{j1})^{1-\sigma} = \sum_{f \in \mathcal{F}_j} \pi_{fj1} (\hat{p}^S_{fj1})^{1-\sigma}.$$

Changes of final price indices are

$$(\hat{P}^S_{j1})^{1-\rho} = (1 - \pi^F_{j1})(\hat{P}^{F,S}_{j1})^{1-\rho} + \pi^F_{j1} (\hat{P}^{H,S}_{j1})^{1-\rho}.$$

A firm's counterfactual market share is

$$\pi_{c,fj1} = \frac{(\hat{p}^S_{fj1})^{1-\sigma} \pi_{fj1}}{\sum_{f' \in \mathcal{F}_j} (\hat{p}^S_{f'j1})^{1-\sigma} \pi_{f'j1}}.$$

A counterfactual import share is

$$\pi^F_{c,j1} = \frac{(\hat{P}^{F,S}_{j1})^{1-\rho} \pi^F_{j1}}{(\hat{P}^{H,S}_{j1})^{1-\rho}(1 - \pi^F_{j1}) + (\hat{P}^{F,S}_{j1})^{1-\rho} \pi^F_{j1}}$$

Counterfactual exports are

$$EX_{c,j1} = (\hat{c}^S_{j1})^{1-\rho} \hat{D}^F_{j1} EX_{j1}$$

Labor market clearing can be written as

$$\hat{w}_1^S \hat{H}_1^S w_1 H_1 = \frac{\sigma - 1}{\sigma} \sum_{j \in \mathcal{J}_M} \gamma_j^H X_{c,j1} + \sum_{j \in \mathcal{J}_{NM}} \gamma_j^H X_{c,j1},$$

where

$$w_1 H_1 = \frac{\sigma - 1}{\sigma} \sum_{j \in \mathcal{J}_M} \gamma_j^H X_{j1} + \sum_{j \in \mathcal{J}_{NM}} \gamma_j^H X_{j1}$$

Goods market clearing is expressed as

$$X_{c,j1} = (1 - \pi_{c,j1}^F) \left[\alpha^j (\hat{w}_1^S \hat{H}_1^S w_1 H_1 + \Pi_{c,1} + T_{c,1}) + \frac{\sigma - 1}{\sigma} \sum_{k \in \mathcal{J}_M} \gamma_k^j X_{c,k1} + \sum_{k \in \mathcal{J}_{NM}} \gamma_k^j X_{c,k1} \right] + E X_{c,j1}$$

Firms' sales and profits are expressed as

$$X_{c,fj1} = \pi_{c,fj1} X_{c,j1},$$

and

$$\pi_{c,fj1} = \left[1 - \kappa_{c,fj1} \left(\frac{\lambda_{j1}}{\kappa_{c,fj1}} \right)^{\frac{1}{\sigma}} \frac{\sigma - 1}{\sigma} \right] X_{c,fj1}.$$

Aggregate profits are

$$\Pi_{c,1} = \sum_{j \in \mathcal{J}_M} \sum_{f \in \mathcal{F}_j} \Pi_{c,fj1}.$$

Lump-sum transfers are

$$T_{c,1} = \sum_{j \in \mathcal{J}_M} \sum_{f \in \mathcal{F}_j} (\kappa_{c,fj1} - 1) \left(\left(\frac{\lambda_{j1}}{\kappa_{c,fj1}} \right)^{\frac{1}{\sigma}} \frac{\sigma - 1}{\sigma} X_{c,fj1} \right). \tag{C.7}$$

The long run In the long-run hat algebra, there are four exogenous changes: $\hat{H}_2^L$, $\hat{A}_{fj2}^L$, $\hat{\kappa}_{fj2}^L$, $\hat{\lambda}_{j2}^L$. In the second period, there are no subsidy and no constraints, so we set $\kappa_{fj2} = 1$ and $\lambda_{j2} = 1$. Then, the long-run changes of subsidies and constraints are given as $\hat{\kappa}_{fj2}^L = 1/\kappa_{fj1}$ and $\hat{\lambda}_{j2}^L = 1/\lambda_{j1}$.

