Essays on Bank Lending, Industrial Policy, and Firm Performance

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ABSTRACT

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This dissertation analyzes the effect of politically motivated bank lending and industrial policy on firm performance. It first studies zombies firms and political influence on bank lending in China. Zombie firms—indebted firms that are unprofitable and depend on banks or government bailouts for continued operation—are a drag on the economies in which they operate. The existence of zombie firms has been attributed to banks continuing to provide forbearance lending for their own interests. But local political officials may also contribute to keeping zombie firms alive, even in settings without the pressures of electoral cycles. Studying loans in China, I examine how bank lending is influenced by local officials and tracks their appointment cycle. I find that there is significant targeting of firms: lending to zombie firms increases in local officials’ last service year and exhibits an increasing trend across the appointment cycle, while lending to non-zombie firms shrinks in the last service year and decreases across the cycle. I also find that influence is selective: local officials pressure small local banks more to lend to unprofitable firms, but their ability to affect large nationally operated banks appears to be limited.

Second, this dissertation examines the effect of privatization on enterprise performance using evidence from China’s state-owned enterprises reform. The ownership structure of China’s state-owned enterprises (SOEs) has changed dramatically over the past two decades
as a result of privatization reform. Studies of the effect of privatization on enterprise performance are usually subject to selection bias and endogeneity problems. Based on a panel of SOEs from 1998 to 2007, I use a fixed effects model and propensity score matching method to estimate the effect of privatization on enterprise performance, controlling for both time-invariant and time-variant enterprise characteristics. In addition, I distinguish the average effect of privatization from the contemporaneous effect of each round of privatization. Within the sample, privatization leads to an overall increase in productivity, profitability, and innovation activities. Privatization reduces employment temporarily, but enlarges the scale of operations in the long run. The gain in profitability mainly comes from the reduction in administrative expenses and financial expenses.

Third, this dissertation explores the effects of export subsidies on firms’ investment behaviors and export performances. Although it is well acknowledged that export subsidy is an effective way to increase the scale of exports, its effect on other aspects of firm behaviors and export performances has received less attention. I examine the effect of export subsidy on firms’ investment choices in China. To avoid potential endogeneity problems, the empirical analysis uses exogenous variation in the export tax rebate program in China from 2000 to 2006. I find that export subsidy, in the form of export tax rebate, affects firms’ investment in advertising, R&D activities, and human capital accumulation positively. It has a positive impact on firms’ total export value, average export price, and average estimated quality. In addition, the effect is heterogeneous: it is stronger for non-state firms and less technology-intensive firms.
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Chapter 1

Zombie Firms and Political Influence on Bank Lending in China
1.1 Introduction

Corporate credit growth in China has averaged around 20% per year between 2009 and 2015. This credit boom is related to the large increase in investment after the global financial crisis. However, investment efficiency has fallen, and there is evidence of overcapacity in several industries.\(^1\) The financial performance of firms has deteriorated steadily, affecting asset quality in financial institutions. Loans potentially at risk account for 15.5% of total commercial bank loans to the corporate sector (Maliszewski et al., 2016). In particular, a large group of “zombie firms” has been detected. Zombie firms, as the name suggests, are the “walking dead” in the economy. They are “dead” in the sense that these firms are highly indebted and financially distressed—their profitability is so low that they cannot pay back the interest or principal on their loans. On the other hand, they are “walking”, as these firms continue operating in the market while depending heavily on banks or government bailouts, though they would have exited the market otherwise.

In this paper, I examine one possible reason for the prevalence of zombie firms in China: the political cycle of local party officials who have an incentive to influence bank lending in order to improve their career prospects within the party. Previous work has highlighted an electoral cycle in lending (Dinc, 2005; Cole, 2009; Carvalho, 2014; Englmaier and Stowasser, 2017), but to my knowledge, a political cycle has not been documented in a bureaucratic system such as that of China. I provide evidence that although local party

\(^1\)See European Union Chamber of Commerce in China (2016) for a review of China’s overcapacity problem.
officials are appointed rather than elected, bank lending is manipulated by prefecture Party Secretaries (the highest ranking official in a prefecture) and tracks their appointment cycles. Specifically, lending to zombie firms increases at the end of the cycle mainly through local banks when a new appointment is close, while lending to non-zombie firms is the greatest early in the cycle through national banks.²

My identification strategy is straightforward. In China, each prefecture Party Secretary has a scheduled service term of five years. At the end of the term, a higher-level Party Committee (province-level in this case) will make a (re-)appointment decision on the incumbent prefecture Party Secretary: promotion, demotion, stay, or transfer. A new prefecture Party Secretary will be assigned if the incumbent leaves. By comparing bank lending in the critical appointment year—the last service year in the term of service prior to scheduled appointment—to lending in off-appointment years, I can test for potential political manipulation of lending to serve the career advancement interests of local Party Secretaries. Using a dataset on individual loans of publicly listed firms and aggregating them to the prefecture level, I can examine whether the intensity of political influence on bank lending varies by the type of firms and banks.

Based on the dataset on individual loans from national and local banks to all publicly

²In this paper, banks are categorized as local banks or national banks by operating scope, not by ownership structure. A bank is defined as a national bank if it has local operating branches across the country. National banks include both state-owned banks and joint-stock banks. A bank is defined as a local bank if it operates in one prefecture or several adjacent prefectures. Local banks include urban/rural commercial banks, credit unions, and village and town banks. For details on banks in China, refer to Section 1.2.
listed firms in China from 2000 to 2016, I find that bank lending does not respond to the last service year or appointment year of Party Secretaries on average. But this average effect masks significant heterogeneity: lending to zombie firms dramatically increases in the last service year (by 228%) and exhibits an increasing trend across the cycle, while lending to non-zombie firms shrinks in the last service year (by 87%) and decreases gradually across the cycle. In addition, the political influence on banks is selective: Party Secretaries can pressure small local banks more to lend to zombie firms, but their ability to influence large nationally operated banks is limited. I also find suggestive evidence that the effort of bailing out zombie firms does not improve firm performance later on: zombie firms show lower efficiency after a new Party Secretary is assigned, while their profitability does not change significantly. Lending to zombie firms is a short-term instrument used by Party Secretaries to boost local economic performance in the critical promotion period, and it does appear to help Party Secretaries move up the career ladder.

This paper brings together two strands of literature: the literature on political cycles in lending and the literature on zombie firms. First, this paper provides evidence of the effect of a political cycle in a bureaucratic system as opposed to an electoral system. Motivated by the idea of pre-electoral manipulation of macroeconomic and fiscal policies to enhance the probability of electoral success, numerous empirical studies on political cycles have been done in both developed and developing countries.³ It is widely believed that opportunistic

³Drazen (2001) provides an excellent review of the literature.
political cycles are stronger for developing countries that are new democracies, where weak institutional structures allow for greater political discretion over policy instruments (Akhmedov and Zhuravskaya, 2004; Shi and Svensson, 2006; Brender and Drazen, 2008). This paper is most closely related to the literature on political cycles in lending. There is cross-country evidence of increased lending from government-owned banks in election years relative to private banks (Dinc, 2005). Similar patterns and tactical redistribution (more loans are made in more competitive areas) are found in India for agricultural credit lent by government-owned banks (Cole, 2009), in Brazil for state-owned banks to shift employment toward politically attractive regions (Carvalho, 2014), and in Germany for savings banks that are controlled by local politicians (Englmaier and Stowasser, 2017).

This paper complements these studies by providing evidence of the effect of a political cycle in a bureaucratic system, as opposed to an electoral system. In China, the Communist Party-government dual administrative system arranges a hierarchy by which the Party leader is in charge of determining the directions of policies as well as personnel changes, and the corresponding government leader is responsible for implementing Party policy and arranging the annual budget, as well as other everyday government matters. The Party Secretary, the highest ranking politician at any administrative region division level, is appointed by higher-level Party organizations rather than directly elected by voters. The fact that local Party officials are not subject to elections would seem to insulate them from political pressures. However, I find political manipulation of bank lending across the appointment cycle.
Another contribution of this paper is that it leverages individual loan information between each firm and bank to explore potential heterogeneity of borrowers and lenders. Previous studies on bank credit manipulation mainly use aggregate lending data (e.g., at the district level) and thus cannot track the specific origin (lending bank) and destination (borrowing firm) of the loans. This paper uses individual lending data (at the firm-bank level) and can observe characteristics of the borrowing firms and lending banks. This method allows me to distinguish between loans to zombie firms and loans to healthy firms and between loans from small local banks and loans from large national banks. Although the analysis is largely conducted at the prefecture level (the level of variation of the political cycle), the loan-level data allows me to construct prefecture-level aggregates by type of firm (zombie/non-zombie) and type of bank (local/national).

This paper is also related to the literature on zombie firms. The phenomenon of zombie firms was first recognized in Japan. It is often claimed that one factor contributing to Japan’s economic weakness in the 1990s is that Japanese banks have continued to provide financial support for highly inefficient, debt-ridden zombie firms (Caballero et al., 2008; Hoshi and Kashyap, 2010; Fukuda and Nakamura, 2011). Zombie firms have also been detected in other developed economies such as the United States (Wilcox, 2008), Korea (Hoshi and Kim, 2012), England (Arrowsmith et al., 2013), Italy (Albertazzi and Marchetti, 2010), the European Union (Bruche and Llobet, 2014), and transition economies such as Russia (Papava, 2010).
The related literature on zombie firms mainly focuses on their negative impacts on aggregate outcomes from a macro perspective (Fukuda et al., 2006; Caballero et al., 2008). The prevalence of zombie firms has been proven to be costly to the economy. There is extensive macroeconomics literature showing that zombie firms depress market prices, congest markets, distort credit allocation, and crowd out healthy firms (Ahearne and Shinada, 2005; Caballero et al., 2008; Hoshi and Kim, 2012; Tan et al., 2017). The congestion created by zombies reduces the profits for healthy firms and prevents more productive firms from gaining market share, strangling a potentially important source of productivity gains for the overall economy.

Unlike studies that take the existence of zombie firms as given and examine their impacts, in this paper, I take a step back and examine why zombie firms exist in the first place from a political cycle perspective. In the literature, the existence of zombie firms has been mainly attributed to banks continuing to provide forbearance lending for their own business interests (Peek and Rosengren, 2005; Watanabe, 2011; Ueda, 2012). When faced with an insolvent borrower, a bank usually is not willing to immediately start the liquidation process because it does not want to recognize the loss and lead its own balance sheet to deteriorate. Instead, it will reduce the interest payment, roll over the loan, or issue new loans for the firm to pay back the old loan, expecting the firm to recover soon or the government to bail it out. Moreover, by downgrading the loan, the bank will automatically reduce its capital adequacy ratio (CAR), which, if it falls below a minimum regulated level, will
induce large adjustment costs. Therefore, a minimum CAR constrained bank (CAR lower than 8% in China) will try to avoid downgrading the loan in order to maintain its CAR. Third, the problem can be compounded by the existence of lending promises (Tanaka, 2008; Giannetti and Simonov, 2013), bank-firm affiliations (Peek and Rosengren, 2005), and government-firm connections (Khwaja and Mian, 2005).

Political manipulation of bank lending is largely omitted from the literature on zombie firms. The existing literature on the role of government in creating zombie firms is mostly descriptive and interprets the role of government as a passive, imperfect regulator. When faced with a growing budget deficit and a voting public weary of funding bank bailouts, the government may loosen supervision and allow banks to continue their forbearance lending policy in order to avoid massive firm bankruptcies and bank failures and the associated financial and political costs (Peek and Rosengren, 2005; Chernobai and Yasuda, 2013; Kawai and Morgan, 2013; Willam, 2014; Jaskowski, 2015). Nevertheless, in China and many other developing economies with immature financial systems, local Party officials may actively influence bank lending and provide targeted favors to different groups of firms.

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4The capital adequacy ratio (CAR) is the ratio of capital to risk-weighted (adjusted) assets. If a loan, which is an asset for the bank, is downgraded to a riskier level, i.e., its risk weight increases, CAR will be reduced. CAR reflects whether a bank has sufficient capital to buffer losses while still honoring withdrawals. A minimum capital requirement determines how much liquidity is required to be held for a certain level of assets. For example, Basel III, an international regulatory framework for banks, requires that banks maintain a minimum CAR of 8%.

5In 2004, China adopted the Measures for the Management of Capital Adequacy Ratios of Commercial Banks and enforced a minimum CAR of 8% on all banks. Banks with CAR below 8% will be forced to undertake corrective measures, including raising capital level and restricting the growth rate of new loans, which will lead to great costs for the banks.
during their term of office to serve their own career interests. As a result, at some critical moment, local officials may actively pressure banks into over-lending and keeping zombie firms alive.

Local officials target zombie firms (or more generally, target different types of firms in different periods) because of career concerns. In China, the personnel control of the Chinese Communist Party (CPC) and government leaders has a highly centralized structure. Higher-level officials control the selection and (re-)appointment of lower-level officials. Economic performance is the most important indicator in personnel evaluation.6 Under this performance-based promotion scheme, or “promotion tournaments”, as they are called in Zhou (2005), local officials have strong incentives to build up the local economy to beat their peers.

To boost economic growth, local officials may pressure banks to increase lending to firms to promote local investment. The payoff to investments may be lagged. Thus, it may be more beneficial for local officials to direct more lending to healthy firms early and realize profits gradually in their term of service and to direct more lending to zombie firms late, when the loans may help to avoid a surge in unemployment and massive bankruptcies. Employment and social stability are also factors in personnel assessment. Bailing out zombies is one of the limited short-term instruments that can be used by local officials to

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6At any administrative level, each official’s performance is individually distinguishable and comparable to peers, which allows for a sensible link between performance and turnover (Li and Zhou, 2007).
maintain performance temporarily.

The third contribution of this paper is to add to the literature on zombie firms by providing new evidence on the causes of zombie firms from the political cycle perspective as described above. Local officials, instead of simply taking a regulator’s stand and turning a blind eye to banks’ forbearance lending behavior, may actually have strong incentives to tactically manipulate bank credit and pressure banks into over-lending to specific interest groups in critical (re-)appointment years for promotional success. It suggests that the current corrective measures that emphasize reinforcing regulation on banks to eliminate zombie firms may not truly work, unless political influence and banks’ independent lending decisions can be separated.

This paper proceeds as follows. In the next section, I introduce the institutional background of politics and banks in China, including how local officials influence banks. Section 1.3 develops the empirical strategy. In Section 1.4, I summarize the data used in the paper and describe how to identify zombie firms and solve potential endogeneity concerns. Section 1.5 presents the main results regarding political influence. Section 1.6 discusses the impacts of targeted favors on the performance of zombie firms and on the probability of promotion for local officials. Section 1.7 concludes.
1.2 Institutional Background

1.2.1 Politics in China

1.2.1.1 Executive Levels of Local Officials

In China, the administrative divisions are structured in a hierarchy on six different levels. From the highest to the lowest, they are provinces (sheng), prefectures (di), counties (xian), townships (xiang), and villages (cun). Each level in the hierarchy is responsible for overseeing the work carried out by lower levels. At each level, corresponding to the Communist Party and government’s dual administrative system, there are two officials or leaders (termed cadres in the Communist lexicon) who are the most important.

The first key official that represents the Communist Party of China (CPC), commonly called the Party Secretary, is the leader of the CPC organization in the administrative region. Party Secretary is the de facto highest-ranking political official in his or her area of jurisdiction. As the policy maker, Party Secretary is responsible for policy formulation and personnel management. Party Secretaries are selected and appointed by their superiors at higher levels. The second key official is the head of the local government, usually called the governor (at the province level), mayor (at the prefecture level), or magistrate (at the county level). This figure is the second-highest-ranking official, who usually serves concurrently as the “Deputy Party Secretary” in the local CPC organization. The head of the local government is in charge of the day-to-day execution of policies made by the Party Secretary.
Theoretically, mayors are “elected” by the local People’s Congress under the indirect hierarchical electoral system. However, candidates are nominated by the Party, and the People’s Congress is supposed to implement the recommendation. Since the Party Secretary is always in precedence above the head of the local government at each administrative level, I focus on the Party Secretary as my main unit of analysis.

A fundamental principle of the Chinese leader (cadre) system is that the Communist Party is in firm control of the leader system, especially with regard to the leaders’ appointment and promotion. A multilayer stratified leader management system has been adopted. The system delegates powers of leader management to Party committees at each level and sets up a one-level-down leader management formula (i.e., a Party Committee and its Organization Department are in charge of leader management for the next lower level). Specifically, the central Party authority is responsible for supervising leaders at the provincial level; provincial Party Committees manage leaders at the prefectural level; prefectural Party Committees take care of leader management affairs at the county level; and county Party Committees are in charge of overseeing leaders at township level.

1.2.1.2 Term of Office

According to the Interim Provisions on the Term of Office for the Leaders of the Party and Government (2006), the term of office of all Party and government leaders shall be five years (Provision 3). In addition, leaders should remain stable during their term of office and
stay for a full term of five years, except for the following special cases: (1) reaching the retirement age of 65; (2) under bad health conditions; (3) being unequal to the position and requiring adjustment; (4) voluntarily resigning or being forced to resign; (5) being punished and dismissed; and (6) special work needs (e.g., being rotated to a new region at the same administrative level) ( Provision 4). Leaders shall stay in the same position for at most two terms ( Provision 6).

In practice, new appointments frequently occur before they are scheduled. From 2000 to 2016, the average term of office for 1,443 Party Secretaries from 334 prefectures was 4.5 years. As there is evidence that Party Secretaries who serve for more than one term may have different incentives in the second five-year period (Zhang and Gao, 2007), I restrict my sample to Party Secretaries who have a term of office less than or equal to five years (namely who serve for one term only) to make the analysis cleaner.

1.2.1.3 Selection and Appointment of Party Secretaries

To examine the potential manipulation of bank lending by Party Secretaries in their last service year, a natural concern is whether to keep the first five service years of Party Secretaries who serve for two terms. The key to this question is, in the fifth year of service (the critical promotion year), do Party Secretaries know in advance whether they are likely to be promoted or to stay in the same place for a second term? If the chances can be at least vaguely known prior to the (re-)appointment decision, then Party Secretaries who have
slim chance (and finally stay for a second term) will not have strong incentives to boost performance and particularly help zombie firms in their fifth year. Thus, including the first five years of their service will tend to attenuate the last year manipulation effect on bank lending. The answer is yes.

The selection and appointment of Party Secretaries follows the Regulations on the Work of Selecting and Appointing Leading Party and Government Cadres and is presided over by the Organization Department of the Party Committee at the higher level. As shown in Figure 1.1, it takes a five-step procedure: Proposal, Democratic Recommendation, Appraisal, Discussion and Decision, and Appointment. Leaders of the Party Committee and the government shall, as a rule, be selected from backup candidates.

First, the Party Committee and its Organizational Department (at the higher level) make preliminary suggestions and form a plan for appointing and selecting new leaders. Second, it determines the candidates for appraisal through a democratic process of recommendation.
The methods for recommending candidates include voting at meetings and interviewing individuals. The results of recommendations shall be valid for one year. Third, determined candidates will be assessed in an all-around manner, including integrity, ability, diligence, performance, and honesty, with the emphasis on their actual achievement. Information is acquired by interviews of individuals, the issuance of questionnaires, democratic opinion polls, on-the-spot investigations, perusal of relevant files, investigation of specialized items, and interviews of candidates. Fourth, the Party Committee discusses and decides on the appointment or removal of leaders. A vote shall be cast, and the decision shall be adopted if half of the Party Committee members who are entitled to attend the meeting vote in favor. Fifth, public notification before the appointment of a Party or government leader is implemented. There will be a probationary period of one year. When the appointment of a leader is decided upon, the Party Committee shall designate a person to inform the appointee.