The long-run counterfactual productivity changes are computed as

$$\hat{A}_{c,fj2}^L = \left(\frac{A_{f_0 j2}}{A_{f_0 j1}} \right) \times \left(\frac{A_{fj2}/A_{f_0 j2}}{A_{fj1}/A_{f_0 j1}} \right) \times (\hat{q}_{c,fj1}^S)^{\xi}$$

relative to some reference firm f_0, where $\frac{A_{fj2}/A_{f_0 j2}}{A_{fj1}/A_{f_0 j1}}$ is obtained directly from the data, $\frac{A_{f_0 j2}}{A_{f_0 j1}}$ is internally calibrated by exactly fitting the data, and $\hat{q}_{c,fj1}^S$ is obtained from the short-run hat algebra.

A firm's price changes and market shares are written as

$$\hat{p}_{fj2}^{L} = \left(\frac{\hat{\lambda}_{j2}^{L}}{\hat{\kappa}_{fj2}^{L}} \right)^{-\frac{1}{\sigma}} \frac{\hat{c}_{j2}^{L}}{\hat{A}_{c,fj2}^{L}}, \tag{C.8}$$

and

$$\pi_{fj2} = \frac{(\hat{p}_{fj2}^{L})^{1-\sigma} \pi_{fj1}}{\sum_{f' \in \mathcal{F}_j} (\hat{p}_{f'j2}^{L})^{1-\sigma} \pi_{f'j1}}.$$

Changes in Home sectoral price indices are

$$(\hat{P}_{j2}^{H,L})^{1-\sigma} = \sum_{f \in \mathcal{F}_j} \pi_{fj1} (\hat{p}_{fj2}^{L})^{1-\sigma}.$$

Changes in final price indices are

$$(\hat{P}_{j2}^{L})^{1-\rho} = (1 - \pi_{j1}^{F})(\hat{P}_{j2}^{F,L})^{1-\rho} + \pi_{j1}^{F} (\hat{P}_{j2}^{H,L})^{1-\rho}.$$

Import shares are

$$\pi_{j2}^{F} = \frac{(\hat{P}_{j2}^{F,L})^{1-\rho} \pi_{j1}^{F}}{(\hat{P}_{j2}^{H,L})^{1-\rho} (1 - \pi_{j1}^{F}) + (\hat{P}_{j2}^{F,L})^{1-\rho} \pi_{j1}^{F}}. \tag{C.9}$$

Exports are

$$EX_{j2} = (\hat{c}_{j2}^{L})^{1-\rho} \hat{D}_{j2}^{F,L} EX_{j1} \tag{C.10}$$

Labor market clearing can be written as

$$\hat{w}_2^{L} \hat{H}_2^{L} w_1 H_1 = \frac{\sigma - 1}{\sigma} \sum_{j \in \mathcal{J}_M} \gamma_j^{H} X_{j2} + \sum_{j \in \mathcal{J}_{NM}} \gamma_j^{H} X_{j2},$$

where

$$w_1 H_1 = \frac{\sigma - 1}{\sigma} \sum_{j \in \mathcal{J}_M} \gamma_j^{H} X_{j1} + \sum_{j \in \mathcal{J}_{NM}} \gamma_j^{H} X_{j1}$$

Goods market clearing is expressed as

$$X_{c,j2} = (1 - \pi_{c,j2}^{F}) \left[\alpha^{j} (\hat{w}_2^{L} \hat{H}_2^{L} w_1 H_1 + \Pi_2 + T_2) + \frac{\sigma - 1}{\sigma} \sum_{k \in \mathcal{J}_M} \gamma_k^{j} X_{k2} + \sum_{k \in \mathcal{J}_{NM}} \gamma_k^{j} X_{k2} \right] + EX_{c,j2}.$$

Firms' sales and profits are expressed as

$$X_{fj2} = \pi_{fj2} X_{j2},$$

and

$$\Pi_{fj2} = \frac{1}{\sigma} X_{fj2}.$$

Aggregate profits are

$$\Pi_2 = \sum_{j \in \mathcal{J}_M} \sum_{f \in \mathcal{F}_j} \Pi_{fj2}.$$

Lump-sum transfers are

$$T_2 = 0. \tag{C.11}$$

C.5 Data Construction for the Quantitative Analysis

This section describes the data cleaning procedure for the quantitative analysis. Sectoral import shares and exports are obtained directly from the IO tables. We merge the 1982 firm-level sales to the national IO table for 1983.[36] Let X_{jt}^{IO} denote gross output of sector j, where the superscript reflects the fact that the data come from the IO table. From our firm-balance sheet data, we calculate the sum of sales of all firms in sector j: $X_{jt}^{Firm} = \sum_{f \in \mathcal{F}_j} X_{fjt}^{Firm}$, where the superscript $Firm$ is used to denote that these come from micro firm-level data. Then, we calculate the residuals as $X_{jt}^{Resid} = X_{jt}^{IO} - X_{jt}^{Firm}$ and take X_{jt}^{Resid} as a separate firm. X_{jt}^{Resid} accounts for the sum of sales of small-sized firms that are not present in our firm-level data. Firm-level sales shares are then obtained as

$$\pi_{fjt} = \frac{X_{fjt}^{Firm}}{X_{jt}^{IO}}$$

for both actual firms in the data and the residual firm.

For some observations, sales are missing, whereas the assets are available for all observations. For observations with missing sales, we impute sales using assets. We run

$$\ln Sales_{ft} = \beta_1 \ln Assets_{ft} + \delta_t + \epsilon_{ft}$$

for each sector, where we use cross-sectional variation in assets to predict sales. Then, we use the predicted values as imputed sales.

C.6 Model Solution and Algorithm

The model solution solves Equations (C.6)-(C.11). To solve the model, we require the following information.

[36] The IO table is not available for 1982.

Pre-shock data values in 1982 The data values in 1982 correspond to the first period in the model:

- Gross sales of firms in the manufacturing sectors, $\forall f \in \mathcal{F}_j$ and $\forall j \in \mathcal{J}_M$
- Gross sales of sector j. For $j \in \mathcal{J}$, $X_{j1} = \sum_{f \in \mathcal{F}_j} X_{fj1}$
- Sectoral import shares π^F_{j1}
- Sectoral export values EX_{j1}

Shocks

- Levels of $\{\lambda_{j1}\}$ in the first period, $\forall j \in \mathcal{J}_M$. In the second period, no firms are constrained, i.e. $\lambda_{j2} = 1$, $\forall j$
- Subsidy level in the first period κ_{fj1}, $\forall j \in \mathcal{J}_M$. In the second, there is no subsidy, i.e., $\kappa_{fj2} = 1$, $\forall f, j$
- Long-run productivity changes of firms in the manufacturing sectors, $\{\hat{A}^L_{fj2}\}$, $\forall f \in \mathcal{F}_j$ and $\forall j \in \mathcal{J}_M$. For the non-manufacturing sectors, there is a representative firm in each sector, so we only require sectoral long-run productivity changes $\{\hat{A}^L_{j2}\}$, $\forall j \in \mathcal{J}_{NM}$.
- Long-run Foreign demand shocks $\{\hat{D}^{F,L}_{j2}\}$
- Long-run Foreign import price shocks $\{\hat{P}^{F,L}_{j2}\}$

Parameters

- The elasticity of substitution σ and ρ
- The learning-by-doing parameter ξ
- Final consumption shares α^j, $\forall j \in \mathcal{J}$
- Production parameters γ^H_j and γ^k_j, $\forall j, k \in \mathcal{J}$

Model algorithm Given the values of the parameters, the shocks and the data values in 1982, the model is solved using the following algorithm

- Step 1: Apply short-run hat algebra to the pre-shock data values in 1982
  1. Feed in $\hat{\kappa}^S_{fj1}$
  2. Solve for the short-run equilibrium using Equations (C.6)-(C.7).
  3. Calculate the counterfactual equilibrium allocation.
- Step 2: Construct the counterfactual long-run productivity changes
  1. From Step 1, calculate the counterfactual changes of quantity produced

$$\hat{q}^S_{c,fj1} = \hat{p}^S_{c,fj1}(\hat{P}^{H,S}_{c,j1})^{\sigma-1}\hat{X}^S_{c,j1}$$

2. Calculate $\hat{A}^L_{c,fj2} = \hat{A}^L_{fj2} \times \hat{q}^S_{c,fj1}$ where $\hat{A}^L_{fj2}$ is backed out from the data.