The whole procedure can take a few months to a year. Party Secretaries know whether they are in the pool of candidates to be promoted at least from Step 3, when they are interviewed as a part of appraisal and assessment. In practice, they may obtain access to the information even earlier. Feng (2010) conducted field work in Zhong County (a county in Beishan Prefecture, Henan Province), investigated the changes and promotion of local leaders since 1978, and provided a panorama of Zhong County leaders and their complete political careers. Feng’s study provided evidence on leaders knowing the recommendation voting results (Step 2), campaigning for votes, and lobbying the higher-level leaders to support them in further steps. Campaigning often includes providing entertainment and bribes
to higher-level leaders.

"Bribe usually takes place before voting: 1000 yuan for Section-Head level (Party Secretaries of Townships) leaders; 2000 yuan for Deputy-Division-Head level (Deputy Party Secretary of Counties) leaders; more for higher level leaders. There are 260 leaders at the Section-Head level in Zhong County. You have to bribe most, if not all, leaders. ... Entertainment is a way to cultivate affection. Many Party Secretaries know that bribe is not enough. Frequent social interactions are necessary to cultivate mutual respect and understanding, so that they will vote for you."

As Party Secretaries know their status in the pool of candidates in the early stages of the appointment procedure, those who are in the pool and rank high will have different motivation from those who rank low or are not even in the pool. The latter group tends to be less motivated to put great effort in the last service year and become Party Secretaries who stay for more than one term. In summary, in the last service year, Party Secretaries are likely to know in advance their chances of being promoted. Those who are not in the promotion pool will stay in the same position for the second term. They may not have incentives to boost performance in the fifth year. Thus, including the first five years may underestimate the effect of the last year on lending.

1.2.2 Banks in China

China has a bank-centered financial system and an underdeveloped capital market, which makes it difficult for firms to raise external financing from the bond or equity market (Allen et al., 2005). According to the National Bureau of Statistics of China, the bank credit to
GDP ratio in China was approximately 112% in 2013, and banks provided about half of the total financing for Chinese firms.

I divide all the banks into two broad categories: national banks and local banks. Here, “national” does not indicate that the bank is controlled by the state. Instead, a bank is defined as a national bank if it operates nationally and has local branches across the country. In this group, there are three policy banks\(^7\), four state-owned commercial banks (the “Big Four”)\(^8\), and twelve joint-stock commercial banks (JSCBs)\(^9\). They have local branches across the country in almost all provinces, prefectures, and counties. Although there may be (central) state shares in their ownership structure, the local branches of these national banks are not affiliates of the local government. Thus, local officials have relatively limited control over these banks.

A bank is defined as a local bank if it operates only in one prefecture or several adjacent

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\(^{7}\)The three policy banks include the Agricultural Development Bank of China (ADBC), China Development Bank (CDB), and the Export-Import Bank of China (Chexim). They were established in 1994 to take over the government-directed spending functions of the four state-owned commercial banks. These banks are responsible for financing economic and trade development and state-invested projects.

\(^{8}\)The four state-owned banks include the Bank of China (BOC), the China Construction Bank (CCB), the Agricultural Bank of China (ABC), and the Industrial and Commercial Bank of China (ICBC). Each bank specializes in providing financing to different sectors.

\(^{9}\)The twelve Joint-Stock Commercial Banks include China Merchants Bank (Merchants), CITIC Industrial Bank (CITIC), Shanghai Pudong Development Bank (Pudong), China Minsheng Banking Corporation (Minsheng), Fujian Industrial Bank (Industrial), China Everbright Bank (Everbright), Guangdong Development Bank (GDB), Huaxia Bank (Huaxia), Hengfeng Bank (Hengfeng), Shenzhen Development Bank (SDB), Huishang Bank (Huishang) and Bohai Bank (Bohai). Their capital is partly held by the state, mainly either directly through the Ministry of Finance or Central Huijin Investment Company Limited or indirectly through SOEs. Some also have been invested in by foreign entities.
prefectures. This group includes hundreds of urban/rural commercial banks, credit unions, and village and town banks. Many of them were founded on the bases of urban/rural credit cooperatives. Most urban commercial banks have strong ties to their local government, and the majority of shares are owned by the local state. Since 2005, some urban commercial banks started to diversify their shareholders by inviting Chinese and foreign private companies to take minority shares, merging, and cross-shareholding. Some of the banks have even listed their shares. The urban commercial banks’ market orientation is toward supporting the regional economy and financing local infrastructure and other government projects. As the local government is the largest shareholder (typically 30%) of urban commercial banks, local officials usually have actual control over the activities of these banks. They can appoint bank managers or organize meetings to ask for support for local projects from these banks.

Local officials are able to channel money through banks to targeted firms because they have varying degrees of control over different types of banks in their jurisdiction, as described above. However, this is not the only way local officials mobilize credit resources. On the other hand, as local governments are prevented from borrowing directly from financial markets, they may turn to borrow indirectly from banks via local government financing platforms (LGFPs) and award unprofitable firms large-scale projects to increase their productive capacity (Tan et al., 2016).

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10Local government financing platforms (LGFPs) are corporate vehicles for local governments to engage in local public welfare projects, such as affordable housing construction, infrastructure, social services, and ecological and environmental protection (Lu and Sun, 2013). LGFPs are set up, fully owned and operated by local governments to borrow money from the banking and financial system to promote local infrastructure development.
1.3 Empirical Strategy

1.3.1 Instruments for Last Service Year and Appointment Cycle

The most straightforward approach to test for temporal political manipulation in the last service year is to compare the amount of bank lending in (re-)appointment years (the last service years) to the amount of bank lending in non-appointment years. Specifically, the first step is to define the indicator for a new Party Secretary coming into force, $New_t$. In reality, (re-)appointment of a new Party Secretary can occur at any time in year. Around 50% of the (re-)appointments occur before June, while the remaining occur after June. I define an indicator for a new Party Secretary coming into force: $New_t$. Similar to Zhang and Gao (2007), in a given year, (1) if there is a new Party Secretary being appointed, and the appointment occurs before June 30, then $New_t = 1$ for the current year; (2) if a new Party Secretary is appointed but the appointment occurs after June 30, then $New_t = 1$ for the next year, and $New_t = 0$ for the current year; (3) if there is no appointment, then $New_t = 0$ for the current year. Therefore, $New_t$ represents the first year of a new Party Secretary coming into power in the prefecture.

The next step is to define the indicator for the de facto last service year of the incumbent Party Secretary $Last_t$. For each prefecture, $Last_t = New_{t+1}$. Suppose a new
appointment occurs on March 1, 1998, in a prefecture, then $New_{1998} = 1$, $Last_{1997} = 1$, and $Last_{1998} = 0$. Suppose another new appointment occurs on September 1, 2001, then $New_{2002} = 1$, $New_{2001} = 0$, and $Last_{2001} = 1$. Table 1.1 provides an example to show how $New_t$ and $Last_t$ are defined.

Table 1.1: Definition of Last Service Year Indicator

<table>
<thead>
<tr>
<th>city_id</th>
<th>year</th>
<th>secretary_id</th>
<th>New</th>
<th>Last</th>
<th>Term</th>
<th>$S^{-t}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1997</td>
<td>A</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1998</td>
<td>B</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1999</td>
<td>B</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2000</td>
<td>B</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2001</td>
<td>B</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2002</td>
<td>B</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2003</td>
<td>C</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2004</td>
<td>C</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2005</td>
<td>C</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2006</td>
<td>C</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2007</td>
<td>D</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2008</td>
<td>D</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2009</td>
<td>D</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2010</td>
<td>D</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2011</td>
<td>E</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2012</td>
<td>E</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2013</td>
<td>F</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2014</td>
<td>F</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2015</td>
<td>G</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2016</td>
<td>G</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2017</td>
<td>G</td>
<td>0</td>
<td>—</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

In reality, the timing of new (re-)appointment is not fixed and subject to some changes, and thus, the actual “last service year” is uncertain and can be endogenous. A typical cause of an early (re-)appointment is a new vacancy in the Party Committee at the higher level (in this case, the province level). On the one hand, if the incumbent Party Secretary is
promoted unexpectedly in the middle of the scheduled term of office before he/she could
direct more loans to zombie firms, the last year effect on bank lending to zombie firms will
be underestimated. On the other hand, if early (re-)appointments only occur when the local
economic performance is particularly good, a spurious correlation between bank lending
and appointment years may be observed and the last year effect will be overestimated.

Similar to Khemani (2004) and Cole (2009), I use a dummy as an instrument for the actual
last service year, $S^{-0}$, for whether five years have passed since the previous “last service
year” (thus, 0 year left until the next scheduled appointment). This “scheduled last service
year” is a predictor of the “actual last service year”. To avoid having the instrument only
assign scheduled last service years ($= 1$) to years $t, t + 5, t + 10,$ and $t + 15$, I reset the
instrument after an early (re-)appointment. Table 1.1 also illustrates how to define $S^{-0}$.

If the instrument is not reset after an early appointment, the weak instrument problem
becomes a concern. This can be shown by tabulating the term of office for the next Party
Secretary following the current Party Secretary. As shown in Table 1.2, the rows represent
the term of current Party Secretary, ranging from 1 year to 5 years, and the columns
represent the term of next Party Secretary following the current one. Following the current
Party Secretaries who serve for 1 year or 2 years, the majority of the next Party Secretaries
have a term of 3 years (29% and 28%, respectively). Following the current Party Secretaries
who serve for 3 years, the majority of the next Party Secretaries have a term of 2 years
(30%). Following the current Party Secretaries who serve for 4 years or 5 years, the majority
of the next Party Secretaries have a term of 5 years or 4 years (27% and 29%, respectively).
This finding suggests that a full term of five years is rarely reached following an early appointment. Thus, if the instrument simply assigns the scheduled last service year (\(= 1\)) to years \(t\), \(t+5\), \(t+10\), and \(t+15\) and is not reset after an early appointment, its explanatory power in the first stage tends to be very weak.

<table>
<thead>
<tr>
<th>Term of Current Party Secretary (%)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Term of Next Party Secretary</td>
<td>8</td>
<td>20</td>
<td>29</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>2. Term of Current Party Secretary</td>
<td>14</td>
<td>25</td>
<td>28</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>3. Term of Current Party Secretary</td>
<td>13</td>
<td>30</td>
<td>21</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>4. Term of Current Party Secretary</td>
<td>12</td>
<td>23</td>
<td>19</td>
<td>19</td>
<td>27</td>
</tr>
<tr>
<td>5. Term of Current Party Secretary</td>
<td>13</td>
<td>18</td>
<td>21</td>
<td>29</td>
<td>18</td>
</tr>
</tbody>
</table>

Analogously, to examine how bank lending tracks the actual appointment cycles, which are potentially endogenous, I define an instrument appointment cycle, which follows a 5-year cycle that begins anew after every early appointment (Khemani, 2004; Cole, 2009). Specifically, I define five indicators: \(S^{-k}\) (\(k = 0, 1, 2, 3, 4\)), reflecting the \((5 - k)\)th year of service. Thus, the current Party Secretary expects \(k\) years left until the scheduled last year of the term. For example, \(S^{-4} = 1\) indicates the first year of service; thus, the Party Secretary expects 4 years left until the scheduled last service year of the term. Similarly, I reset the instrument after an early appointment to avoid the weak instrument problem.
1.3.2 Targeting of Firms and Banks

To test for which types of firms and banks are being targeted by local officials, I use individual loan information (at firm-bank level) between each firm and bank to explore the potential heterogeneity of borrowers and lenders. With information on the characteristics of borrowing firms and lending banks, I can separate loans into different bins according to the type of borrower and lender and make distinctions between loans to zombie firms and loans to healthy firms, loans from small local banks and loans from large national banks, as well as their interactions. Specifically, I first divide all loans into two bins: loans to zombie firms and loans to non-zombie firms. Then, I aggregate the loans in each bin separately to the prefecture level to examine which firms are provided with targeted favors. I also divide all loans into another two bins: loans from local banks and loans from national banks. Similarly, I aggregate the loans in each bin separately to the prefecture level to examine which banks are being pressured to increase lending more across the appointment cycle. Finally, I interact the two sets of bins to show a complete picture of bank lending manipulation in the last service year and the appointment cycle of local officials.

1.4 Data and Estimation

1.4.1 Data Description

My analysis makes use of five datasets.
1.4.1.1 Loans

The data on loans from all commercial and policy banks to publicly listed firms come from China Listed Firm’s Bank Loans Research Database, established by GTA Information Technology Company (CSMAR). \(^\text{11}\) As far as I know, this is the only database that provides detailed information on individual loans for each publicly listed firm obtained from banks and nonbank financial institutions in China. My sample contains 59,961 loans from 772 banks to 2,591 firms from 2000 to 2016. On average, there are 3,331 loans per year. The advantage of the database is that, for each firm, it not only documents which bank the loan comes from but also the local branch of the bank (at the prefecture and finer levels). This allows me to aggregate loans to the prefecture level and distinguish between loans from national banks and loans from local banks.

One issue with the database is that the local bank branch information is not reported exactly at the prefecture level. There are 30\% of observations with ambiguous locations that are reported at finer levels (e.g., township, village, and street levels), which may not correspond to a unique prefecture. For these observations, I identify the prefecture by mapping these towns, villages, and streets to the prefectures to which they belong. When

\(^{11}\) Publicly listed firms represent a relatively limited sample of firms in China. Lending to small and medium non-publicly listed firms is not included, as these firms are not required by the regulators to report individual borrowing information. An approximation of loans to non-publicly listed firms can be achieved by extracting the short-term debt and long-term debt information from the balance sheet of each individual firm, which is accessible from databases such as Chinese Industrial Enterprise Database (CIED). Thus, the last year effect on lending to zombie firms among nonpublicly listed firms can be estimated and compared to the results in this paper. However, it is impossible to distinguish between loans from local banks and loans from national banks, as firms do not report their creditors in their financial statements.
the prefecture is not unique, I try to identify the prefecture by tracking the borrowing history of the firm and choose the most likely prefecture in which the local branch lies. There are also 15% of observations without local branch information. For these observations, I impute the missing location with a simple algorithm, which is described in more detail in Appendix I. Following this algorithm, I extrapolate local branch information for 4,002 observations, which increases my sample size by 8%.

However, when individual loans are aggregated to the prefecture-year level, there are still cases where missing loans are detected in a random number of years in a prefecture-cycle. Here, a prefecture-cycle indicates an appointment cycle of a Party Secretary in a prefecture. The missing loan problem is particularly serious for the subsample of loans from local banks to zombie firms, as loans from local banks account for 14% of all loans, and loans to zombie firms only account for 12% of all loans.

For example, the publicly listed firm *China Southern Glass* was a zombie firm in 2009 and received 42 loans in that year. In the original dataset, none of these 42 loans have records of bank local branch information and thus are supposed to be dropped from the analysis because of missing prefectures. Using the algorithm described above, 19 of the loans are recognized as zombie loans and assigned to a prefecture. The remaining 23 loans are not recognized as zombie loans and dropped from the sample. In comparison, in 2008, this firm borrowed from all prefectures recognized in 2009 and an additional prefecture: Yichang. It is possible that the missing prefectures in 2009 include this additional prefecture. For each
zombie firm, the seriousness of missing prefectures varies.

In order to fill in the loan gaps (at the prefecture-year level), I follow Verhoogen (2008) and impute the missing loans by regressing aggregate loan values (in logs) on the following variables: one-year lead and one-year lag of the same variable, the current value, and one-to-four-year lags of local GDP growth, unemployment rate, fiscal surplus ratio (the ratio of fiscal surplus to GDP), fixed asset investments (in logs), year fixed effects, and prefecture-cycle fixed effects. The predicted values from the regression are imputed for the missing loans. If a lead and/or lag of any independent variable is missing, I impute the missing loans with the predicted values from an analogous regression without the lead and/or lag.

1.4.1.2 Firms

The data on firms come from the Chinese Stock Market & Accounting Research Database, also established by GTA Information Technology Company (CSMAR). This database contains basic information (e.g., name, registered address, ownership structure, and initial number of employees) and financial statement information (asset, liability, capital, sales revenue, costs, financial expenses, and gross and net profit) of all publicly listed companies in China. There are 31,925 observations in my sample, which includes 3,231 firms, from 2000 to 2016. On average, there are 1,774 firms per year. As many of observations have missing information on interest expense, I supplement the CSMAR database with the
The data on local government officials come from two sources: GTA Information Technology Co., Ltd., and Fudan University Social Science Lab. The database on prefectural Party Secretaries is a balanced city-year panel, containing 1,443 Party Secretaries from 334 prefectures, from 2000 to 2016. Personal information such as name, birth year and place, education, undergraduate major, working experience, and party membership for each government official is documented in the database. As shown in Figure 1.2, in the whole sample, the average term of service for all Party Secretaries is 4.5 years. In the subsample of Party Secretaries who serve for one term only, the average term of service is 3.6 years. I use the one-term subsample in the analysis to avoid changing incentives in the second term.
1.4.1.4 Banks

The data on banks come from Orbis Bank Focus (previously known as BankScope), established by Bureau van Dijk Electronic Publishing. BankScope is a database of banks worldwide. It contains financial information, asset quality and capital adequacy information at the individual bank level. It includes 302 banks in China, from 2010 to 2016. Since it only keeps 6 years of history for listed banks and 4 years of history for unlisted banks, I supplement this database with another two databases on banks: the Chinese Banks Financial Research Database (a sub-database of CSMAR) and the Wind Economic Database.
1.4.1.5 Prefecture Characteristics

The data on prefecture-level characteristics come from the CEIC China Premium Database. In this database, fixed asset investment, urban population, GDP, fiscal revenue and expenditure, and unemployment can be observed at the individual prefecture level from 2000 to 2016.

1.4.2 Identifying Zombie Firms

As in most of the literature on zombie firms, the definition of zombie firms in this paper focuses on two key aspects. First, zombie firms are close to or already in insolvency, i.e., their profit is too low to cover interest payments on loans. Second, zombie firms receive extremely subsidized loans from their lending banks, i.e., they obtain very favorable interest rates on their loans.

Following Caballero, Hoshi, and Kashyap (2008), I start with identifying zombie firms as firms that receive extremely subsidized lending from banks (the second aspect). To put it differently, firms are identified as zombie firms if they are actually paying an interest ($R_t$) that is lower than the minimum required interest payment ($R_t^*$) in the market. The first step is to calculate the minimum required interest payment ($R_t^*$). I select interest rates that are extremely advantageous for the firm (the lowest interest rates possible in a normal market); thus, $R_t^*$ is in fact less than what most firms would pay in the absence of bank subsidization.
$R_t^*$ is defined as:

$$R_t^* = r_{s_{t-1}}BS_{t-1} + \left( \frac{1}{5} \sum_{j=1}^{5} r_{l_{t-j}} \right) BL_{t-1}$$

where $r_s$ and $r_l$ are the short-term (< 1 year) and long-term (1-3, 3-5, and ≥ 5 years) prime rate for loans suggested by the People’s Bank of China (the central bank). The actual interest rate of a firm loan is usually the prime rate plus a positive risk premium; thus, it is higher than the suggested prime rate. $BS$ and $BL$ are the short-term and long-term bank loans of a firm, respectively. Calculated using the prime rates, $R_t^*$ represents the lower bound a firm would pay for its loan under normal conditions.