- Step 3: Long-run hat algebra to the pre-shock data values in 1982
  1. Feed in six shocks: $\hat{A}^L_{fj2}$, $\hat{D}^{F,L}_{j2}$, $\hat{P}^{F,L}_{j2}$, $\lambda_{j2} = 1$, $\kappa_{fj2} = 1$, and $\hat{H}^L_2$ to the baseline (pre-shock) data values
  2. Obtain long-run equilibrium allocation changes by solving Equations (C.8)-(C.11).
  3. Calculate the long-run real income changes $\hat{y}^L_2/\hat{P}^L_2$

- Step 4: Long-run hat algebra to the counterfactual data values in 1982
  1. Feed in six shocks: $\hat{A}^L_{fj2}$, $\hat{D}^{F,L}_{j2}$, $\hat{P}^{F,L}_{j2}$, $\lambda_{j2} = 1$, $\kappa_{fj2} = 1$, and $\hat{H}^L_2$ to the counterfactual data values in 1982
  2. Obtain long-run equilibrium allocation changes under counterfactual by solving Equations (C.8)-(C.11).
  3. Calculate the long-run real income changes $\hat{y}^L_{c,2}/\hat{P}^L_{c,2}$ under counterfactual

- Step 5: Calculate welfare changes under counterfactual
  1. Based on the results obtained under steps 1-4, calculate the following welfare changes under the counterfactual

$$U_c/U = \left(\frac{\hat{y}^S_1}{\hat{P}^S_1}\right)\left(\frac{\tilde{y}^L_2}{\tilde{P}^L_2}\frac{\hat{y}^S_1}{\hat{P}^S_1}\right)^{\beta}$$

where

$$\frac{\tilde{y}^L_2}{\tilde{P}^L_2} = \frac{\hat{y}^L_{c,2}}{\hat{P}^L_{c,2}} \Big/ \frac{\hat{y}^L_2}{\hat{P}^L_2}$$

and $\hat{y}^S_1/\hat{P}^S_1$ is obtained from the short-run hat algebra applied to the baseline (pre-shock) data values in 1982, $\hat{y}^L_2/\hat{P}^L_2$ is obtained from the long-run hat algebra applied to the baseline (pre-shock) data values in 1982, and $\hat{y}^L_{c,2}/\hat{P}^L_{c,2}$ is obtained from the long-run hat algebra applied to the counterfactual data values in 1982.

C.7 Backing Out the Long-Run Shocks

To implement the long-run hat algebra, we have to compute the long-run shocks $\{\hat{A}^L_{f_0j2}, \hat{D}^{F,L}_{j2}, \hat{P}^{F,L}_{j2}\}$. This matrix of shocks is of dimension $3 \times J$. We compute these shocks by exactly matching the model to the observed data on changes in producer price indices, import shares, and exports between 1983 and 2010. Import shares and exports are obtained from the IO tables. Producer price indices are obtained from the OECD Stan database. When fitting the price changes, we normalize price changes across sectors by price change of one sector, which pins down $\hat{A}^L_{f_0j2}$ relative to the reference sector. Without loss of generality, we use the first sector (Food, Beverages, & Tobacco) as our reference

sector ($j = 1$). Then, we use real output changes of the reference sector to pin down $\hat{A}^L_{f_0j2}$ of the reference sector.