The next step is to calculate the gap between actual interest payment ($R_t$) and the minimum required interest payment ($R_t^*$). The interest gap is defined as:

$$\text{gap}_t = R_t - R_t^*$$

The third step is to generate the zombie indicator. A firm is identified as a zombie firm if the interest gap is below zero:

$$z_t = 1\{\text{gap}_t < 0\}$$
A major concern of this method is that it may misidentify healthy firms as zombie firms. Specifically, profitable firms with good reputations and low default risk may obtain very favorable loans from banks, but they are misclassified as zombies by the above method. To correct for this measurement error, I follow Fukuda and Nakamura (2011) by applying a profitability criterion (filter) when identifying zombie firms. That is, I re-identify a zombie firm (with negative interest gap) as non-zombie if the firm has a net profit that is sufficiently large to cover the minimum required interest payment. Thus, only firms that are truly “underwater” are classified as zombies (the first aspect). I use this method (referred to as the “CHK-FN” method) as the main method of zombie identification.

Another concern is that some firms are identified as zombie in just one year during the whole sample period because of some temporary negative shock. To correct for this, I follow Nie et al. (2016) and identify a firm as zombie in year \( t \) if it is identified as a zombie in both year \( t \) and year \( t - 1 \). This method allows me to eliminate one-shot zombie firms in the sample. I use this method (referred to as the “eliminating one-shot zombie” method) for robustness checks.

Figure 1.3 depicts the percentage of zombie firms in China from 2000 to 2016. The blue dashed line represents the percentage of zombie firms in all publicly listed firms using the main CHK-FN method, while the red dotted line represents the percentage of zombie firms in all publicly listed firms after eliminating all one-shot zombies in the sample. On average, the percentage of zombie firms among all firms is 12% across the years. The percentage of
Figure 1.3: Percentage of zombie firms

Zombies increase significantly after 2008, when there was a credit boom related to the large increase in investment after the Global Financial Crisis. This finding is consistent with the stylized fact that in the same period, investment efficiency has fallen and the financial performance of firms has deteriorated.

Figure 1.4 shows the percentage of zombie assets in the economy from 2000 to 2016. Compared to Figure 1.3, although the relative proportion of zombie firms in the economy remains stable (except for year 2009 to 2011), the percentage of zombie assets has been decreasing over time. This finding suggests that the zombie group has consisted of smaller firms in recent years.

Table 1.3 shows the summary statistics of zombie firms and non-zombie firms. Com-
pared to non-zombie firms, zombie firms on average have larger size (asset and liability), lower profitability (total profit and net profit), more short-term loans and long-term loans, but similar interest expense. Zombie firms and non-zombie firms have similar state share in their ownership structure. There are both state-owned and private enterprises in zombie firms. The relative proportion of state-owned enterprises (SOEs) for both central SOEs and local SOEs is higher in zombie firms.

1.4.3 Endogeneity of Zombie Firms

The above definition of zombie firms allows for variation in zombie status across years for a firm, which will result in changes in the set of firms that are zombies. One concern regarding this definition is the potential endogeneity of zombie firms. Specifically, obtaining
Table 1.3: Summary Statistics: Zombie Firms vs. Non-zombie Firms

<table>
<thead>
<tr>
<th></th>
<th>Zombie</th>
<th>Non-zombie</th>
<th>Diff.</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>asset</td>
<td>13652.82</td>
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<tr>
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<td>0.35</td>
<td>0.31</td>
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more loans may cause firms to become zombies. Then, a lending boom to zombies late in the service term may not be interpreted as the result of temporary manipulation of lending by local officials.

To rule out the possibility of loan-induced zombie firms, a preliminary Granger causality analysis at the firm level is carried out in order to test the relationship between getting loans and being a zombie. The results, presented in Table A.1 in Appendix A, suggest that for a firm, loans in the previous year do not affect its zombie status in the current year. This finding may reduce the concern regarding endogenous zombies to some degree.

Another related concern is that there may be other political cycle effects that confound zombie lending effect. Assume the total amount of lending to firms is constant over time. If weak firms obtain favorable treatment in other forms (e.g., direct subsidy or tax rebate) from
local officials early in their service term, then when that favorable treatment is removed in the end, they may be recognized as zombies in the later years. Then, it will appear that lending to zombies increases late in the service term, when in fact lending has not changed.

A cleaner solution to the potential endogeneity problem is to use a predetermined definition of zombie firms; thus, the pool of zombie firms is fixed in each prefecture-cycle, and churns in the pool will disappear. Thus, in this paper, I identify a firm as a zombie in every year of the current prefecture-cycle if it has ever been a zombie firm for more than 2 years in the previous 5 years before the start of the current prefecture-cycle. By using a fixed group of predetermined zombie firms, endogenous selection into the zombie group will be ruled out.

1.4.4 Estimation

1.4.4.1 Last Service Year Effect

To test for potential political manipulation in the last service year, I compare the amount of bank lending issued in the last service years, i.e., the (re-)appointment years, to the amount issued in nonappointment years. I include year fixed effects to control for aggregate macro shocks that are common to all prefectures. I also include prefecture-cycle fixed effects (a group identifier of each prefecture-Party Secretary group) to control for time-invariant characteristics in a particular prefecture in the service term of a particular Party Secretary. Finally, I include one-year lag of local GDP growth, unemployment rate, fiscal surplus ratio, fixed
asset investment (in logs) and the share of urban population in each prefecture. Formally, I regress

$$\text{Loan}_{ct} = \alpha + \beta \text{Last}_{ct} + X'_{ct-1} \eta + \mu_{cj} + \theta_t + \varepsilon_{ct}$$

where $\text{Loan}_{ct}$ is aggregated loan in prefecture $c$ in year $t$. $\text{Last}_{ct}$ indicates the appointment year (last service year) of the prefecture Party Secretary, and $X'_{ct-1}$ is the list of lagged prefecture characteristics. $\mu_{cj}$ represents prefecture-cycle fixed effects, where subscript $j$ indicates Party Secretary $j$. $\theta_t$ represents year fixed effects. Standard errors are clustered at the prefecture level.

The timing of new (re-)appointment is subject to some random changes; thus, the “last service year” is uncertain and can be endogenous to some degree. Following Khemani (2004) and Cole (2009), I use a dummy as an instrument for the actual last service year, $S^{-0}$, and for whether five years have passed since the previous “last service year” (thus, 0 year left until the next scheduled appointment). This scheduled “last service year” is a predictor of real “last service year”. To avoid the case where the instrument only assigns last service year to years $t$, $t + 5$, $t + 10$, and $t + 15$, I reset the instrument after an early (re-)appointment to avoid the weak instrument problem.
1.4.4.2 Appointment Cycle Effect

To test how bank lending varies across the whole appointment cycle, I regress the amount of lending on the instrument indicators of each service year in the cycle:

\[
\text{Loan}_{ct} = \alpha + \beta_1 S_{ct}^3 + \beta_2 S_{ct}^2 + \beta_3 S_{ct}^{-1} + \beta_4 S_{ct}^{-0} + X_{ct-1}' \eta + \mu_{cj} + \theta_t + \varepsilon_{ct}
\]

where \( S^{-k} \) \((k = 0, 1, 2, 3, 4)\) represents the \((5 - k)\) year of service. Thus, the Party Secretary expects \(k\) years left until the scheduled last year of the term. City-cycle fixed effects, year fixed effects, and prefecture level controls are included in the regression. Since the five indicators are supposed to add up to 1 in any given year, I use \( S^{-4} \) as the reference group and omit it in the regression.

1.4.4.3 Aggregate Separately by Bin

To test for which firms and banks are being targeted in the political manipulation, I aggregate the individual loan data to the prefecture level separately by different bins and redo the exercise:

\[
\text{Loan}_{ct}^{Bin} = \alpha + \beta_1 S_{ct}^3 + \beta_2 S_{ct}^2 + \beta_3 S_{ct}^{-1} + \beta_4 S_{ct}^{-0} + X_{ct-1}' \eta + \mu_{cj} + \theta_t + \varepsilon_{ct}
\]

where Bins include lending to zombies, lending to non-zombies, lending from local
banks, lending from national banks, and their interactions: zombie-local, zombie-national, non-zombie-local, and non-zombie-national.

1.5 Results

In this section, I present three sets of findings. First, on average, bank lending does not respond significantly to the last service year relative to other years in the term of Party Secretaries. Second, there is significant targeting of firms: lending to zombie firms increases in the last year by 228% and exhibits a significant increasing trend across the cycle; in contrast, lending to non-zombie firms decreases in the last year by 87% and shows a significant decreasing trend across the cycle. Third, Party Secretaries are more capable of pressuring local banks to lend to zombie firms.

1.5.1 Does the appointment year affect bank lending?

Does the appointment year (last service year) affect bank lending to firms in general? Table 1.4 Panel A presents the results of the last year effect on bank lending using the whole sample where all loans (from all banks to all firms) are aggregated to the prefecture level. Column (1) reports the result of OLS regression, column (2) reduced-form regression, column (3) instrumental variable regression, and column (4) the first stage of IV regression. The results from OLS, reduced form, and IV regression show that there is no significant
increase in bank lending in the last service year of the Party Secretary. Thus, there is no evidence of political manipulation of bank lending to firms on average. The IV and OLS estimates vary in magnitude, although neither is significant, suggesting that the endogeneity of appointment years is indeed a concern. The first-stage results show that the scheduled last service year $S^{-0}$ (IV) is a relatively strong predictor of the last service year, with a coefficient of 0.47, $R^2$ of 0.72, and F statistic of 86.7.

Does the appointment year (last service year) affect bank lending to zombie firms? Table 1.4 Panel B presents the results of last year effect on bank lending using the subsample where only loans to zombie firms (from all banks) are aggregated to the prefecture level. Column (1) reports the result of OLS regression, column (2) reduced-form regression, column (3) instrument variable regression, and column (4) the first stage of IV regression. The IV results show that in the last service year of a Party Secretary, lending to the predetermined group of zombie firms in each prefecture-cycle increases dramatically by 228%. There is clear evidence of strong temporary political influence on bank lending to zombie firms. The IV and OLS estimates have different signs and vary significantly in magnitude, which suggests that the appointment year is endogenous. The first-stage results show that the scheduled last service year $S^{-0}$ (IV) is a relatively strong predictor of the last service year, with a coefficient of 0.47, $R^2$ of 0.68, and F statistic of 42.7.

Does the appointment year (last service year) affect bank lending to non-zombie firms? Table 1.5 Panel C presents the results of last year effect on bank lending using the subsample
Table 1.4: The Effect of Last Service Year on Bank Lending

<table>
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<tr>
<th></th>
<th>(1) OLS</th>
<th>(2) Reduced Form</th>
<th>(3) IV</th>
<th>(4) First Stage</th>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Year FE</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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Notes: Each column in each panel represents a regression. The dependent variable is total bank loans in log values to all firms (panel A), zombie firms (panel B), and non-zombie firms (panel C). In each panel, the coefficient reported is a dummy for actual last service year in column (1), scheduled last service year in column (2), and actual last service year instrumented with scheduled last service year in column (3). In addition to the indicated dependent variable of interest, all regressions include year and prefecture-cycle fixed effects, and prefecture-level controls of GDP growth rate, unemployment rate, fiscal surplus ratio, fixed asset investment (in logs) and share of urban population, lagged by one year. The unit of observation is the prefecture-year. Robust standard errors are in parentheses. Standard errors are clustered at prefecture level. The first stage of the IV regression in column (4) is $Last_{ct} = \alpha + \beta S^{-0}_{ct} + X'_{ct-1}\eta + \mu_{ct} + \theta_{t} + \varepsilon_{ct}$.

*** p<0.01, ** p<0.05, * p<0.1.
where only loans to non-zombie firms (from all banks) are aggregated to the prefecture level. Column (1) reports the result of OLS regression, column (2) reduced-form regression, column (3) instrument variable regression, and column (4) the first stage of IV regression. The IV results show that in the last service year of a Party Secretary, lending to non-zombie firms shrinks significantly by 86.5%. The IV and OLS estimates vary in magnitude and significance, suggesting serious endogeneity of appointment years. The first stage results show that the scheduled last service year $S^{-0}\text{ (IV)}$ is a relatively strong predictor of the last service year, with a coefficient of 0.48, $R^2$ of 0.71, and F statistic of 101.

Combining the above results shows that there is a significant substitution of lending to zombie firms for lending to non-zombie firms. In their last service year, which is a critical promotion period, Party Secretaries tend to direct more loans to zombie firms at the cost of fewer loans to non-zombie firms. In general, total lending to all firms does not change significantly in the last year. They bail out zombie firms in this critical year in order to improve performance and avoid a surge in the unemployment rate that could possibly harm the probability of being promoted.

### 1.5.2 How Does Bank Lending Vary across the Appointment Cycle?

Figure 1.5 expands on the above results by tracing out how bank lending varies across the whole appointment cycle. Each plot in Figure 1.5 represents a separate regression of
aggregate loans on dummies for the number of years until the next scheduled appointment year, i.e., the last service year. The x-axis represents dummies for scheduled service year. It ranges from $t = -3$, which indicates the scheduled second year of service (three years left until the scheduled last service year under a five-year appointment schedule) to $t = 0$, which indicates the scheduled last year of service (zero years left until the scheduled last service year). I use the scheduled first year of service ($t = -4$) as the reference group in the regression.

The top plot shows how total loans to all firms vary across the appointment cycle. The middle plot reflects total loans to zombie firms, and the bottom plot represents total loans to non-zombie firms. For zombie firms, the trend of bank lending generally increases at the end of the cycle, which clearly indicates that lending to zombies is higher in the critical promotion period (year 5 of the term) relative to earlier off-appointment years (year 1-4 of the term). For non-zombie firms, a reverse trend is detected, i.e., the trend of bank lending decreases over the appointment cycle. Lending to non-zombies is the highest in the first year of the term and gradually reduces in the following four years. On average, lending to all firms tends to decrease over time, which is mainly driven by the group of non-zombie firms. Taken together, the trends suggest that during the term of service, a Party Secretary tends to put more effort and direct more lending to healthy firms because the payoff of investment may have a several-year lag, and it takes time to generate profitable results. In contrast, lending to zombie firms occurs the most at the end of the term because the money is not used for restructuring these distressed firms, but rather to avoid massive bankruptcies.
Figure 1.5: The Effect of Appointment Cycle on Bank Lending

Notes: Each plot represents a regression. The coefficients plotted are dummies for the number of years until the next scheduled appointment (last service year). The dependent variable is total loan in log values to all firms at the top, to zombie firms in the middle, and to non-zombie firms at the bottom. All regressions include year and prefecture-cycle fixed effects, as well as prefecture controls. Standard errors are clustered at the city level. Line segments around the dots gives the 90% confidence interval.
and potential increases in the unemployment rate. At the end of the term, a Party Secretary has limited short-term instruments to boost (or at least maintain) performance. Bailing out zombie firms is one of them.

1.5.3 Which Banks are Being Pressured the Most?

National banks are banks that are relatively large in size and have local branches in most of the prefectures in China, while local banks are smaller in size and only operate in a particular prefecture or adjacent prefectures. By ownership structure, local banks have stronger ties to their local government and tend to be affected more by the local government officials.

Table 1.5 reports the results of last year effect on bank lending by bank type. Panel A uses the subsample where only loans from local banks are aggregated to the prefecture level. Similar to the analysis in Section 1.6.1, Column (1) reports the result of OLS regression, column (2) reduced-form regression, column (3) instrument variable regression, and column (4) the first stage of IV regression. The IV results show that in the last service year of a Party Secretary, lending from local banks increases by 24.8%, although it is not significant. Again, the IV and OLS estimates vary in magnitude and significance, suggesting serious endogeneity of appointment years. The first-stage results show that the scheduled last service year $S^{−0}$ (IV) is a relatively strong predictor. Analogously, Panel B reports the
results of aggregate loans from national banks. The IV results show that in the last service year of a Party Secretary, lending from national banks decreases by 40.5%, although it is not significant.

Taken together, the results suggest that the last-year effect of bank lending from local or national banks to all firms is not significant. However, local banks tend to have more pressure to increase lending and respond more strongly to the last service year.

Figure 1.6 expands on the above results by tracing out how bank lending from local banks and national banks varies across the whole appointment cycle. The top plot shows the trend of total loans from local banks, and the bottom plot shows the trend of total loans from national banks. Loans from local banks, which account for 20% of all loans, do not exhibit any trend, with differences in lending in later years of the term and earlier years of the term not significant. Loans from national banks, which account for 80% of all loans, show a decreasing trend over the cycle.
### Table 1.5: The Effect of Last Service Year on Bank Lending by Bank Type

<table>
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<tr>
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<td>OLS</td>
<td>Reduced Form</td>
<td>IV</td>
<td>First Stage</td>
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<tr>
<td><strong>Panel A: Local Banks</strong></td>
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<tr>
<td><strong>Panel B: National Banks</strong></td>
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<tr>
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**City Characteristics** Yes Yes Yes Yes
**City_Cycle FE** Yes Yes Yes Yes
**Year FE** Yes Yes Yes Yes

*Notes: Each column in each panel represents a regression. The dependent variable is total loans from local banks in log values (panel A), total loans from national banks in log values (panel B). In each panel, the coefficient reported is a dummy for the actual last service year in column (1), the scheduled last service year in column (2), and the actual last service year instrumented with the scheduled last service year in column (3). In addition to the indicated dependent variable of interest, all regression include year and prefecture-cycle fixed effects, and prefecture-level controls of GDP growth rate, unemployment rate, fiscal surplus ratio, fixed asset investment (in log values) and the share of urban population, lagged by one year. The unit of observation is prefecture-year. Robust standard errors are in parentheses. Standard errors are clustered at the prefecture level. The first stage of the IV regression in column (4) is $Last_{ct} = \alpha + \beta S_{ct}^{-0} + \eta X_{ct}^\prime + \mu_{c} + \theta_{t} + \epsilon_{ct}$.*** p<0.01, ** p<0.05, * p<0.1.
1.5.4 Interactions

I further interact with the destination and source of loans and generate four different bins:

1. loans from local banks to zombie firms,
2. loans from national banks to zombie firms,
3. loans from local banks to non-zombie firms, and
4. loans from national banks to non-zombie firms.

Figure 1.6: The Effect of Appointment Cycle on Bank Lending by Bank Type

Notes: Each plot represents a regression. The coefficients plotted are dummies for the number of years until the next scheduled appointment (last service year). The dependent variable is total loan in log value from local banks at the top, from national banks at the bottom. All regressions include year and city-cycle fixed effects, as well as prefecture controls. Standard errors are clustered at city level. Line segments around the dots give the 90% confidence interval.
Table 1.6 reports the results of the last-year effect on bank lending using each bin, where only loans in that bin are aggregated to the prefecture level. Similar to previous analysis, in each panel, column (1) reports the result of OLS regression, column (2) reduced-form regression, column (3) instrument variable regression, and column (4) the first stage of IV regression.

In Table 1.6 Panel A and Panel B, the IV results show that local banks increase lending to zombie firms massively in the last service year of a Party Secretary. The lending boom is larger than putting all loans to zombie firms together. There is also suggestive evidence that national banks increase lending to zombie firms in the last service year, though the effect is not significant. The effect of local banks is much stronger than that of national banks, which is consistent with the fact that local banks are more closely controlled by local government officials by nature. In Panel C and Panel D, for non-zombie firms, lending from local banks is not significant and small in magnitude in the last year, while lending from national banks decreases. The magnitude is larger than when putting all loans to non-zombie firms together.

Figure 1.7 expands the analysis by tracing out how bank lending in each bin varies across the appointment cycle. Each plot in Figure 1.7 represents a separate regression of total loans on dummies for the number of years until the next scheduled appointment year, i.e., the last service year. Comparing the first plot (loans from local banks to zombie firms) and the second plot (loans from national banks to zombie firms), it can be seen that both
Table 1.6: The Effect of Last Service Year on Bank Lending by Firm Type and Bank Type

<table>
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<tr>
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Notes: Each column in each panel represents a regression. The dependent variable is total loans from local banks to zombie firms (panel A), from national banks to zombie firms (panel B), from local banks to non-zombie firms (panel C), and from national banks to non-zombie firms (panel D), all in logs. *** p<0.01, ** p<0.05, * p<0.1.
local banks and national banks increase lending to zombie firms across the appointment cycle over time. Local banks are more responsive in every year, indicating that these smaller local banks are better manipulated by local government officials. Comparing the third plot (loans from local banks to non-zombie firms) and the fourth plot (loans from national banks to non-zombie firms), it can be seen that lending from local banks to non-zombie firms is less responsive than lending from national banks to non-zombie firms. The proportion of zombie firms in all firms and the proportion of local banks in all banks are relatively small. It can be inferred that local government officials mainly use loans from large national banks as long-term tools to support the growth of healthy firms. Loans from small local banks are taken as short-term tools to help zombie firms.
Figure 1.7: The Effect of Appointment Cycle on Bank Lending by Firm Type and Bank Type

Notes: Each plot represents a regression. The dependent variable is total loans from local banks to zombie firms (first plot), from national banks to zombie firms (second plot), from local banks to non-zombie firms (third plot), and from national banks to non-zombie firms (fourth plot), all in log values. All regressions include year and city-cycle fixed effects, as well as prefecture controls. Standard errors are clustered at the prefecture level. Line segments around the dots give the 90% confidence interval.
1.6 Discussion

1.6.1 Zombie Performance after the Assignment of A New Party Secretary

As Party Secretaries increase lending to zombie firms in their last service year as a short-term tool to boost performance in the critical promotion period, a natural question follows: do zombie firms do much worse in the year after an official is re-assigned?

I measure performance with three indicators: asset turnover, net profit margin, and return on assets. Asset turnover is the ratio of net sales revenue to average total assets. It measures the efficiency with which a firm uses its assets to generate sales revenue. The larger the asset turnover is, the higher the operational efficiency. Net profit margin is the ratio of net profit to sales revenue and is an indicator of profitability, representing how much profit each dollar of sales generates. Return on assets is the ratio of net profit to average total assets and indicates how profitable a company is relative to its total assets.

To test the performance of zombie firms after the new Party Secretary arrives, I specify the following regression:

\[
\text{Performance}_{zt} = \alpha + \beta \text{New}_{zt} + X'_{zt-1} \eta + \mu_c + \theta_t + \varepsilon_{zt}
\]

where \( \text{Performance}_{zt} \) is a measure of average performance of zombie firms in
prefecture \( c \) in year \( t \), including asset turnover, net profit margin, and return on assets. \( New_{ct} \) indicates the first service year of a new prefecture Party Secretary, and \( X'_{ct-1} \) is the list of lagged prefecture controls. \( \mu_c \) represents city-cycle fixed effects, and \( \theta_t \) represents year fixed effects. Standard errors are clustered at the prefecture level.

Similarly, as the timing of (re-)appointment is subject to some random changes, I use a dummy as an instrument for the actual first service year, \( NewIV \), for whether five years have passed since the previous “first service year”. This scheduled “first service year” is a predictor of the real “last service year”. To avoid the case where the instrument only assigns the last service year to years \( t, t + 5, t + 10, \) and \( t + 15 \), I reset the instrument after an early (re-)appointment.

Does zombie performance deteriorates after a new Party Secretary comes? Table 1.7 shows the results of first-year effect on zombie performance indicators. In each panel, column (1) reports the result of OLS regression, column (2) reduced-form regression, column (3) instrument variable regression, and column (4) the first stage of IV regression. There is no significant effect of the first service year on any performance measure.

I then expand on the results by tracing out how zombie performance changes across two cycles: five years in the current cycle and the first three years in the next cycle. Figure 1.8 shows the results. The x-axis represents dummies for the scheduled service year. It ranges from \( t = -3 \), which indicates the scheduled second year of service for the current cycle,
Table 1.7: The Effect of New Appointment Year on Zombie Firm Performance

<table>
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<tr>
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<th>(2) Reduced Form</th>
<th>(3) IV</th>
<th>(4) First Stage</th>
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<td></td>
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<td>(0.0780)</td>
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<td>0.658***</td>
<td>(0.0750)</td>
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<td></td>
<td>(0.0750)</td>
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<td>(0.0761)</td>
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<td>(0.176)</td>
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<td></td>
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<td>(0.00941)</td>
<td>(0.0761)</td>
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<td>(0.00913)</td>
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<td>(0.0761)</td>
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<td>0.962</td>
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<td>Yes</td>
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<td>Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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Notes: Each column in each panel represents a regression. Each column in each panel represents a regression for zombie firms. The dependent variable is average asset turnover (panel A), average net profit margin (panel B), and return on asset (panel C). The coefficient reported is a dummy for actual first service year in column (1), scheduled first service year in column (2), and actual first service year instrumented with scheduled first service year in column (3). The first-stage result of the IV regression is reported in column (4). All regressions include year and city-cycle fixed effects. Standard errors are clustered at the prefecture level.

*** p<0.01, ** p<0.05, * p<0.1.
to $t = 3$, which indicates the scheduled third year of service for the next cycle. I use the scheduled first year of service for the current cycle ($t = -4$) as the reference group in the regression.

The top plot shows how the average asset turnover of zombie firms varies across two appointment cycles. The middle plot reflects the average net profit margin, and the bottom plot represents the return on assets. For zombie firms, the efficiency to use assets to generate sales revenue improves across the current cycle and dips when the current Party Secretary leaves and a new Party Secretary comes into power. Return on asset tends to decrease over the current cycle, and the trend extends further to the next cycle. Net profit margin does not exhibit a significant trend across two cycles. Taken together, the evidence suggests that zombie firms show lower efficiency in the year after an official is reassigned, but their average profitability does not change significantly.

1.6.2 Does Lending to Zombies Help Promotion?

Finally, I provide some suggestive evidence on how Party Secretaries’ subsequent assignments respond to zombie lending. Although it is stated in the Regulations on the Work of Selecting and Appointing Leading Party and Government Cadres that candidates for promotion will be evaluated in an all-around manner, emphasis is placed on their actual achievement. Measures for achievement include local GDP growth, unemployment, social
Figure 1.8: The Effect of Appointment Cycle on Zombie Firm Performance

Notes: Each plot represents a regression. The coefficients plotted are dummies for service years for the current and next appointment cycle. The dependent variable is average asset turnover in the top left corner, net profit margin in top right corner, and average return on assets in the bottom left corner. All regressions include year and city-cycle fixed effects, as well as prefecture controls. Standard errors are clustered at the prefecture level. Line segments around the dots give the 90% confidence interval.
stability, and other indicators. Bailing zombie firms out in the last service year is not one of the indicators, but it may help maintain investment growth and avoid a surge in unemployment and social unrest. The questions is as follows: Do Party Secretaries who pressure banks to partake in zombie lending end up with better assignments (conditional on performance indicators such as local GDP growth, unemployment rate)?

To test whether lending to zombies helps promotion, I specify the following cross-sectional regression:

\[
Promotion_{cj} = \alpha + \sum_{m=1}^{5} \beta_m Loan_{cjm}^{\text{zombie}} + \sum_{m=1}^{5} \gamma_m Loan_{cjm}^{\text{non-zombie}} + \sum_{m=1}^{5} \eta_m \Delta GDP_{cjm} \\
+ \sum_{m=1}^{5} \rho_m UMP_{cjm} + \sum_{m=1}^{5} \lambda_m FSR_{cjm} + X'_j + \varepsilon_{cj}
\]

where \(Promotion_{cj}\) is an indicator of whether the incumbent Party Secretary \(j\) in prefecture \(c\) gets promoted at the end of the service term. \(Loan_{cjm}^{\text{zombie}}\) represents lending to zombie firms in each service year \(m\) \((m = 1, 2, 3, 4, 5)\) of Party Secretary \(j\) in prefecture \(c\), and \(Loan_{cjm}^{\text{non-zombie}}\) represents lending to non-zombie firms in in each service year \(m\) analogously. \(\Delta GDP_{cjm}\), \(UMP_{cjm}\), and \(FSR_{cjm}\) reflects GDP growth, unemployment rate, and fiscal surplus ratio in each service year \(m\) respectively. \(X'_j\) is a series of Party Secretary individual characteristics, including length of service term, current term starting age, gender, and years of education.
Table 1.9 shows the results of logit regressions. Lending to zombie firms in the critical appointment year (last service year) significantly increases the probability of being promoted, while lending to zombie firms in earlier years (especially in the fourth year) has a negative impact on promotional success. In contrast, lending to non-zombie firms has a negative impact on the promotion probability in the last service year and mostly positive impacts in earlier years, although the effects are insignificant. In an alternative specification, I use the percentage of total lending to zombie firms in each year as the main independent variables, all else the same. The results show that a higher percentage of lending to zombies in the last service year increases the promotion probability significantly, while higher percentage in earlier years reduces the promotion probability, although it is insignificant. Among the achievement indicators, GDP growth in the second to the last year seems to be the most important determining factor of promotion. Admittedly, there are other factors such as relationship (guanxi) with higher level officials that can affect the chance of promotion, and these factors are omitted in the regression. Thus, it only provides suggestive evidence that lending to zombies at the end of the political cycle in general helps promotion.

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<td>Lending to zombie firms</td>
<td>Percentage to Zombie</td>
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Table 1.8: Probability of Promotion: Lending to Zombie Firms

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Lending to non-zombie firms

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<th>Standard Error</th>
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<td>-0.00790</td>
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<td>Year</td>
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<td>GDP Growth</td>
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### Fiscal surplus ratio

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<th>SE 1</th>
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<td>0.147</td>
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<td>-0.180*</td>
<td>0.100</td>
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\text{s\_term} & 0.153 & 0.161 \\
& (0.137) & (0.134) \\
\text{s\_startage} & -0.0455 & -0.0578 \\
& (0.0507) & (0.0497) \\
\text{s\_male} & -0.100 & -0.0981 \\
& (0.649) & (0.702) \\
\text{s\_education} & 0.0199 & 0.00377 \\
& (0.0998) & (0.0948) \\
\text{Constant} & 3.279 & 2.978 \\
& (3.951) & (3.645) \\
\hline
\text{Observations} & 332 & 332

1.7 Conclusions

The existence of zombie firms has been proven to be costly. Banks continuing to provide forbearance lending are attributed to be the main contributing factor to zombie firms in most of the relevant literature. In this paper, I explain the causes of zombie-firm lending
from a political cycle perspective and examine how local political officials, even if they are appointed under a bureaucratic system rather than elected, may manipulate bank lending and contribute to keeping zombie firms alive. Specifically, I aggregate individual loan data to the prefecture level, explore how bank lending responds to the appointment cycles of local political officials to serve their promotion interests, and explore how it contributes to the existence of zombie firms.

On average, bank lending does not respond to the last service year or appointment cycle of Party Secretaries. However, there is significant targeting of firms: lending to zombie firms increases in the last year by 228% and exhibits a significant increasing trend across the cycle, and lending to non-zombie firms shrinks by 87% and shows a significant decreasing trend across the cycle. Party Secretaries tend to direct more credit to non-zombies in the early years of service because it may take a few years for non-zombie firms to transform credit resources to profitable projects and the payoff of investment tend to be lagged; thus, early lending support will be more beneficial. In the later years of service, Party Secretaries will substitute lending to zombie firms for lending to non-zombie firms, as helping zombie firms is one of the limited short-term instruments that can be used to avoid a surge in unemployment and maintain performance at the end of a cycle. In addition, Party Secretaries are more capable of pressuring small local banks to support unprofitable, distressed local zombie firms. Their ability to manipulate large nationally operated banks and influence their lending decisions is relatively limited.
For zombie firms, there is suggestive evidence that their performance does not change significantly after a new Party Secretary is assigned. The efficiency to use assets to generate sales revenue improves across the current cycle and dips when the current Party Secretary leaves and a new Party Secretary comes into force. The two profitability measures do not exhibit a significant trend across the two appointment cycles. Lending to zombie firms is a short-term tool used by Party Secretaries to maintain or boost achievement temporarily in the critical promotion period, and it does seem to help Party Secretaries move up the career ladder.

Considering the damage caused by zombie firms, various policies have been proposed to eliminate zombie firms, including increasing regulation on banks. These measures may not be truly effective if the role of local government officials is omitted, especially in the context of developing countries where financial markets are immature and largely affected by the government. As suggested in this paper, local governments may not have the incentives to increase regulation and protect the independent operation of banks. They may instead actively influence banks and manipulate credit resources to serve their own political interests at the cost of social welfare. Thus, reduced intervention or even separation between local government officials and banks, particularly local banks, may be needed to correct the problem of zombie firms.
Chapter 2

Privatization and Enterprise Performance:
Evidence from China’s State-Owned Enterprises

Reform
2.1 Introduction

China’s experience of economic reforms and transition from a planned economy towards a market economy since the late 1970s has been successful in many aspects. As a key part of the transition, bottom-up initiatives of privatization of state-owned Enterprises (SOE) have taken place since 1997. From 1998 to 2007, the proportion of registered SOEs among large- and medium-sized enterprises declined from 32% to 3%, and the proportion of collectively-owned enterprises (COE) decreased from 36% to 6%, while the total proportion of foreign-owned, privately-owned, jointly-owned, and shareholding enterprises increased from 32% to 91%. Associated with the privatization process was a dramatic improvement in productivity, profitability, and scale of operation for those privatized SOEs, which is illustrated by Figure 2.1 and Figure 2.2. Figure 2.1 shows the performance of SOEs that are privatized in 2003, compared to that of non-privatized SOEs.

\[1\] Privatization was first experimented in several localities and later approved and promoted by the central government across the country (Cao, Qian, and Weingast, 1999).

\[2\] Chinese enterprises can be divided into 8 categories according to the registration status: SOE (state-owned enterprises, owned by the central government), COE (collectively-owned enterprises, owned by the local government), HMT (Hong Kong, Macao, Taiwan-owned enterprises), FOE (Foreign-owned enterprises), POE (Privately-owned enterprises, owned by domestic private entities), JOE (Jointly-owned enterprises, owned jointly by foreign enterprises and domestic SOEs, COEs, or POEs), SHR (Shareholding enterprises, owned by government and private shareholders), OTH (Other enterprises).

\[3\] SOEs that are privatized in 2003 are used in Figure 2.1 as the treated group for illustrative purposes. Since multiple enterprises are privatized in each year from 1999 to 2007, using privatized SOEs in one cohort (e.g., SOEs privatized in 2003) ensures that the performance of the treated group is not contaminated by SOEs that are privatized in other years. As an alternative, performance of SOEs that are privatized in 2004 is shown in Figure B.1 in Appendix B.
profitability (Panel b) between privatized and non-privatized SOEs increased significantly since the privatization in 2003. On the other hand, the operation scale, measured by asset and employment, of privatized SOEs grows less (or decreases more) in 2003 compared to non-privatized SOEs, as workers of privatized SOEs are laid off and assets are depleted during the privatization (Panel c).

Instead of using one privatization cohort, Figure 2.2 pools all the SOEs that are privatized during the sample period from 1998 to 2007 together and conducts an event study analysis for privatized SOEs. The x-axis indicates each year prior to and after privatization. It shows that compared to the pre-treatment period, privatized SOEs experience significant increase in productivity (Panel a) and profitability (Panel b) after privatization. Their operation scale (Panel c) decreases temporarily in the privatization year, and recovers gradually in the long run.

However, the estimation of the effect of privatization on enterprise performance is likely to be subject to selection bias. Privatization of SOEs has taken a gradual and selective approach. The quota of privatization is distributed from the central government to the provincial government, and then further allocated to target SOEs. The standards by which government officials choose target SOEs are not publicly announced, but are likely to depend on specific conditions of each SOE. A key question is naturally raised: is it privatization of SOEs that leads to improvement in enterprise performance? In other words, is it possible that unobserved systematic differences between privatized SOEs and non-privatized SOEs
(a) Productivity

(b) Profitability
(c) Innovation and Operation Scale

**Figure 2.1:** Performance of Privatized SOEs (in 2003) and Non-privatized SOEs

*Notes:* Each plot shows the performance of privatized SOEs and non-privatized SOEs during the sample period from 1998 to 2007. The blue solid line represents SOEs that are privatized in 2003. The red dash line represents SOEs that are not privatized during the whole sample period.

affect the selection of the privatization target and then drive the difference in performance? To answer this question, this paper tries to control for potential selection bias resulted from both time-invariant and time-variant enterprise characteristics, using a fixed effects model and propensity score matching method. In addition, regularized regression method in machine learning (Post-Double-Selection Lasso) is used to facilitate variable selection in order to enhance the accuracy of inference on the effect of privatization.

Based on a panel of medium- and large-sized SOEs in China from 1998 to 2007, I find
(a) Productivity

(b) Profitability
that privatization leads to an overall increase in productivity, profitability, and innovation activities for privatized SOEs. In addition, different rounds of privatization have heterogeneous effects on enterprise performance. The first two rounds of privatization contribute most to the improvement in performance. Subsequent rounds of privatization occasionally affect performance, but the influence is smaller. The first round of privatization has a negative contemporaneous effect on operation scale, measured by the size of employment and asset, which is consistent with the workers layoff policy and suggests the existence of adjustment costs. The gain in profitability mainly comes from the initial reduction in
administrative expenses and financial expenses.

During the past two decades, there is a growing body of literature focusing on the determinants and impacts of enterprise restructuring and privatization in China. The privatization of SOEs in China has been characterized as a gradual and selective process. Ownership reform takes a bottom-up approach, i.e., conversion is first experimented in several localities and later approved and promoted by the central government across the country. It is not publicly announced by the central or local government how and why they select particular SOEs to be privatization target. Thus, the potential selection bias problem is a serious concern when estimating the effect of privatization, since SOEs undergoing privatization may have some unobserved characteristics explaining their post-privatization performance.

Studies on the determinants of privatization demonstrate the existence of selection bias in the privatization process of SOEs. For example, Jefferson and Su (2003) find that the probability of ownership conversion increases with the firm’s profitability, productivity, and the intensity of competition faced by the firm, but it decreases with firm size, a result consistent with the government policy of “retain the large, release the small”. ⁴ Tong (2009) finds that the factors most conducive to privatization are the increase of competition and

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⁴The “retain the large, release the small” policy was adopted in 1997 by the central government as part of industrial forms. It indicates that the reform should aim at maintaining state ownership of the largest SOEs and privatizing the small ones.
FDI concentration, and the hardening of SOEs? budget constraints.\textsuperscript{5} Besides, relatively better performing SOEs, measured by value-added, profitability per employee, and export propensity, are more prone to privatization. Similarly, Tian (2001) and Li, Li, and Zhang (2000) show that more competition in the product market forces the government to privatize SOEs, as competition reduces the profit margin of the SOEs. Jefferson and Su (2003) show that competition in the input market can also lead managers to accept privatization.