We compute these shocks using the following algorithm:

- Step 1: Guess $\{\hat{A}^{L,0}_{f_0j2}, D^{F,L,0}_{j2}, P^{F,L,0}_{j2}\}$
- Step 2: Compute the firm-level long-run productivity shock based on the guess:

$$A^{L,0}_{fj2} = \hat{A}^{L,0}_{f_0j2} \times \underbrace{\left(\frac{A_{fj2}/A_{f_0j2}}{A_{fj1}/A_{f_0j1}}\right)}_{\text{Data}}.$$

  The changes in relative productivity are taken directly from the data, see (5.11).
- Step 3: Given the guess, compute prices.
- Step 4: Update $\hat{P}^{F,L,0}_{j2}$ using Equation (C.9) and observed import share changes between 1982 and 2010.
- Step 5: Update $\hat{D}^{F,L,0}_{j2}$ using Equation (C.10) and observed exports changes between 1982 and 2010.
- Step 6: Compute price changes. Update $\hat{A}^{L,0}_{f_0j2}$ for $j = 2, \ldots, J$ until $\hat{P}_{jt}/\hat{P}_{1t}$ fits the PPI changes relative to the reference sector ($j = 1$).
- Step 7: Update $\hat{A}^{L,0}_{f_0j2}$ for $j = 1$ until $\hat{X}^L_{jt}/\hat{P}^L_{jt}$ fits the real output changes of the data.
- Step 8: Iterate Steps 2-7 until the convergence.

C.8 Satisfying Market Clearing

We require the market-clearing conditions in levels to be satisfied in the first and second periods to apply the hat algebra and to back out the shocks. Given $\{\kappa_{fj1}\}$ and $\{\lambda_{j1}\}$, in the first period, firm-level sales $\{X_{fj1}\}$ and industry-level gross outputs $\{X_{j1}\}$, exports $\{EX_{j1}\}$, and import shares

$\{\pi^F_{j1}\}$ should satisfy

$$X_{fj1} = \pi_{fj1}(1-\pi^F_{j1})\Bigg[\alpha^j\Bigg\{\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^H_k\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)X_{fk1}+\sum_{k\in\mathcal{J}_{NM}}\gamma^H_j X_{k1}}_{w_1H_1}$$
$$+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\left(1-\kappa_{fk1}\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)\right)X_{fk1}}_{=\Pi_1}$$
$$+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_j}(\kappa_{fk1}-1)\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)X_{fk1}}_{=T_1}\Bigg\}$$
$$+\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^j_k\left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{\frac{1}{\sigma}}\frac{\sigma-1}{\sigma}X_{fk1}+\sum_{k\in\mathcal{J}_M}\gamma^j_k X_{k1}\Bigg]+\pi_{fj1}EX_{j1},\quad\forall f,j.$$

Similarly, in the second period, the following equation should be satisfied:

$$X_{fj2} = \pi_{fj2}(1-\pi^F_{j2})\Bigg[\alpha^j\Bigg\{\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^H_k\left(\frac{\sigma-1}{\sigma}\right)X_{fk2}+\sum_{k\in\mathcal{J}_{NM}}\gamma^H_j X_{k2}}_{w_2H_2}+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\frac{1}{\sigma}X_{fk2}}_{=\Pi_2}\Bigg\}$$
$$+\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^j_k\frac{\sigma-1}{\sigma}X_{fk1}+\sum_{k\in\mathcal{J}_M}\gamma^j_k X_{k2}\Bigg]+\pi_{fj2}EX_{j2},\quad\forall f,j.$$

In the data, these conditions are unlikely to hold. Therefore, following Costinot and Rodríguez-Clare (2014) and di Giovanni et al. (2020), we introduce sector-specific wedge $\{\zeta_{jt}\}$ that makes the above market clearing condition to hold exactly, that is,

$$X_{fj1} = \pi_{fj1}(1-\pi^F_{j1})\Bigg[\alpha^j\Bigg\{\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^H_k\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)X_{fk1}+\sum_{k\in\mathcal{J}_{NM}}\gamma^H_j X_{k1}}_{w_1H_1}$$
$$+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\left(1-\kappa_{fk1}\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)\right)X_{fk1}}_{=\Pi_1}+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_j}(\kappa_{fk1}-1)\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)X_{fk1}}_{=T_1}\Bigg\}$$
$$+\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^j_k\left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{\frac{1}{\sigma}}\frac{\sigma-1}{\sigma}X_{fk1}+\sum_{k\in\mathcal{J}_M}\gamma^j_k X_{k1}\Bigg]+\pi_{fj1}EX_{j1}+\pi_{fj1}\zeta_{j1},\quad\forall f,j,$$