Due to the potential selection bias and endogeneity of privatization, studies on the impacts of privatization need to carefully address these problems. Yusuf et al. (2005) and Song and Yao (2004) use enterprise survey data and show that privatization of SOEs positively affects enterprise management, governance, and performance. However, after controlling for time-invariant selection bias by including firm fixed effects, the impact of privatization becomes less evident. Bai et al. (2009) address time-variant selection bias by refining the sample and focus only on SOEs that were privatized in the sample period. Assuming that all privatized SOEs share common time-variant characteristics, they difference out the time-variant characteristics by comparing the performance of those SOEs that were privatized in early years during the sample period to those that were privatized in the last year. Jefferson and Su (2006) use industry, location, and firm size dummies as

\textsuperscript{5}This is related to the soft budget constraint syndrome, a concept formulated by Kornai (1979). The “softening” of the budget constraint appears when the strict relationship between expenditure and earnings has been relaxed, because excess expenditure over earnings will be paid by some other institution, typically by the state (Kornai, 1986). It is particularly evident in transitional economies. The “hardening” of the budget constraint indicates creating conditions in which the state can make credible commitments not to refinance an enterprise (Kornai et al., 2003).
instruments for growth of non-state share of assets, conduct 2SLS regressions, and find that privatization leads to the use of more labor-intensive modes of production, which is associated with significant increase in returns to capital.

Ownership reform and privatization of SOEs is not a unique phenomenon in China. Megginson and Netter (2001) examine 12 studies on the effectiveness of privatization in transition economies of Central and Eastern Europe and 6 studies on the Commonwealth of Independent States. They find that privatization in general improves enterprise performance, and that concentrated private ownership, foreign ownership, and majority outside ownership lead to significantly larger improvement than majority inside ownership (privatization to insiders such as managers and employees). Djankov and Murrell (2002) combine more than 100 studies of enterprise restructuring in transition economies and rank the effectiveness of various privatization strategies and outcomes. Similar to Megginson and Netter (2001), they find that outsider privatization is more effective than insider privatization. In addition, privatization strategies have heterogeneous effects on enterprises in different regions.

This paper may contribute to the existing literature in two aspects. First, most of the literature controls for selection bias from time-invariant enterprise characteristics using fixed effects model (e.g., Yusuf et al., 2005; Song and Yao (2004)), or controls for selection bias from time-variant enterprise characteristics by sample refinement (e.g., Bai et al., 2009). This paper uses fixed effects model and propensity score matching method to control for both time-invariant and time-variant enterprise characteristics,
and to better match the privatized SOEs and non-privatized SOEs based on their initial conditions. In addition, a machine learning method (Post-Double-Selection Lasso) is used to optimize variable selection in order to generate a more accurate estimation of the treatment effect of privatization on enterprise performance (with high-dimensional controls).

Second, existing literature mainly focuses on the average effect (across all years) of each round of privatization or privatization as a whole. This paper also considers the contemporaneous effect of each round of privatization in the particular year when the privatization happens, and relates the contemporaneous effect to the government policies associated with privatization, such as the workers layoff policy. It shows the difference in influence of each round of privatization and relates it to adjustment costs or transition costs.

The rest of the paper is organized as follows. In the next section, I introduce the institutional background of privatization reforms in China, including the definition of SOEs used in this paper. Section 2.3 presents the empirical strategies to estimate the effect of privatization on enterprise performance. Section 2.4 describes the data used in the empirical analysis and shows the summary statistics of privatized SOEs and non-privatized SOEs. Section 2.5 presents the main regression results and discusses the contemporaneous effect of each round of privatization. Section 2.6 concludes.
2.2 Institutional Background

2.2.1 The Objectives of Privatization Reforms

China’s economic reforms and transition from a planned economy towards a market economy started in the 1970s. The keys to reforms were initially the reduction or elimination of government control of markets (e.g., removing production quotas and price controls, enhancing labor mobility, and allowing individuals to engage in business activities), and then the privatization of selected SOEs with the aim of profitability improvement became a major objective. The intents of privatization reforms of SOEs include increasing the self-reliance of individual enterprises, increasing innovation, improving economic efficiency, and decreasing the financial demands placed on the state in supporting SOEs and social welfare.

At the beginning, while reforms aiming at eliminating government controls of market and granting managerial autonomy to enterprises were implemented, the ownership structure of SOEs was left untouched (Rawski, 1994). There were no changes in the heavy social burdens placed on SOEs either (Hu, 1997). At the same time, SOEs became increasingly unprofitable, inefficient and under-invested (Cheng and Lo, 2002). As the reform progressed, the government gradually realized that private ownership was needed to increase the economic efficiency of SOEs. On the other hand, the government also wanted to dump loss-making SOEs to relieve heavy fiscal burden caused by subsidies (Li and Lu, 2001). Therefore, a policy was established to privatize selected SOEs and sell the shares to
institutional and individual investors. After privatization, the management of SOEs, who were originally appointed by the State Assets Agency to achieve social welfare objectives, was required to take profit maximization strategies.

2.2.2 The Stages and Methods of Privatization Reforms

The privatization reform has been a gradual, experimental and pragmatic process which can be characterized by four interrelated stages. The first three stages, entry of new non-state enterprises, reform of managerial control rights, and accumulation of non-state assets, were preliminary stages that weakened the government control and created pressures for deep restructuring of SOEs. They finally led to the last stage, formal privatization of SOEs.

The first stage was the entry of new non-state enterprises, which happened between 1978 and the mid-1990s. At this stage, a large number of new non-state enterprises, including collectively-owned enterprises (COEs) and private-owned enterprises (POEs) entered the industrial sector. Meanwhile, some SOEs and COEs absorbed foreign investment from Hong Kong, Taiwan, Macao, and from foreign sources such as OECD and Southeast Asian countries, and were transformed to joint ventures. Compared to the early 1980s when China’s industrial sector consisted almost exclusively of SOEs and COEs, the amount and variety of enterprises in the industrial sector exploded in the mid-1990s, which led to dramatic increase in competition and decline in profitability across all enterprise types. As
a result, SOEs experienced a significant loss of monopoly rents and were forced to pursue technical innovations and new governance mechanisms (Naughton, 1992; Jefferson and Su, 2003).

The second stage was the reform of managerial control rights within SOEs. To strengthen the incentive and reward structure for SOE managers and workers, the enterprise “contract responsibility system” was introduced in the mid-1980s. Vertically, this system reassigned control rights from government supervisory agencies to enterprises. Horizontally, it reallocated managerial control rights among managers, workers’s councils, and party secretaries within enterprises (Jefferson et al., 1998a; Jefferson et al., 1998b). As a result, SOEs became more market-oriented and experienced an overall improvement in efficiency, although productivity growth in state sector still lagged behind that outside the state sector (Jefferson et al., 2000).

The third stage was the accumulation of non-state assets. Despite the lagged change of formal ownership classification (registration status) of existing enterprises, non-state assets were accumulated rapidly in the 1990s. By the end of 1999, SOEs accounted for one-third of the population of large- and medium-sized industrial enterprises by formal registration status. However, 1,417 of the SOEs actually had a minority of state asset ownership, while 1,936 of the non-SOEs actually had a majority of state asset ownership (Jefferson and Su, 2006). The accumulation of non-state assets in the state sector, which reflected a de facto conversion of ownership structure, promoted the formal privatization reform and was
associated with improvement in performance.

The fourth stage was the formal conversion of SOEs. Entry of new non-state enterprises, increasing competition and erosion of monopoly profit margins, intensified managerial control rights, and the accumulation of non-state assets led to the issuance of a series of restructuring policies since 1997. The first policy was to lay off 6 million out of 44 million workers of SOEs by the end of 1999, which diminished the role of the state sector as guaranteed employment and made the politically sensitive conversion more feasible (Rawski, 2002; Jefferson and Su, 2006). The second policy was to gradually privatize all but the largest 300 of the nation’s industrial SOEs, under the principle of “retain the large, and release the small” (see Footnote 4). The 300 largest SOEs were retained because they were in heavily regulated industries and/or were considered to be of economic and strategic importance. Along with the principle, a three-year schedule of implementing the “modern enterprise system” and converting losses to profits was established for those loss-making SOEs.

The privatization of SOEs were mainly conducted through reorganization, mergers and acquisitions, takeovers, leasing contracts, converting to shareholding companies, or outright closures. Among these strategies, conversion to shareholding enterprises was the principal method. It generally included a change in the enterprise’s formal ownership classification (registration status), the establishment of a board of directors consisting of representatives of the major shareholders, and the infusion of new assets from private sector, sometimes
through initial public offerings.

The privatization of SOEs has taken a gradual and selective approach. Although many SOEs were willing to privatize, the government restricted the number of SOEs to be privatized in each year and maintained an orderly flow of privatization. The number was set up by the State Planning Commission, the People’s Bank of China, and the China Securities Regulatory Commission. The central government allocated the quota to the provincial governments, and the latter further distributed the quota to target SOEs. The standards for selecting target SOEs were not publicly announced, but there was anecdotal evidence that the selection of SOEs was based on economic and financial needs, commercial viability, political objectives, society concerns, and personal relationships between managers of SOEs and local planning officials (IPOs).

2.2.3 Enterprise Ownership Status

There are two sources of enterprise ownership status, formal legal registration status and ownership composition of the capital. First, formal legal registration status is the status an enterprise registers with the National Bureau of Statistics in China. It includes 8 categories (see Footnote 2). Table 2.1 describes the ownership distribution by official registration status from 1998 to 2007. The total number of enterprises with sales above 5 million Yuan (about 0.66 million U.S. Dollars according to the average exchange rate in 2007) grows from 144
thousand in 1998 to 334 thousand in 2007. At the beginning of the sample period, SOEs and COEs dominate the whole sample. There are 46,169 SOEs and 51,360 COEs, accounting for 32% and 36% of the sample respectively. The remaining types of enterprises add up to 32% of the sample. From 1998 to 2007, the number and percentage of SOEs both decrease gradually. Till 2007, the number of registered SOEs reduces to 9,715, only accounting for 3% of the sample. The same trend holds for COEs as well. At the same time, nonpublic shares of economy increase dramatically, especially for POEs and SHRs.

On the other hand, the ownership status of an enterprise can also be generated by calculating the actual capital ownership composition. The components of an enterprise’s capital structure can include state-owned capital, collectively-owned capital, legal-person-owned capital, privately-owned capital, Hong Kong, Macao, and Taiwan (HMT)-owned capital, and foreign-owned capital. Total capital is the sum of these components. For many enterprises in China, when there is a change in their actual ownership structure (e.g., from totally state-owned to mixed ownership), their official registration status usually changes with a time lag. Thus, actual ownership composition of the capital, instead of registration status, can reflect the de facto control right of stakeholders. Thus, I use ownership composition of the capital to measure ownership status and the extent of privatization in the empirical strategy section.

There are different definitions of SOEs. A commonly used definition is, an enterprise is defined as an SOE if in its capital structure, the state have significant control through full
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</tr>
</tbody>
</table>

**Notes:** The table is generated using Enterprise Industrial Enterprise Database (CIED) from 1998 to 2007. It is a survey of all enterprises in China with sales above 5 million Yuan (about 0.66 million U.S. Dollars according to the average exchange rate in 2007). The total number of enterprises in the data grows from 144 thousand in 1998 to 334 thousand in 2007. The 8 types of enterprises are SOE (state-owned enterprises), COE (collectively-owned enterprises), HMT (Hong Kong, Macao, Taiwan-owned enterprises), FOE (Foreign-owned enterprises), POE (Privately-owned enterprises), JOE (Jointly-owned enterprises), SHR (Shareholding enterprises), and OTH (Other enterprises).
ownership (100%), majority ownership (≥ 50%), or significant minority ownership (< 50% but is still large enough to be influential). In this paper, SOEs only include enterprises with 100% state-owned capital (pure SOEs). They are chosen as the targets of the privatization reform. Other enterprises with majority ownership or significant minority ownership by the state are classified as sharing-holding enterprises (SHRs) and jointly-owned enterprises (JOEs). They are not the privatization targets. The advantage of focusing on pure SOEs is that their initial performance and selection to be the privatization target will not be affected by any private component. An initial pure SOE is defined as “being privatized” if its state-owned share decreases below 100%, while the share of other components in the capital structure becomes positive.

2.3 Empirical Strategy

2.3.1 Sources of Endogeneity

To examine the effect of privatization on enterprise performance, measured by productivity, profitability, innovation, and operation scale, it is crucial to control for potential selection bias and endogeneity resulting from enterprise characteristics. China has taken a gradual and selective process to privatize SOEs. The central government first distributes privatization quota to each province in each year, and the local government officials then decide which SOEs to be privatized and allocate the quota to the target SOEs. Privatization of SOEs has
also taken a bottom-up approach, i.e., privatization of SOEs is usually first experimented in several localities and later promoted across the country. The standards by which local government officials choose target regions and SOEs are not publicly announced. Officials may consider local economic and financial needs, commercial viability, political objectives, society concerns, and personal relationships with the managers of SOEs. Thus, it naturally raises the selection bias problem, i.e., SOEs selected as privatization targets may be systematically different from those unselected in some unobserved ways. Therefore, any differences in enterprise performance between privatized and non-privatized SOEs may actually result from those unobserved characteristics, not privatization.

On the one hand, SOEs may have some specific time-invariant characteristics that can explain performance. For example, SOEs in certain regions or industries or SOEs that have high-quality managerial skills may be more likely to be privatized. SOEs that are particularly large in scale and produce strategically important products may be less likely to be privatized, which is consistent with the “retain the large, release the small” policy. Thus, simply regressing enterprise performance on privatization dummy may generate bias in the estimate.

On the other hand, privatized SOEs may have some time-variant enterprise characteristics that can affect both performance and privatization decision. For example, local government officials may consider performance in the past years when selecting target SOEs. It might be the case that good performers are first privatized because government officials want them to further drive up local economic growth and industrial transformation.
It might also be the case that bad performers are first privatized because government officials want to incentivize the management or hive off bad assets and relieve the fiscal burden. In the former case, the estimate of privatization effect will be biased upward. In the latter case, the estimate of privatization effect will be biased downward.

To reduce potential selection bias and associated endogeneity problem, a fixed effects model can be used to control for time-invariant enterprise characteristics and unobserved time-invariant features that may affect both performance and privatization decision. Another solution is to precisely match the privatized SOEs with SOEs that are not privatized but have similar observable characteristics, so that the privatized (treated) SOEs and the non-privatized (control) SOEs are truly comparable. In the matched sample, any difference in performance between the two groups is more likely to be driven by privatization, not particular enterprise characteristics. Propensity score matching method allows for a precise matching of SOEs based on multiple dimensions. When the number of potential characteristics to be matched is too large, machine learning method can be used in combination with propensity score matching method to achieve optimal model selection (more details in the following subsections).
2.3.2 Fixed Effects Model

2.3.2.1 Continuous Private Share

Assume that some selection bias is generated by enterprise-specific time-invariant characteristics and other time-invariant factors (e.g., region, industry). To estimate the effect of privatization on performance, I use the following baseline fixed effects model specification:

$$y_{it} = \alpha_1 PSR_{it} + \alpha_2 FS_{it} + \beta \ln HHI_{jt} + \gamma X_{it-1} + \theta_i + \delta_t + \mu_{kt} + \epsilon_{it} \quad (2.1)$$

where \(i, j, k, \) and \(t\) represents SOE \(i\) in industry \(j\), located in region \(k\) in year \(t\) respectively. The outcome variable \(y_{it}\) includes a list of performance variables of interest: productivity indicators, profitability indicators, innovation indicator, operation scale indicators, and profitability sources indicators.

Profitability indicators include \(\ln Profit_{L_{it}}, \ln Profit_{Sales_{it}}, \) and \(\ln Profit_{Assets_{it}}.\) I use operating profit in all variables. \(\ln Profit_{L_{it}}\) is profit per employee. \(\ln Profit_{Sales_{it}}\) is profit per unit of sales revenue. \(\ln Profit_{Assets_{it}}\) is profit per unit of total assets. All values are in log.

---

\(^6\)By definition, operating profit equals the sum of sales profit of main products and profit of other business, minus administrative expenses and financial expenses. Sales profit equals sales revenue minus costs of good sold, sales expenses, and sales tax.
Productivity indicators include $lnV_{A_L_it}$, $lnV_{A_K_it}$, and $lnSales_{L_it}$. $lnV_{A_L_it}$ is value added per employee, which represents labor productivity. $lnV_{A_K_it}$ is value added per unit of capital, which reflects capital productivity.\(^7\) $lnSales_{L_it}$ is sales revenue per employee. All values are in log.

Innovation indicator is $lnNew_{Sales_it}$, which is new product output value per unit of sales revenue. Another potential indicator of innovation is R&D expenses per unit of sales revenue. But data on R&D expenses is not available in most of the sample years in the CIED data. Thus, $lnNew_{Sales_it}$ is used to represent innovation. The value is in log.

Operation scale indicators include $lnAssets_{it}$, $lnSales_{it}$, and $lnEmp_{it}$. $lnAssets_{it}$ is total assets, which represents enterprise size or scale. $lnSales_{it}$ is sales revenue. $lnEmp_{it}$ is the number of employees. All values are in log.

Profitability sources indicators include $lnSalesProfit_{Sales_{it}}$ and $lnOtherProfit_{Sales_{it}}$ (two sources of profit), and $lnAdminExp_{Sales_{it}}$ and $lnFinExp_{Sales_{it}}$ (two sources of cost). By the definition of operating profit, these four components are the four sources of profitability. Specifically, $lnSalesProfit_{Sales_{it}}$ is sales profit of main products per unit of sales revenue. $lnOtherProfit_{Sales_{it}}$ is profit of other business per unit of sales revenue. $lnAdminExp_{Sales_{it}}$ is administrative expenses

\(^7\)Here, capital is measured by net fixed assets of an enterprise.
per unit of sales revenue. $\ln \text{FinExp}_{\text{Sales}}$ is financial expenses per unit of sales revenue. All values are in log.

On the right hand side, the main independent variables of interest are the privately-owned share of capital ($\text{PSR}_{it}$) and foreign-owned shared of capital ($\text{FSR}_{it}$). In China, the components of an enterprise’s total capital can include state-owned capital, collectively-owned capital, legal-person-owned capital, privately-owned capital, Hong Kong, Macao, and Taiwan (HMT)-owned capital, and foreign-owned capital. Total capital is the sum of these components. $\text{PSR}_{it}$, which represents private share, is calculated as the percentage of private-owned capital in total capital. It reflects the private control right of the enterprise. $\text{FSR}_{it}$, which represents foreign share, is calculated as the percentage of foreign-owned capital in total capital.

Other covariates include $\ln \text{HHI}_{jt}$, which is the Herfindahl-Hirschman index, indicating the level of market concentration or competition in industry $j$ in year $t$. It is calculated by taking the sum of squared market share of sales of each enterprise operating in a 3-digit industry category. $\ln \text{HHI}_{jt}$ can range from close to 0 (perfect competition) to 10,000 (monopoly). Higher $\ln \text{HHI}_{jt}$ means that the market of industry $j$ in year $t$ is closer to being a monopoly, and that market is more concentrated (less competition). The value is in log.

A list of lagged enterprise characteristics $X_{it-1}$ is also incorporated. It includes indicators of an enterprise’s access to finance: $\ln \text{Subsidy}_{L_{it-1}}$, subsidy per employee
(in log), which reflects an enterprise’s access to direct government financial assistance; $D_{it-1}$, debt-to-asset ratio, which reflects an enterprise’s direct access to borrowing; and $SoftBudget_{it-1}$, the interaction term of $lnSubsidy_{it-1}$ and $D_{it-1}$. These three variables together captures the softness of an enterprise’s budget constraint (see Footnote 5). In addition, I include $expsh_{it-1}$, the export share of an SOE, which is calculated as the share of export sales in total sales. It captures an enterprise’s export propensity. Since these enterprise characteristics are one-year lagged variables in year $t - 1$, they will not be affected reversely by the privatization decision or enterprise performance in year $t$.