and

$$X_{fj2} = \pi_{fj2}(1-\pi^F_{j2})\Bigg[\alpha^j\Bigg\{\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^H_k\left(\frac{\sigma-1}{\sigma}\right)X_{fk2}+\sum_{k\in\mathcal{J}_{NM}}\gamma^H_j X_{k2}}_{w_2H_2}+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\frac{1}{\sigma}X_{fk2}}_{=\Pi_2}\Bigg\}$$
$$+\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^j_k\frac{\sigma-1}{\sigma}X_{fk1}+\sum_{k\in\mathcal{J}_M}\gamma^j_k X_{k2}\Bigg]+\pi_{fj2}EX_{j2}+\pi_{fj2}\zeta_{j2},\quad\forall f,j.$$

Then we apply the hat algebra and then feed the shocks $\hat{\zeta}^S_{jt}=0$, $\forall j,t$ that eliminate the wedges. Other shocks are held constant. We obtain $\{\hat{X}^S_{fjt}\}$ and $\{\hat{X}^S_{jt}\}$ by solving

$$\hat{X}^S_{fj1}X_{fj1}=\hat{\pi}^S_{fj1}\pi_{fj1}$$
$$\times(1-\hat{\pi}^{F,S}_{j1}\pi^F_{j1})\Bigg[\alpha^j\Bigg\{\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^H_k\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)\hat{X}^S_{fk1}X_{fk1}+\sum_{k\in\mathcal{J}_{NM}}\gamma^H_j\hat{X}^S_{k1}X_{k1}}_{\hat{w}^S_1w_1H_1}$$
$$+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\left(1-\kappa_{fk1}\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)\right)\hat{X}^S_{fk1}X_{fk1}}_{=\hat{\Pi}^S_1\Pi_1}$$
$$+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}(\kappa_{fk1}-1)\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)\hat{X}^S_{fk1}X_{fk1}}_{=\hat{T}^S_1T_1}\Bigg\}$$
$$+\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^j_k\left(\frac{\lambda_{k1}}{\kappa_{fk1}}\right)^{\frac{1}{\sigma}}\frac{\sigma-1}{\sigma}\hat{X}^S_{fk1}X_{fk1}+\sum_{k\in\mathcal{J}_M}\gamma^j_k\hat{X}^S_{k1}X_{k1}\Bigg]$$
$$+\hat{\pi}^S_{fj1}\pi_{fj1}\hat{EX}^S_{j1}EX_{j1}+\hat{\pi}^S_{fj1}\pi_{fj1}\hat{\zeta}^S_{j1}\zeta_{j1},\quad\forall f,j,$$

and

$$\hat{X}^S_{fj2}X_{fj2} = \hat{\pi}^S_{fj2}\pi_{fj2}(1-\hat{\pi}^{F,S}_{j2}\pi^F_{j2})\Bigg[\alpha^j\Bigg\{\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^H_k\left(\frac{\sigma-1}{\sigma}\right)\hat{X}^S_{fk2}X_{fk2}+\sum_{k\in\mathcal{J}_{NM}}\gamma^H_j\hat{X}^S_{k2}X_{k2}}_{\hat{w}^S_2 w_2 H_2}$$
$$+\underbrace{\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\frac{1}{\sigma}\hat{X}^S_{fk2}X_{fk2}}_{=\hat{\Pi}^S_2\Pi_2}\Bigg\}+\sum_{k\in\mathcal{J}_M}\sum_{f\in\mathcal{F}_k}\gamma^j_k\frac{\sigma-1}{\sigma}\hat{X}^S_{fk1}X_{fk1}+\sum_{k\in\mathcal{J}_M}\gamma^j_k\hat{X}^S_{k2}X_{k2}\Bigg]$$
$$+\hat{\pi}^S_{fj2}\pi_{fj2}\hat{EX}^S_{j2}EX_{j2}+\hat{\pi}^S_{fj2}\pi_{fj2}\hat{\zeta}^S_{j2}\zeta_{j2},\quad\forall f,j.$$

After solving for $\{\hat{X}^S_{fjt}\}$, $\{\hat{X}^S_{jt}\}$, $\{\hat{EX}^S_{jt}\}$, and $\{\hat{\pi}^{F,S}_{j1}\}$, we obtain the new $\{X^S_{fjt}\}$, $\{X^S_{jt}\}$, $\{EX^S_{jt}\}$, and $\{\pi^{F,S}_{j1}\}$ that satisfy the market clearing conditions. We use the new set of $\{X^S_{fjt}\}$, $\{X^S_{jt}\}$, $\{EX^S_{jt}\}$, and $\{\pi^{F,S}_{j1}\}$ as our main data for the counterfactual analysis.

C.9 Construction of Alternative Subsidies

This appendix describes the construction of an alternative counterfactual in which firms in every sector-region received the same subsidy, while keeping the total amount of subsidies received by firms in each sector-region equal to that in the data.

1. Using the short-run estimates, we calculate the firm-level subsidy rates κ_{fj1}.
2. Based on these firm-level subsidy rates, we calculate amounts of firm-level subsidies provided to each firm:
$$T_{fj1} = (\kappa_{fj1}-1)\left(\frac{\lambda_{j1}}{\kappa_{fj1}}\right)^{\frac{1}{\sigma}}\frac{\sigma-1}{\sigma}X_{fj1}.$$
and amounts of subsidies provided at each region and sector level:
$$T_{nj1} = \sum_{f\in\mathcal{F}_j\cap\mathcal{F}_n}(\kappa_{nj1}-1)\left(\frac{\lambda_{j1}}{\kappa_{nj1}}\right)^{\frac{1}{\sigma}}\frac{\sigma-1}{\sigma}X_{fj1},$$
where $\mathcal{F}_n$ denotes for a set of firms located in region n.
3. Guess $\{\kappa^p_{nj1}\}$ that are constant at region-sector level.
4. Based on the guess, solve the short-run algebra and calculate
$$T^p_{nj1} = \sum_{f\in\mathcal{F}_j\cap\mathcal{F}_n}(\kappa^p_{nj1}-1)\left(\frac{\lambda_{j1}}{\kappa^p_{nj1}}\right)^{\frac{1}{\sigma}}\frac{\sigma-1}{\sigma}X^p_{fj1},$$

where X^p_{fj1} is firm-level sales under the guess.

5. Update κ^p_{nj1} and repeat Step 3-5 until $|T_{nj1} - T^p_{nj1}| < \epsilon$ holds for some threshold ϵ.

Table C1 reports the results, which are discussed in the main text.

Table C1: Robustness: Same Subsidy within Sector-Region. Counterfactual: No Subsidy

Welfare change (%):	(1) Total	(2) Short-run	(3) Long-run
Productivity change:			
Permanent ($\beta = 1.62$)	−26.15	−1.84	−24.31
Temporary ($\beta = 0.90$)	−15.35	−1.84	−13.51

Notes. The table reports the welfare effects under the counterfactual in which the Korean government did not conduct the industrial policy. It uses a subsidy that has the same fiscal cost, but is allocated to all firms within each sector-region uniformly.

C.10 Robustness: Different Parameter Values

Table C2: Robustness. Elasticities of Substitution. Counterfactual: No Subsidy

σ	ρ	β	Welfare loss (%)		
			Total	Short-run	Long-run
(1)	(2)	(3)	(4)	(5)	(6)
3	2	0.9	−12.59	−1.67	−10.92
3	2	1.62	−21.32	−1.67	−19.65
3	3	0.9	−14.36	−2.12	−12.24
3	3	1.62	−24.14	−2.12	−22.02
4	2	0.9	−6.85	−0.66	−6.19
4	2	1.62	−11.80	−0.66	−11.14
4	3	0.9	−7.76	−0.91	−6.85
4	3	1.62	−13.24	−0.91	−12.33
4	4	0.9	−8.77	−1.17	−7.60
4	4	1.62	−14.85	−1.17	−13.68

Notes. The table reports the welfare effects under the counterfactual in which the Korean government did not conduct the industrial policy. The rows differ in the elasticities of substitution σ and ρ and in the values of β, where $\beta = 1.62$ corresponds to the assumption of a permanent technology improvement, and $\beta = 0.9$ to a temporary one.