I also include a list of fixed effects. $\theta_i$ is firm fixed effects, which controls for unobserved time-invariant enterprise characteristics that can affect enterprise performance. $\delta_t$ is year fixed effects, which controls for changes in external environment over time that can affect performance and are common for all enterprises, such as macroeconomic fluctuations and changes in government policy over time. $\mu_{kt}$ is region-year fixed effects, which is the grouped dummy (interaction) of region $k$ and year $t$. Region $k$ is a dummy for the 3,555 counties where enterprises are located.

### 2.3.2.2 Binary Privatization Indicator

The above specification (Equation (2.1)) can estimate the intensity of privatization (measured by the continuous $PSR_{it}$) on performance. Alternatively, I use the following specification to estimate, in a simpler way, the incidence of the privatization effect on performance:
where $Priv_{it}$ is an indicator for whether an SOE is privatized. It equals 1 if SOE $i$ is privatized in year $t$ (or has been privatized in earlier years). All the other independent variables and outcome variables are the same as in Equation (2.1).

### 2.3.3 Within-Cell Estimates

Due to potential selection bias, the privatized SOEs and non-privatized SOEs may be systematically different and thus not comparable. Thus, to better match privatized SOEs and non-privatized SOEs that are similar in characteristics, I calculate the propensity score of being privatized for each SOE using a logit model (more details in Section 2.3.4), divide the propensity scores into 10 equally-spaced cells (e.g., the first cell includes all observations with a p-score between 0 to 0.1, the second cell includes all observations with a p-score between 0.1 to 0.2, etc.), and run the fixed effects regression (Equation (2.1)) for observations within each cell. After generating the estimate within each cell, I then calculate the average treatment effect by taking a weighted average of the 10 within-cell estimates. Following Imbens and Wooldridge (2009), I choose the weight as the share of privatized SOEs in all SOEs (privatized and non-privatized) within each cell.
The method above runs the fixed effects regression for observations within each propensity score cell (with year fixed effects). As an alternative, I pool all the observations together and run the fixed effects regression with propensity score interacted with year:

$$y_{it} = \alpha_1 PSR_{it} + \alpha_2 FSR_{it} + \beta \ln HHI_{jt} + \gamma X_{it-1} + \rho PS_i \times \delta_t + \theta_i + \delta_t + \mu_{kt} + \epsilon_{it}$$

(2.3)

where $PS_i$ represents the propensity score of being privatized for SOE $i$ (the way to generate propensity score is in Section 2.3.4). The specification is based on the fixed effects regression (Equation (2.1)) with an additional term, the interaction of propensity score $PS_i$ with year $\delta_t$.

### 2.3.4 Propensity Score Matching

Propensity score matching method allows me to better compare SOEs that are privatized with those that have similar initial performance and characteristics but do not undergo privatization. It has two stages. The first stage is to estimate the effects of enterprises’ initial characteristics (pre-privatization) on the decision of privatization and generate a propensity score for being privatized. The second stage is to match the privatized (treated) and non-privatized (control) SOEs with similar propensity scores, calculate the difference in their outcomes for each propensity score, and take an average of the differences across all
Specifically, in the first stage, I run a logistic regression of privatization decision on a list of initial conditions of enterprises. The specification of the logit model is given by the following equation:

\[
Pr(PrivTarget_i) = f(y_{i,1998}, \text{lnHHI}_{j,1998}, X_{i,1998})
\]  

(2.4)

where \(f(*)\) is the logistic function. The variable \(PrivTarget_i\) is a dummy for whether SOE \(i\) is chosen as privatization target and is privatized in the sample period. Note that it is different from the explanatory variable \(Priv_{it}\) in Equation (2.2) because it does not vary by year \(t\). The predictors include a list of initial conditions in 1998 (pre-treatment period for all SOEs in the sample). \(y_{i,1998}\) represents all the initial performance indicators in 1998, which reflects the potential for performance improvement. \(\text{lnHHI}_{j,1998}\) is the pre-privatization market concentration in 1998. \(X_{i,1998}\) is a list of pre-treatment enterprise characteristics, which contains all enterprise characteristics (as explained in Section 2.3.2.1) in 1998 and two additional enterprise characteristics: capital-to-labor ratio \(K_{-L_{i,1998}}\) and firm age (in log) \(\text{lnAge}_{i,1998}\). The predicted values from the logit regression is used as propensity scores.

---

8 Xia et al. (2009) uses a combination propensity score regression method, which predicts the p-score in the first stage, calculate a weight using the p-score, and run a weighted regression of performance on privatization indicator.
In the second stage, I match the propensity scores of privatized (treated) SOEs and non-privatized (control) SOEs using the 10-nearest neighbors matching method, calculate the difference in their outcomes between the treated and control group for each propensity score, and take an average of the differences across all propensity scores.

2.3.5 Post-Double-Selection Lasso

As the number of potential predictors of privatization is relatively large, a machine learning method, Lasso (least absolute shrinkage and selection operator), can be used to achieve the optimal choice of predictors and improve accuracy. Lasso is a penalized regression method that minimizes the sum of squared errors with a bound on the sum of the absolute values of the coefficients. It selects the model by producing some coefficients that are 0 to reduce dimensionality and yield interpretable models (Tibshirani, 1996).

Particularly, I apply the Post-Double-Selection Lasso method developed by Belloni et al. (2014), which selects variables that are important for both the treatment variable and the outcomes. Specifically, in the first selection step, I select terms from the predictors that predict the treatment variable (privatization target indicator), i.e., terms that explain the propensity score. In the second selection step, I select terms from the predictors that predict the outcomes (performance indicators), i.e., terms that explain the outcome regressions. Then, I run a final regression of outcomes on the privatization target indicator and the union
of selected terms. In summary, this method relies on the selection of control variables relevant for both the propensity score and the outcome regressions and is related to treatment effect estimators that use regression adjustment after conditioning on the propensity score. This method allows for imperfect selection of the controls and provides uniformly valid confidence intervals across a large class of models (Belloni et al., 2014).

2.3.6 Heterogeneous Effects of Different Rounds of Privatization

Privatization of SOEs is a gradual process, which usually takes several rounds to complete (state-owned share of capital decreases from 100% to 0%). In the sample period from 1998 to 2007, SOEs experience at most 6 rounds of privatization. Table 2.2 shows the number of SOEs that have experienced the $n$th ($n = 1, 2, ..., 6$) round of privatization in each year. For example, in 2007, 2,027 SOEs have been privatized (and have experienced the 1st round of privatization). 228 of them have undergone two rounds of privatization. 55 of them have experienced the third round, 14 of them the fourth, 2 of them the fifth, and 1 of them the sixth. The extent of each round of privatization varies across SOEs. However, on average, the change in privately-owned share of capital (per round) decreases with the number of rounds.

It is not clear how each round of privatization contributes to the changes in enterprise performance. On the one hand, it is possible that the first round of privatization has the
Table 2.2: Rounds of Privatization

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<td>4655</td>
<td>4655</td>
<td>4655</td>
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</table>

Notes: The table is generated using Enterprise Industrial Enterprise Database (CIED) from 1998 to 2007. Each column represents the number of SOEs that have experienced the \( n \)th round of privatization in a year. In 1998, none SOEs have been privatized, as privatization starts from 1999.

The largest impact on performance, and the subsequent rounds add some value but in a decreasing trend. On the other hand, it may take some time for the privatized SOEs to adjust to the new ownership and governance structure and to achieve improvement in performance. Thus, due to transitional costs or adjustment costs, net gains from privatization may appear one or more years after the first privatization (Li and Rozelle, 2000; Jefferson and Su, 2006).

To distinguish between the effect of each round of privatization, I create six indicators, each representing one round of privatization. The revised fixed effects model specification is given by the following equation:

\[
y_{it} = \sum_{n=1}^{6} \alpha_n \times Round_{n_{it}} + \beta \ln HHI_{jt} + \gamma X_{it-1} + \theta_i + \delta_t + \mu_{kt} + \epsilon_{it} \tag{2.5}
\]

where \( Round_{n_{it}} \) is the indicator for the occurrence of the \( n \)th round of privatization for SOE \( i \) in year \( t \). \( Round_{n_{it}} \) equals 1 for year \( t \) and all the years thereafter if SOE \( i \) is privatized.
the $n$th time in year $t$. The coefficient on $Round_{n_{it}}$ reflects the contemporaneous effect of the $n$th round of privatization on performance, controlling for the lasting effects of earlier rounds of privatization.

2.4 Data

2.4.1 CIED Database

The empirical analysis in this paper draws on the Chinese Industrial Enterprises Database (also called the China Annual Survey of Industrial Firms), which is established by the National Bureau of Statistics (NBS) in China in 1998. The data is collected and compiled from the annual report and quarterly report submitted by the sample enterprises to the local Bureau of Statistics since 1998. There is no comparable data available before 1998, due to changes made to the survey instrument in 1998. NBS collects the data through a self-report system, and monitor data quality by conducting random checks on reporting enterprises.

The database covers all medium- and large-sized enterprises with sales revenue that is equal to or larger than 5 million Yuan (around 0.66 million U.S. Dollars according to the average exchange rate in 2007). The small enterprises are not included. The unit of the database is enterprise legal person, thus it is at the enterprise level. It contains more than 130 indicators of enterprises’ basic identification information (e.g., legal person code, enterprise name, sector, ownership registration status, starting year, and number of
employees) and detailed financial statement information (e.g., value-added, gross industrial output, new product output, export delivery value, sales revenue, cost of sales, sales profit, profit from other business, administrative expenses, financial expenses, assets, liabilities, and equity). The majority of the sample are manufacturing enterprises, belonging to 30 industrial categories (based on 2-digit industry code), such as agricultural and non-staple food processing, food manufacturing, textile manufacturing, and machinery and equipment manufacturing, which correspond to the China Standard Industrial Classification System (GB/T4754-2002) entry 13-43 (except 38).

2.4.2 Summary Statistics

This paper focuses on pure SOEs (enterprises with 100% state-owned capital) in the dataset. The sample period is from 1998 to 2007. I generate the estimation sample of SOEs by the following steps: (1) Calculate the state-owned share of capital for each enterprise in each year from 1998 to 2007. (2) Keep enterprises that are 100% SOEs (state-owned share of capital=100%) in 1998, and delete all enterprises that are not 100% SOEs in 1998. (3) Keep enterprises that operate and have observation data in each year from 1998 to 2007, and delete all enterprises that have at least one missing year, in order to get a balanced panel. In the final balanced sample, there are 4,655 enterprises in each year. Among these 4,655 initial SOEs, 2,027 of them are privatized, once or several times, from 1999 to 2007, while 2,328 of them are not privatized and continue to be 100% SOEs till the end of the sample
period.

The summary statistics for privatized and non-privatized SOEs are shown in Table 2.3. Privatized SOEs dominate non-privatized SOEs in all productivity, profitability, and innovation indicators. Privatized SOEs are larger in operation scale than non-privatized SOEs on average. Decomposition of profitability shows that the higher profitability of privatized SOEs mainly comes from lower administrative expenses and financial expenses.

On average, privatized SOEs have a state-owned share (SSR) of 48%, a privately-owned share (PSR) of 26%, a collectively-owned share (CSR) of 5%, and a foreign-owned share of 1%. It indicates that the state-owned capital is mostly transferred to the domestic private sector. Average competition within industry is higher for privatized SOEs. They also have higher subsidy per employee and higher debt-to-asset ratio, indicating a softer budget constraint. The average export share of privatized SOEs is also higher than that of non-privatized SOEs.
### Table 2.3: Summary Statistics

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<td>0.00</td>
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<td>-0.04***</td>
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</table>

Notes: The table is generated using the estimation sample of 4,655 initial SOEs from the Enterprise Industrial Enterprise Database (CIED). The sample period is from 1998 to 2007. The variables in the first column are explained in Section 2.3.2.1. SSR and CSR represents state-owned share and collectively-owned share of capital respectively. The last two column show the results of a t-test of the difference between privatized SOEs and non-privatized SOEs.

*** p<0.01, ** p<0.05, * p<0.1.
2.5 Results

2.5.1 The Effects of Privatization on Performance: FE Model

Following the empirical strategies described in Section 2.3.2, I first estimate the effects of privatization on enterprise performance using fixed effects model, with continuous private share and binary privatization indicator respectively.

Table 2.4 shows the results of fixed effects model with continuous private share. Privately-owned share of capital has a significantly positive impact on all productivity indicators. Specifically, as shown in column (1)-(3), if privately-owned share increases by 1%, value added per employee will increase by 0.09%, value added per capital will increase by 0.11%, and sales revenue per employee will increase by 0.16%. Similarly, privately-owned share has a significantly positive impact on all profitability indicators. As shown in column (4)-(6), if private-owned share increases by 1%, operating profit per employee will increase by 0.25%, operating profit per unit of sales revenue will increase by 0.03%, and operating profit per unit of asset will increase by 0.02%. In addition, as shown in column (7), innovation activity does not increase significantly when privately-owned share increases. The effects are significant at 1% level. On the other hand, there is a decrease in operation scale measured by asset and employment, while sales revenue increases, as shown in column (8)-(10). Decrease in employment is consistent with the worker lay-off policy associated with privatization.
As for the sources of gain in profitability resulted from privatization, column (11)-(14) reflect four components of gain in profit per unit of sales revenue. A 1% increase in privately-owned share will lead to a 0.02% decrease in administrative expenses, a 0.01% decrease in financial expenses, and a 0.01% decrease in profit of other business, but no significant impact on sales profit of main products (all measured in per unit of sales revenue). This indicates that the increase in profitability mainly comes from the decrease in costs at the management level. The management of SOEs in China is appointed (and controlled) by the State Assets Agency which pursues multiple social welfare objectives other than profit maximization. The management of SOEs is not incentivized or disciplined to maximize profit (Bai et al., 2009). Instead, they care more about the size of operation and the benefit and socioeconomic status they can enjoy from managing a big enterprise, which usually generates unnecessary agency costs. However, after privatization, profit-seeking shareholders will put pressure on the management to pursue profit maximization strategies, thus agency costs will be effectively reduced.

Foreign-owned share also has a positive impact on productivity and profitability indicators, with an influence in larger magnitude. It’s effect on operation scale measured by asset and employment size is not significant. It also does not have significant impact on most of the profitability sources except for financial expenses.

Table 2.5 shows the results of the fixed effects model using binary privatization indicator. The results are very similar to Table 2.4. For example, privatization leads to a 12% increase
Table 2.4: Fixed Effects Model with Continuous Private Share

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
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<td>lnV_L</td>
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<td>0.111***</td>
<td>0.157***</td>
<td>0.248***</td>
<td>0.0328***</td>
<td>0.0219***</td>
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<td>(0.0211)</td>
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<tr>
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<td>lnSales_L</td>
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<td>(0.00456)</td>
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<td>(0.00178)</td>
</tr>
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<td>lnProfit_L</td>
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<td>0.521***</td>
<td>4.450***</td>
<td>1.471***</td>
<td>-0.0509**</td>
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<td>(0.0590)</td>
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<td>(0.00842)</td>
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<td>0.628</td>
<td>0.758</td>
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</table>

R-squared: 0.806 0.742 0.892 0.786 0.596 0.628 0.758
Firm FE: Yes Yes Yes Yes Yes Yes Yes
Year FE: Yes Yes Yes Yes Yes Yes Yes
Region_Year FE: Yes Yes Yes Yes Yes Yes Yes

Notes: Each column represents a regression: \( y_{it} = \alpha_1 PSR_{it} + \alpha_2 FSR_{it} + \beta lnHHI_{jt} + \gamma X_{it-1} + \theta_i + \delta_t + \mu_{kt} + \epsilon_{it}. \)
All variables are explained in Section 2.3.2.1. The coefficients on lagged enterprise characteristics are not reported for brevity. The unit of observation is enterprise-year. Robust standard errors are in parentheses. Standard errors are clustered at the enterprise level.

*** p<0.01, ** p<0.05, * p<0.1.
### Table 2.5: Fixed Effects Model with Binary Privatization Indicator

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<td>32,246</td>
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<tr>
<td>R-squared</td>
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<td>0.743</td>
<td>0.892</td>
<td>0.786</td>
<td>0.597</td>
<td>0.628</td>
<td>0.758</td>
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<td>0.0217*</td>
<td>0.00692</td>
<td>0.00444</td>
<td>-0.000151</td>
<td>0.00265</td>
</tr>
<tr>
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<td>(0.00868)</td>
<td>(0.0129)</td>
<td>(0.0276)</td>
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<td>(0.00178)</td>
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<td>0.0246**</td>
<td>0.190***</td>
<td>0.0338***</td>
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<td>(0.0106)</td>
<td>(0.0135)</td>
<td>(0.00750)</td>
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<td>R-squared</td>
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<td>0.945</td>
<td>0.953</td>
<td>0.678</td>
<td>0.522</td>
<td>0.708</td>
<td>0.563</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Year FE</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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</table>

Notes: Each column represents a regression: $y_{it} = \alpha_1 Priv_{it} + \beta lnHHI_{it} + \gamma X_{it-1} + \theta_t + \delta_i + \mu_{it} + \epsilon_{it}$. All variables are explained in Section 2.3.2.2. The coefficients on lagged enterprise characteristics are not reported for brevity. The unit of observation is enterprise-year. Robust standard errors are in parentheses. Standard errors are clustered at the enterprise level.

*** p<0.01, ** p<0.05, * p<0.1.

in value added per employee. The counterpart in Table 2.4 suggests that if privately-owned share increases from 0% to 100%, value added per employee will increase by 9%.
2.5.2 The Within-Cell Effects

Following the steps described in Section 2.3.3, I first calculate the propensity score of being privatized using a logit model, divide the p-scores into 10 cells with equal intervals, and run the fixed effects regressions within each cell. Figure 2.3 shows the number of privatized SOEs and non-privatized SOEs within each cell. The x-axis represents 10 equally-spaced p-score cells. Each cell has an interval of 0.1. For example, cell 1 includes observations with a p-score between 0 and 0.1, and cell 2 includes observations with a p-score between 0.1 and 0.2. The blue bar represents the number of privatized SOEs, and the red bar represents the number of non-privatized SOEs.

![Figure 2.3: Number of Privatized and Non-privatized SOEs in Propensity Score Cells](image)

*Figure 2.3: Number of Privatized and Non-privatized SOEs in Propensity Score Cells*

*Notes: The x-axis represents 10 equally spaced propensity score cells. Cell k contains all observations (privatized and non-privatized SOEs) with propensity scores in the range of \((0.1 \times (k - 1), 0.1 \times k]\). The blue bar represents the number of privatized SOEs, and the red bar represents the number of non-privatized SOEs.*
Figure 2.4 shows the fixed effects regression results by cells. The blue solid line represents the coefficients on continuous private share from a fixed effect regression (see specification in Section 2.3.2.1) in each cell. The red dotted line represents the weighted average of the coefficients, using the share of privatized SOEs in all SOEs within each cell as weight. The average estimates are similar to that in Table 2.4 and Table 2.5. The coefficients in the two ends (cell 1 and cell 10) diverge from the average, as the observations in the two ends are very unbalanced—cell 1 contains mostly non-privatized SOEs, while cell 10 contains mostly privatized SOEs.

As an alternative to running the fixed effects regression within each propensity score cell, I pool all observations together and run the fixed effects regression with an additional term, the interaction of propensity score with year (Equation (2.3)). Table 2.6 shows the results of the specification with propensity score interacted with year. The coefficients are similar to the average estimates across cells (the red dotted line) in Figure 2.4 and are similar to that in Table 2.4 and Table 2.5.