C.11 Distortionary Taxation

The baseline model assumes that households supply labor inelastically and subsidies are financed through lump-sum taxation. Therefore, subsidies are not distortionary, which may affect the welfare consequences of the subsidies. As a sensitivity check, this appendix introduces upward-sloping labor supply and labor taxes τ_t^h that finance the subsidies. Labor taxes introduce distortions in households' labor supply decisions.

The consumption-leisure tradeoff is GHH (Greenwood et al., 1988). The household solves:

$$\max \sum_{t=1,2} \beta^{t-1} \ln \left(\prod_{j \in \mathcal{J}} C_{jt}^{\alpha^j} - \frac{\varphi_t}{1+1/\psi} H_t^{1+1/\psi} \right)$$

subject to the budget constraint:

$$\sum_{j \in \mathcal{J}} P_{jt} C_{jt} = (1 - \tau_t^h) W_t H_t + \Pi_t,$$

where Π_t is still the total profits, and φ_t is a preference shock to the disutility of labor. Households' maximization implies that

$$H_t^{1/\psi} = \frac{1 - \tau_t^h}{\varphi_t} \frac{W_t}{P_t}$$

and

$$\hat{H}_t^{1/\psi} = \frac{1}{\hat{\varphi}} \frac{1 - \tau_{c,t}^h}{1 - \tau_t^h} \frac{\hat{W}_t}{\hat{P}_t}$$

in changes. Goods market clearing conditions are:

$$X_{c,jt} = (1 - \pi_{c,jt}^F) \left[\alpha^j (1 - \tau_{c,t}^h) \hat{w}_t \hat{H}_t w_t H_t + \sum_{k \in \mathcal{J}} \gamma_k^j c_{kt} m_{kt} \right] + E X_{c,jt}.$$

The other equilibrium conditions are the same as those in Section C.4.

We have to calibrate two additional parameters: ψ and φ_t. We set ψ to be 0.5 following Chetty et al. (2011). For the short-run hat algebra, we set $\hat{\varphi}_t^S = 1$. For the long run, we calibrate $\hat{\varphi}_t^L$ by matching changes in total hours worked by employees between 1982 and 2010. We obtain these changes in hours worked from the OECD Stan database. Similar to the baseline counterfactual without distortionary taxation, we report changes in discounted real consumption. Table C3 reports the results, which are discussed in the main text.

Table C3: Robustness: Distortionary Taxation. Counterfactual: No Subsidy

Real consumption change (%):	(1) Total	(2) Short-run	(3) Long-run
Actual subsidies			
Productivity change:			
Permanent ($\beta = 1.62$)	−21.48	−0.65	−20.83
Temporary ($\beta = 0.90$)	−12.22	−0.65	−11.57

Notes. The table reports the welfare effects under the counterfactual in which the Korean government did not conduct the industrial policy, in the model with distortionary taxation and upward-sloping labor supply.

Table C4: Welfare Multiplier across Sectors

Sector	Short-run (%)	Long-run (%)	Total (%)	Share of Credit (%)
Food, Beverages, and Tobacco	0.2	0.4	0.6	1.6
Textiles, Apparel, Leather	0.2	0.4	0.6	8.0
Pharmaceuticals and Medicine Chemicals	0.2	0.5	0.7	0.0
Other Non-Metallic Mineral Products	0.2	1.4	1.6	7.4
Wood, Paper, Printing, and Furniture	0.4	2.0	2.4	1.5
Machinery and Transport Equipment*	0.2	2.5	2.8	14.3
Chemicals, Petrochemicals, and Rubber and Plastic Products*	0.4	2.6	3.0	38.8
Electrial Equipment*	0.3	3.4	3.7	3.0
Basic and Fabricated Metals*	0.5	5.2	5.7	25.4

Notes. The table reports the welfare changes from subsidizing each sector in the amount of 1% of initial GDP. The last column reports the share of the aggregate HCI drive credit received by each sector in the data. Superscript * denotes the HCI sectors.