### 2.5.3 The Effects of Privatization on Performance: PSM

As described in Section 2.3.4, propensity score matching includes two stages. In the first stage, I calculate the propensity score of being privatized using a logit model. The table of the regression results of the first stage is not reported here for brevity. Figure 2.5 shows the
(a) Productivity

(b) Profitability
Figure 2.4: The Within-Cell Estimates

Notes: Each plot represents the results of the following regression within propensity score cells: $y_{it} = \alpha_1 PSR_{it} + \alpha_2 FSR_{it} + \beta \ln HHI_{jt} + \gamma X_{it} + \theta_i + \delta_t + \mu_k + \epsilon_{it}$. All variables are explained in Section 2.3.2.1. The blue solid line represents the coefficients on $PSR_{it}$. The red dotted line represents the weighted average of the coefficients, using the share of privatized SOEs in all SOEs within each cell as weight.
Table 2.6: Fixed Effects Model with Interaction of Propensity Score with Year

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<th>(1)</th>
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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<tbody>
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<td>lnVA_L</td>
<td>PSR 0.108*** (0.0257)</td>
<td>0.111*** (0.0175)</td>
<td>0.162*** (0.0214)</td>
<td>0.226*** (0.0477)</td>
<td>0.0339*** (0.00665)</td>
<td>0.0215*** (0.00398)</td>
<td>0.00222 *** (0.00347)</td>
</tr>
<tr>
<td>lnVA_K</td>
<td>FSR 0.326*** (0.147)</td>
<td>0.118 (0.115)</td>
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<td>0.797*** (0.264)</td>
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<td>-0.0371 *** (0.0157)</td>
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<td>lnSales_L</td>
<td>lnProfit_L 0.0479*** (0.0157)</td>
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<td>0.0282** (0.0131)</td>
<td>-0.00526 (0.0279)</td>
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<td>0.00251 *** (0.00181)</td>
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<td>lnProfit_Assets 3.199*** (0.0822)</td>
<td>0.541*** (0.0455)</td>
<td>4.384*** (0.0670)</td>
<td>1.641*** (0.153)</td>
<td>0.0185* (0.0254)</td>
<td>0.0214*** (0.00956)</td>
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<td>Constant 3.199*** (0.0822)</td>
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<td>lnSales</td>
<td>Observations 35,456</td>
<td>36,226</td>
<td>36,306</td>
<td>22,005</td>
<td>35,790</td>
<td>36,299</td>
<td>32,246</td>
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<td>lnAssets</td>
<td>R-squared 0.806</td>
<td>0.743</td>
<td>0.892</td>
<td>0.786</td>
<td>0.597</td>
<td>0.628</td>
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<td>PSR -0.0766*** (0.0189)</td>
<td>0.0820*** (0.0224)</td>
<td>-0.0853*** (0.0169)</td>
<td>0.00397 (0.00354)</td>
<td>-0.00832*** (0.00246)</td>
<td>-0.0227*** (0.00378)</td>
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<td>0.0124 (0.0162)</td>
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<td>-0.00725* (0.000371)</td>
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<td>0.122*** (0.0121)</td>
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<td>0.213*** (0.0186)</td>
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<td>(10)</td>
<td>(11)</td>
<td>(12)</td>
<td>(13)</td>
<td>(14)</td>
</tr>
</tbody>
</table>

Notes: Each column represents a regression: $y_{it} = \alpha_1 PSR_{it} + \alpha_2 FSR_{it} + \beta lnHHI_{jt} + \gamma X_{it-1} + \rho PS_i \times \delta_t + \theta_i + \delta_t + \mu_k + \epsilon_{it}$. All variables are explained in Section 2.3.3. The coefficients on lagged enterprise characteristics and the interactions of propensity score with year are not reported for brevity. The unit of observation is enterprise-year. Robust standard errors are in parentheses. Standard errors are clustered at the enterprise level. *** p<0.01, ** p<0.05, * p<0.1.
overlap of the propensity scores of the privatized SOEs and non-privatized SOEs.

Figure 2.5: Overlap of the Propensity Scores of Privatized and Non-privatized SOEs

Notes: The x-axis represents 10 equally spaced propensity score cells. Cell $k$ contains all observations (privatized and non-privatized SOEs) with propensity scores in the range of $(0.1 \times (k - 1), 0.1 \times k]$. The blue bar represents the number of privatized SOEs, and the red bar represents the number of non-privatized SOEs.

In the second stage, I match the privatized (treated) and non-privatized (control) SOEs by 10-nearest neighbors matching method, calculate the difference in outcomes between the two groups for each propensity score, and take an average of the differences across all propensity scores. Table 2.7 shows the results of propensity score matching method. The coefficients are similar in direction and magnitude as in Table 2.4, Table 2.5, and Table 2.6.

Table 2.8 shows the balance test results of the predictors in the first stage. After matching, the privatized (treated) and non-privatized (control) group are balanced in most of the
Table 2.7: Propensity Score Matching

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<td>(0.0107)</td>
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<td>(0.0110)</td>
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<td>47,233</td>
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<td>46,630</td>
<td>47,227</td>
<td>42,504</td>
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<td>47,155</td>
<td>47,227</td>
<td>47,233</td>
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</table>

Notes: Each column represents the results of the propensity score matching method. The estimates are the average difference in outcomes between privatized SOEs and non-privatized SOEs after matching. The unit of observation is enterprise-year. Robust standard errors are in parentheses. The first stage regression of the propensity score matching is \( Pr(PrivTarget) = f(y_i, HHI_j, X_{i,1998}) \). All variables are explained in Section 2.3.4.

*** p<0.01, ** p<0.05, * p<0.1.

covariates: the standardized difference in means is close to 0, and the variance ratio is close to 1, except for initial profit per unit of assets, other profits per unit of sales, export share, and capital-to-labor ratio.

### 2.5.4 The Effects of Privatization on Performance: Post-Double Selection Lasso

Due to the large number of potential predictors of privatization, I use a Post-Double-Selection Lasso method (as described in Section 2.3.5) to help model selection. This method selects control variables that are relevant for both the propensity score (the first selection) and the outcome regressions (the second selection). The treatment effect of privatization is then estimated by regressing the outcomes on the treatment (privatization) and the
Table 2.8: Balance Test of Predictors

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<th>Variance ratio</th>
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Notes: The first two columns represent the standardized difference in means between the privatized (treated) SOEs and non-privatized (control) SOEs in the raw sample and matched sample respectively. Standardized difference equals the difference in means between the treated group and the control group, divided by the mean of the control group. The third and fourth column represent the variance ratio in the raw sample and matched sample respectively. Variance ratio equals the ratio of the variance of the treated group to the variance of the control group.
union of the set of controls selected in the two steps. Table 2.9 shows the results of the Post-Double-Selection Lasso method. Compared to Table 2.7, the Post-Double-Selection Lasso method yields similar results that are slightly larger in magnitude. It generates positive coefficients on productivity, profitability, and innovation indicators and negative coefficients on operation scale indicators measured by asset and employment size.

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<td>47,233</td>
<td>47,233</td>
<td>47,233</td>
<td>47,155</td>
<td>47,227</td>
<td>47,233</td>
<td>47,230</td>
</tr>
</tbody>
</table>

Notes: Each column represents the results of the Post-Double-Selection Lasso method. The estimates are generated by two variable selection steps followed by a final estimation step (as described in Section 2.3.5). The union of the set of control variables selected in the two variable selection steps includes lnVA_Ki,1998, lnSales_Li,1998, lnProfit_Li,1998, lnAssets_i,1998, lnSales_i,1998, lnFinExp_Sales_i,1998, lnHHI_i,1998, D_Ai,1998, expsh_i,1998, and lnAge_i,1998. The coefficients on control variables are not reported for brevity. The unit of observation is enterprise-year. Robust standard errors are in parentheses. All variables are explained in Section 2.3.4. *** p<0.01, ** p<0.05, * p<0.1.

In summary, after controlling for potential selection bias generated by unobserved enterprise characteristics, an increase in privately-owned share of capital due to privatization will lead to an increase in enterprise productivity, profitability, innovation activity, and operation scale. Specifically, if private-owned share of capital increases by 1%, for productivity, labor
productivity will increase by 0.09-0.14%, capital productivity will increase by 0.09-0.12%, sales revenue per employee will increase by 0.14-0.18%; for profitability, operating profit per employee will increase by 0.13-0.31%, operating profit per unit of sales revenue will increase by 0.03-0.04%, and operating profit per unit of asset will increase by around 0.01-0.02%; for innovation activity, new product output per employee will increase by around 0-0.02%; for operation scale, asset scale will decrease by 0.06-0.09%, sales revenue will increase by 0.06-0.14%, and employment will decrease by 0.04-0.11%. The gain in profitability mainly comes from a 0.02-0.03% decrease in administrative expenses and a 0.01% decrease in financial expenses.

2.5.5 The Heterogeneous Effects by Rounds of Privatization

Following the empirical strategies described in Section 2.3.6, I estimate the effects of different rounds of privatization on enterprise performance using the fixed effects model. Table 2.10 shows the results. An outstanding result is that the first two rounds of privatization generates the most significant effect on almost all performance measures. The increase in productivity and profitability is mainly shown in the first two rounds, with the effects of the second round slightly smaller than that of the first round (except for value added per employee). The decrease in operation scale, administrative expenses, and financial expenses is only significant in the first round. Subsequent rounds of privatization also affect productivity, but rarely have any significant effect on other performance indicators. This suggests
that although many privatized SOEs experience several rounds of privatization, only the
first two rounds of privatization contributes greatly to the improvement in performance.
Subsequent rounds add limited value to performance.

In summary, the first round of privatization has the largest effect on almost all perfor-
mance indicators, followed by the second round effect. The magnitude and significance of
the effect of the first round of privatization on performance are close to the overall effect of
privatization across all years. Subsequent rounds of privatization occasionally affect perfor-
mance, but their influences are much smaller compared to the first round. The first round
of privatization also has a negative contemporaneous effect on employment and asset scale,
which is related to the worker lay-off policy and the asset depletion in the adjustment process.

2.6 Conclusions

In this paper, I investigate whether and how privatization of state-owned enterprises (SOEs)
affects enterprise performance in China. There are two definitions of ownership status,
formal registration status and ownership composition of the capital. The change in the
former one always lags behind the change in the latter one due to political sensitivity. Since
ownership composition of the capital reflects the de facto control rights of stakeholders
and directly affects performance, I use the change in ownership composition to define and
measure privatization.
### Table 2.10: The Heterogeneous Effects by Rounds of Privatization

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<td>-0.352***</td>
<td>-0.263***</td>
<td>-0.0590</td>
<td>-0.206</td>
<td>-0.0370</td>
<td>-0.0219**</td>
<td>0.0160</td>
</tr>
<tr>
<td>lnProfit_Sales</td>
<td>(0.0589)</td>
<td>(0.0402)</td>
<td>(0.0512)</td>
<td>(0.118)</td>
<td>(0.0155)</td>
<td>(0.00729)</td>
<td>(0.0103)</td>
</tr>
<tr>
<td>lnNew_Sales</td>
<td>(0.125)</td>
<td>(0.0768)</td>
<td>(0.0934)</td>
<td>(0.211)</td>
<td>(0.0284)</td>
<td>(0.0108)</td>
<td>(0.0203)</td>
</tr>
<tr>
<td>lnRound_1</td>
<td>0.026</td>
<td>0.128</td>
<td>0.0251</td>
<td>0.230</td>
<td>0.0419</td>
<td>0.0275</td>
<td>-0.00193</td>
</tr>
<tr>
<td>lnRound_2</td>
<td>0.226</td>
<td>0.114</td>
<td>0.221</td>
<td>0.477</td>
<td>0.0489</td>
<td>0.0211</td>
<td>0.0214</td>
</tr>
<tr>
<td>lnRound_3</td>
<td>0.185</td>
<td>0.283</td>
<td>0.0361</td>
<td>-0.510</td>
<td>-0.00701</td>
<td>-0.0618</td>
<td>-0.0556</td>
</tr>
<tr>
<td>lnRound_4</td>
<td>0.0383**</td>
<td>-0.00147</td>
<td>0.0218*</td>
<td>0.00651</td>
<td>0.00446</td>
<td>-0.000157</td>
<td>0.00265</td>
</tr>
<tr>
<td>lnRound_5</td>
<td>(0.372)</td>
<td>(0.220)</td>
<td>(0.303)</td>
<td>(0.425)</td>
<td>(0.0462)</td>
<td>(0.0641)</td>
<td>(0.0787)</td>
</tr>
<tr>
<td>lnRound_6</td>
<td>0.0154</td>
<td>0.00868</td>
<td>0.0129</td>
<td>0.0276</td>
<td>0.00456</td>
<td>0.00186</td>
<td>0.00178</td>
</tr>
<tr>
<td>lnHHI</td>
<td>0.0806</td>
<td>0.743</td>
<td>0.892</td>
<td>0.787</td>
<td>0.597</td>
<td>0.628</td>
<td>0.758</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
<th>(13)</th>
<th>(14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnSales</td>
<td>35,456</td>
<td>36,226</td>
<td>36,306</td>
<td>22,005</td>
<td>35,790</td>
<td>36,299</td>
</tr>
<tr>
<td>lnEmp</td>
<td>0.0383**</td>
<td>-0.00147</td>
<td>0.0218*</td>
<td>0.00651</td>
<td>0.00446</td>
<td>-0.000157</td>
</tr>
<tr>
<td>lnHHI</td>
<td>(0.0154)</td>
<td>(0.00868)</td>
<td>(0.0129)</td>
<td>(0.0276)</td>
<td>(0.00456)</td>
<td>(0.00186)</td>
</tr>
</tbody>
</table>

Notes: Each column represents a regression: $y_{it} = \sum_{n=1}^{6} \alpha_n \times Round_{-n_{it}} + \beta \lnHHI_{it} + \gamma X_{it,-1} + \theta_i + \delta_t + \mu_{it} + \epsilon_{it}$. All variables are explained in Section 2.3.6. The coefficients on lagged enterprise characteristics are not reported for brevity. The unit of observation is enterprise-year. Robust standard errors are in parentheses. Standard errors are clustered at the enterprise level.

*** p<0.01, ** p<0.05, * p<0.1.
Privatization of SOEs in China has taken a gradual and selective approach. The quota of privatization is distributed from the central government to the provincial government, and then allocated to target SOEs. The standards by which government officials choose target SOEs are not publicly announced, but are quite likely to depend on specific conditions of each SOE. Thus, to identify the effect of privatization on enterprise performance, it is crucial to control for potential selection bias resulted from enterprise characteristics. The fixed effects model (with variations), propensity score matching method, and post-double-selection lasso method are used to address these problems.

Using a balanced panel of 4,655 SOEs from 1998 to 2007, I find that after controlling for selection bias from enterprise characteristics, an increase in privately-owned share of capital due to privatization will lead to an increase in productivity, profitability, innovation activity, and operation scale. Specifically, a 1% increase in privately-owned share of capital will increase labor productivity by 0.09-0.14%, capital productivity by 0.09-0.12%, sales revenue per employee by 0.14-0.18%, operating profit per employee by 0.13-0.31%, operating profit per unit of sales revenue by 0.03-0.04%, operating profit per unit of asset by 0.01-0.02%; new product output per unit of sales revenue by 0-0.02%, asset scale by -0.06-0.09%, sales revenue by 0.06-0.14%, and employment scale by -0.04-0.11%. The gain in profitability mainly comes from a 0.02-0.03% decrease in administrative expenses a 0.01% decrease in financial expenses.
Different rounds of privatization have heterogeneous effects on enterprise performance. The first two rounds of privatization contributes most to the improvement in performance. Subsequent rounds of privatization occasionally affect performance, but the influences are much smaller. The first round of privatization has a negative contemporaneous effect on employment and asset scale, which suggests the effect of worker lay-off policy and the existence of adjustment costs. The gain in profitability mainly comes from the reduction in administrative expenses.
Chapter 3

The Impacts of Export Subsidies: Evidence from Chinese Manufacturing Firms
3.1 Introduction

It is well acknowledged that export subsidy is an effective way to prompt the scale of export. Historically, many developing countries have implemented export-prompting policies to help domestic firms integrate into the global market. For example, India has many long-lasting direct and indirect export subsidy programs such as tax holidays (a temporary reduction or elimination of a tax) for certain export-oriented firms and exporters in special economic zones, duty rebate programs for imported inputs, and pre- and post-shipment financing to exporters at a preferential rate. Argentina, as another example, offered a rapid multiplication of export subsidy programs during the 1960s through the 1980s (Panagariya, 1999).

However, the effect of export subsidy on other aspects of firm behaviors and export performances has received less attention. For example, firms may use the subsidy to enlarge the production scale of the same product, or use it to invest in research and innovation to develop better products. The impact of subsidization on the investment dimensions is particularly crucial for developing countries that are in the process of economic transformation and industrial restructuring. Export subsidy, as one of the most important industrial policies, may promote firms to invest in more innovative ways and change the GDP growth from an extensive pattern to an intensive one.

This paper mainly focuses the impact of export subsidy on firms’ investment behaviors. Particularly, it focuses on the types of investment that may go beyond simple production
expansion and contribute to producing better products or increasing efficiency, e.g., investment in R&D activities (purchasing new tools, setup, assembly line, and technical services) and human capital accumulation (employee training) and investment in advertising to differentiate the products from others. In addition, this paper also examines the impact of export subsidy on export performances, e.g., total export value, average product price, and average income of export destination countries.  

Export subsidy is usually given in the form of a direct cash payment (direct export subsidy) or a tax reduction (export tax rebate). According to the Chinese Industrial Enterprises Database (CIED), 12% of the Chinese manufacturing firms have received at least one kind of subsidy, and 17% of exporting firms have received subsidies during the period of 2000 to 2006. Thus, it is meaningful to explore the effect of export subsidy on manufacturing firms in the context of China.

The major challenge for the empirical analysis is the complexity and the potential endogeneity of export subsidies. First, there are a large number of subsidy programs in

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1 These aspects, combined together, appear to indicate an impact of export subsidy on product quality. On the supply side, increasing product quality requires higher fixed costs of product development and variable costs of production (Hallak and Sivadasan, 2009). Higher fixed costs from additional investment in R&D activities, human capital accumulation and advertising may suggest higher product quality. On the demand side, there is relatively higher demand for higher-quality varieties in richer countries, which leads to higher output prices (Bastos et al., 2014). Thus, higher export price and average destination income may suggest higher product quality.

2 This paper does not focus on product quality because a direct measure of product quality is not available in the current databases. A self-estimated quality index is used to provide some suggestive evidence on the quality dimension, see Section 3.3.2 and Appendix C.
China, many with the goal of promoting exporting and/or technology innovation (especially for firms in the National Economic and Technological Development Zones), which makes it difficult to separate the effect of export subsidy from other types of subsidies. In addition, using direct export subsidies given to firms may be subject to serious endogeneity bias as both outcomes of interest and export subsidies may be determined by unobserved firm characteristics.

To address these problems, this paper uses the export tax rebate program in China from 2000 to 2006. Export tax rebate, i.e., the rebate of value-added tax paid by domestic exporters on exported goods (fully or partially), is an important trade policy tool to promote export. It can be seen as a reduction or elimination of the export tax. The export tax rebate rates have been adjusted for multiple times (e.g., in 2004 and 2005) according to the financial constraints of the central or local government and macroeconomic environment. As the rebate rates are determined by the government at the industry level, independent of individual firm characteristics, I can use the exogenous variation in the export tax rebate program to avoid potential endogeneity problem, and compare the results using export tax rebate with the results using direct export subsidy.

The data used in this paper mainly comes from three datasets: the Chinese Industrial Enterprises Database (CIED) which contains information on a panel of manufacturing firms; the Customs Database which contains trade information at the product level; the World Bank Open Data which includes economic indicators at the country level. By merging the
CIED with the Customs data and the World Bank Open Data, I can generate a panel at the product-firm-country-year level. I then aggregate the data across products and destination countries to the firm level to estimate the impact of export subsidy on firm behaviors and export performances. Data on export tax rebate program is compiled from the yearly Export Tax Refund Rates Library from 2000 to 2006.

Based on the merged data on Chinese manufacturing firms and products from 2000 to 2006, I find that export tax rebate positively affects firms’ investment in advertising, R&D activities, and human capital accumulation. It also has a positive impact on firms’ total export value, average export price, and average estimated quality. The effects on firm investments and export performances are more significant for non-state firms and firms that are less technology-intensive (which are located outside the two special economic zones in China).

This paper combines two strands of literature: the literature on the impact of export subsidy as an industrial policy on export performance, and the literature on the role of exporting per se or exporting destinations in determining firm behaviors. First, this paper enriches the literature on the role of export subsidy by providing evidence on its effect on firms’ investment choices. Literature on the role of export subsidy dates back to the 1960s. Kemp (1966), Jones (1967), Brecher et al. (1983), and Itoh et al. (1987) study the reasons for and the effects of export subsidy, and show that there is national benefit from export subsidization policy. Spencer and Brander (1985), followed by many other researchers, propose the idea
of strategic trade policy. They argue that subsidy can help enhance the strategic position of domestic firms engaged in competition for world markets with foreign rivals. More recently, Hwang et al. (2010) establish a vertical product differentiation model to examine the relationship between optimal trade policies and product qualities for different export countries. Shin et al. (2010) analyze how subsidy policies create incentives for domestic firms to improve product quality and find that not every subsidy method guarantees quality upgrading. ³

Export tax rebate, as another export-prompting policy, can be seen as a reduction or elimination of export tax, which alleviates tax burden of exporters. Many developing countries use export tax rebate programs to promote export. Existing literature studying export tax rebate program mainly focus on its effect on export scale (e.g., Chen et al., 2006) and input price (e.g., Chao and Chou, 2001; Kandilov, 2009), but not the price of final output or firms’ investment behaviors.

Second, this paper is also related to the literature focusing on the role of exporting per se or destinations in determining firm behaviors. There is growing literature on the effect of exporting on firm behavior, using exogenous financial crisis or currency appreciation or devaluation as identification strategy. Bustos (2011) and Matsuyama (2007) indicate

³In terms of quality, existing studies do not find a significant causal effect of export subsidy on product quality or reach a consensus on the direction of the effect. There are three possible reasons. First, it is relatively hard find a direct measure of product quality, and estimates of quality are usually subject to measurement errors. Second, firms’ moral hazard. Exporters may not use the export subsidy properly to invest in technological innovation and quality upgrading under imperfect monitor of the government. Instead, exporters may use export subsidies to expand production and achieve scale effects. Third, adverse selection. Export subsidies may not be appropriately distributed to firms with highest potential for innovation under asymmetric information and prevailing rent-sharing phenomenon in developing countries.
that exporting per se can encourage firms to use more skilled labor and more advanced technologies. Verhoogen (2008), Bastos and Silva (2010), Manova and Zhang (2012), and Brambilla et al. (2012) show that the characteristics of exporting destinations, such as income level, demand for high quality products, geographic and language distance, and transportation cost can affect firm’s quality upgrading behavior.

Although this paper does not address product quality directly, it extends the discussion by studying the impact of export subsidy or export tax rebate on firms’ investment behaviors and export outcomes that may be consistent with a quality-upgrading story. Firms’ higher investments in advertising, R&D activities, and human capital accumulation may lead to better products and higher product qualities. In addition, this paper also considers average export price and average destination income as outcomes of interest, which, suggested by the literature, may also be related to product quality. These aspects, although not enough to draw a conclusive inference, appear to indicate an impact of export subsidy on product quality. Thus, this paper further tries to estimate a quality index (see Appendix) and study the impact of export on it.

The rest of the paper is organized as follows. Section 3.2 provides a review of the institutional background of China’s export tax rebate program. Section 3.3 presents the empirical strategies to study the effect of export subsidy and export tax rebate at the firm level. Section 3.4 describes the data used in the empirical analysis and provides summary statistics. Section 3.5 presents and discusses the main results. Section 3.6 concludes.
3.2 Institutional Background

Export tax rebate entails the refund of value-added tax and consumption tax paid by domestic exporters on exported goods during production, circulation and sales. The goal of export tax rebate is to avoid double taxation, i.e., let the exported goods enter the global market at a tax-excluded price, and thus to promote export. China established the export tax rebate system in 1985. The magnitude of tax rebate has increased significantly over time as export grows, from 1.8 billion RMB (0.88% of total tax revenue) in 1985 to 560 billion RMB in 2006 (12.35% of total tax revenue).

The export tax rebate rates have been adjusted for multiple times according to the financial constraints of the central or local government, as well as changes in macroeconomic environment, as shown in Table 3.1. From 1985 to 1993, the export tax rebate rates ranged from 7% to 11%. When China reformed its tax system in 1994, value-added-tax (VAT) was chosen to be the main component of the new tax system, which provided the basis for export tax rebates. Following the principle of full refund of VAT levied on exported goods during domestic production, the export tax rebate rate was initially set to equal the VAT rate (17% for most of the goods) in 1994, thus there was a 0% net rate applied to exported goods. Since then, the government reduced the rebate rates several times due to heavy fiscal burden accompanied by rapid export growth, such as in 1995, 1996, and 2004.
In some other years, the government increased the tax rebate rates to encourage exports in response to financial crisis, such as in 1998 and 2008. Since the changes in tax rebate rates are mostly driven by exogenous reasons, using export tax rebate as instrument for export subsidy can help address the potential endogeneity problem of export subsidy to some extent.

The sample period of this paper is from 2000 to 2006. Thus, export firms experienced two changes in the export tax rebate program. The first change occurred in 2004. Specifically, in 2004, China started to implement a 5-tier tax rebate system for goods in different industrial categories: 5%, 8%, 11%, 13%, 17%. Compared to earlier years from 2000 to 2003, the tax rebate rate decreased for a wide range of goods: the rate for some mechanical and electrical products, textile and apparel products dropped from 17% to 13%; the rate for general natural resources fell from 8% to 5% and the rebate for crude oil and log was canceled; export goods being affected the most were home appliance, mechanical and electrical products, and cotton textile sectors. In addition, the tax rebate was split between the central and local governments in the ratio of 75% to 25% to alleviate the fiscal burden of the central government (Chen et al., 2006). The second change happened in 2005. Specifically, in 2005, the tax rebate rate was adjusted for specific products: for some high-energy-consuming, high-pollution products, and textile products, the rate decreased from 13% to 8%; for some high-tech, IT, and bio-tech products, the rate increased from 13% to 17%.
Table 3.1: Export Tax Rebate Rate Adjustments

<table>
<thead>
<tr>
<th>Adjustment Time</th>
<th>Products Affected</th>
<th>Export Tax Rebate Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985-1993</td>
<td>—</td>
<td>7-11%</td>
</tr>
<tr>
<td>1994</td>
<td>A universal increase</td>
<td>13%, 17%</td>
</tr>
<tr>
<td>1995, 1996</td>
<td>A universal decrease</td>
<td>3%, 6%, 9%</td>
</tr>
<tr>
<td>1998</td>
<td>A universal increase</td>
<td>5%, 13%, 15%, 17%</td>
</tr>
<tr>
<td>2004.1.1</td>
<td>A universal decrease</td>
<td>5%, 8%, 11%, 13%, 17%</td>
</tr>
<tr>
<td>2005</td>
<td>A decrease in high-energy-consuming, high-pollution, and textile products; an</td>
<td>Specific products:</td>
</tr>
<tr>
<td></td>
<td>increase in high-tech, IT, and bio-tech products</td>
<td>decrease from 13% to 8%; increase from 13% to 17%</td>
</tr>
<tr>
<td>2007.7.1</td>
<td>An increase in 2831 products (37%)</td>
<td>5%, 9%, 11%, 13%, 17%</td>
</tr>
<tr>
<td>2008.8.1</td>
<td>An increase in textile and apparel products</td>
<td>Specific products:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>increase from 11% to 13%</td>
</tr>
<tr>
<td>2008.11.1</td>
<td>An increase in 3486 products (25.8%), especially for textile and apparel, toys,</td>
<td>5%, 9%, 11%, 13%, 14%,</td>
</tr>
<tr>
<td></td>
<td>high-tech, high-value-added products</td>
<td>17%</td>
</tr>
</tbody>
</table>

Notes: The information on export tax rebate rate adjustment is collected from the news and reports issued by the General Administration of Customs of China from 1985 to 2008.

3.3 Empirical Strategy

3.3.1 The Effects on Investment Behaviors

To estimate the effects of export subsidies on firms’ investment behaviors, I first use direct export subsidy a firm receives as the main independent variable (Section 3.3.1.1) in the baseline model. This may be subject to endogeneity bias as the outcomes of interest and direct export subsidy may be both determined by unobserved firm characteristics. Therefore, I then use the average export tax rebate rate a firm is faced with as the main independent variable (Section 3.3.1.2). It avoids the endogeneity problem as export tax rebate rates are determined by the central government at the industry level, which is independent of firm characteristics. I then compare the results using direct export subsidy and the results using
export tax rebate.

3.3.1.1 Direct Export Subsidy

To estimate the effect of direct export subsidy at the product level, I specify the following baseline fixed effect model:

\[ y_{jt} = \alpha \ln \text{Subsidy}_{jt} + \gamma X_{jt} + \phi_j + \lambda_t + \epsilon_{jt} \]  

(3.1)

where \( j \) and \( t \) represents firm \( j \) in year \( t \). The firm-level outcome \( y_{jt} \) includes a list of investment behaviors of interest: investment in advertising (\( \text{Adv\_Output}_{jt} \)), R&D activities (\( \text{RD\_Output}_{jt} \)), and human capital accumulation (\( \text{Training\_L}_{jt} \)). Standard errors are clustered at the firm level.

Specifically, \( \text{Adv\_Output}_{jt} \) is advertisement expenditure per unit of output value, which reflects how much a firm spends on advertising when it generates one dollar of output value. If a firm spends more on advertisement, the information of the product becomes more symmetric, and customers will be more acknowledged about the product, which may increase the demand. Therefore, a firm has incentive to differentiate its products among others. \( \text{RD\_Sales}_{jt} \) is R&D expenditure per unit of output value, which represents a firm’s how much a firm spends on research and development when it generates one dollar of
output value. Higher R&D investment may be associated with production and distribution efficiency in the long run. Training $L_{jt}$ is expenditure on training per employee, which reflects a firm’s investment in human capital accumulation. Training is an endogenous source of technological progress.

On the right hand side, the main independent variable of interests is $\ln \text{Subsidy}_{jt}$, which is the direct export subsidy a firm receives (in log). I also control for a list of time-varying firm characteristics $X_{jt}$. It includes $\text{proc}_{jt}$, which is a dummy for processing trade. $\text{proc}_{jt}$ equals 1 if a firm $j$ is involved in processing trade in year $t$. 4 Exporting firms in developing countries usually import intermediate goods from foreign countries. If a firm imports intermediate parts with high price and quality, then the average output price (the variable is discussed in Section 3.3.2) of processing trade is also supposed to be higher. Among all observations in the estimation sample, 27.9 % of products belong to processing trade. It also includes $\text{age}_{jt}$, firm age, and its square term. In addition, I include firm fixed effects $\phi_j$ and year fixed effects $\lambda_t$ in the regression.

### 3.3.1.2 Export Tax Rebate

The problem with the analysis above is that the baseline regression results can only provide evidence for a positive correlation between outcomes and export subsidy, not a causal effect.

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4Processing trade includes processing with imported materials (trade type 15 in the Customs Database) and processing with supplied materials by foreign clients (trade type 14 in the Customs Database).
It may be the case that more subsidies induce higher outcomes (e.g., investment in training). However, it may also be the case that export subsidy, as a policy instrument, is endogenous. For example, government may choose to give more subsidies to export firms with better employee training system to establish promote endogenous growth. The government may also help the most technological advanced firms to compete in the global market and make them lead the industrial restructuring in the domestic markets. In summary, the baseline method cannot rule out the possibility that it is some particular firm behaviors that causes more subsidies, not the other way around, i.e., it cannot rule out the problem of inverse causality.

To avoid the problem, I use another export subsidization policy, export tax rebate to estimate the effects. Export tax rebate can be seen as a reduction or elimination of export tax, as it alleviates the tax burden of exporters. The advantage of using export tax rebate is that it is less subjective to the endogeneity problem because the determination of tax rebate rate and the change in the export tax rebate program is mainly determined by exogenous factors.

The identification strategy is that during the sample period of 2000 to 2006, the central government changes the tax rebate program in 2004 and 2005 due to reasons exogenous to firms (e.g., fiscal burden). From 2000 to 2003, China maintained a 4-tier tax rebate system (5%, 13%, 15%, 17%). However, in 2004, the tax rebate program changed to a 5-tier system (5%, 8%, 11%, 13%, 17%) and there was a universal decrease in the export tax rebate rate.
for different types of products. In 2005, tax rebate rates were changed for some particular types of products. As a result, a wide range of products with different technological intensity and different added values (e.g., high-tech products, raw materials, intermediate goods, and agricultural products), and it is not specifically associated with a certain firm’s product quality. Thus, I can use the exogenous variation in export tax rebate program to identify the effect of export tax rebate on outcomes of interest.

However, the export tax rebate rate varies at the product level. A firm usually produce multiple products that may or may not be subject to changes in export tax rebate (the changes in rebate rate also vary in magnitude). Thus, I first generate an average export tax rebate (at the firm level) for each firm, and specify the following fixed effect model:

\[
y_{jt} = \beta \text{Avg}_{Rebate_{jt}} + \gamma X_{jt} + \phi_j + \lambda_t + \epsilon_{jt}
\]  

(3.2)

where \( \text{Avg}_{Rebate_{jt}} \) represents the weighted average export tax rebate rate for firm \( j \) in year \( t \). It is calculated by taking the average of the rebate rate of all products a firm produces in a year, weighted by the share of export value of each product in total export value. \(^5\) All the other independent variables and outcome variables are the same as in Equation (3.1).

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\(^5\)The most accurate weight is the share of value added of each product in total value added. However, data on value added is only available at the firm level, not at the product level. Thus, I assume that each product has the same ratio of value added to output value. Thus, the share of value added of each product equals the share of output value.
3.3.2 The Effects on Export Performances

In addition to firms’ investment behaviors, I am also interested in the effects of export subsidies on export performances as outcomes. An exporting firm usually produces multiple types of products in a year, each type being exported to several destination countries. Thus, I first calculate the total export value, average product price across all countries, average income of destination countries, and an average estimated quality for each firm in each year. I then estimate the effect on these performance outcomes of direct export subsidy (Equation (3.1)) and export tax rebate (Equation (3.2)).

Specifically, the export performances include $\ln Value_{jt}$, $\ln Avg\_Income_{jt}$, $Avg\_Price_{jt}$, and $Avg\_Quality_{jt}$. $\ln Value_{jt}$ is the total export value of all products exported to all destination countries by firm $j$ in year $t$ (in log). $\ln Avg\_Income_{jt}$ is the average GDP per capita of all destination countries for firm $j$ in year $t$ (in log), weighted by the share of export value to each destination in total export value. $Avg\_Price_{jt}$ is the average product price for firm $j$ in year $t$. It is calculated by regressing export price on firm-year fixed effects and product-year fixed effects and recovering coefficients on firm-year fixed effects. As the fixed effects vary from large negative values to large positive values, I apply a non-linear transformation—the inverse hyperbolic sine, which is similar to a log transformation but defined at zero (Burbidge et al. 1988). $Avg\_Quality_{jt}$ is a self-estimated average product quality index for firm $j$ in year $t$. To generate average quality index, I first estimate quality index for each product at the product-firm-country-year level.
by regressing the demand of a product on its price and taking the residuals (see Appendix for details). I then take an average of the quality index across all products, weighted by the share of export value of each product in total export value.

Output price is usually related to product quality, but itself may not be a good indicator for product quality because exporters may charge higher mark-ups in richer destination countries for homogeneous goods. Input price is relevant since firm productivity and input quality are complements in producing product quality, and firms use higher-quality inputs to produce higher-quality products (Verhoogen, 2008; Kugler and Verhoogen, 2012). Change in output prices, combined with change in input prices (possibly in the same direction), is often used in the literature to reflect change in product quality, although input price is not available in the sample data in this paper.

3.3.3 Heterogeneous Effects by Firm Type

I want to further test whether there are heterogeneous effects of export tax rebate on firm behaviors for different types of firms, based on the firm’s property rights structure (ownership) or its technology intensity. On the one hand, for state-owned enterprises (SOEs), the effects of export tax rebate on firm’s investment advertising, R&D, or employee training may be less prominent, as subsidies for SOEs in China may be distributed to increase employment or pursue other social responsibilities. Besides, considering the close relationship between
SOEs and the government, there may be rent-seeking behavior when allocating the subsidies.

On the other hand, firms with different technology intensity may also use export tax rebate differently. One way to identify technology-intensive firms in China is to see whether the firm is located in the National Economic and Technological Development Zones (in short, Development Zones) or the National High-Tech Industrial Development Zone (in short, High-Tech Zones). Firms located in these zones can benefit from better infrastructure and usually receive special tax incentives (lower tax rates). The effect of export-prompting policies may be higher for firms in the zones, as they are generally more capable in research and innovation, and thus can use the export subsidies more efficiently to invest in technological improvement. However, these firms also have preferential treatments in other aspects, e.g., a reduction in other types of taxes, which can be substitutes of export subsidies or tax rebates. Thus, it is meaningful to examine whether export subsidies have a larger effect on firms in the zones (which can use the money more efficiently, but also have other sources of money) or outside the zones (which may not use the money as efficiently, but depend more on it).

To examine the potential heterogeneous effect of export tax rebate by different types of firms, I run all regressions by subgroups of firms and compare the coefficients of different subgroups.

---

6 Development Zones are special areas where foreign investment is encouraged. High-Tech Zones are created as science parks to facilitate technology and knowledge spillovers.
3.4 Data

The empirical analysis in this paper draws on three databases, collected by the National Bureau of Statistics of China, the General Administration of Customs of China, and the World Bank. In addition, data on export tax rebate program is compiled from the yearly Export Tax Refund Rates Library from 2000 to 2006, issued by the State Administration of Taxation. I focus on the sample period from 2000 to 2006 for two reasons: First, all databases have large enough sample size for the empirical analysis to be representative enough. Second, there are exogenous variations in the export tax rebate rate during this period.

3.4.1 Chinese Industrial Enterprises Database (CIED)

Chinese Industrial Enterprises Database (China Annual Survey of Industrial Firms) is established by National Bureau of Statistics in 1998. The data is collected and complied from the annual report and quarterly report submitted by the sample firms to the local Bureau of Statistics. The sample covers all state-owned industrial firms and non-state-owned firms with sales revenue that is equal to or larger than 5 million RMB. The unit of the database is enterprise legal person, thus the database is at the firm level. It contains more than 130 indicators on firms’ basic information (e.g., firm code, firm name, sectors, ownership,
starting year, and number of employees) and financial information (for example, current asset, investment, intangible asset, current liability, sales revenue, cost of sales, profit, advertisement investment, R&D investment, value-added tax, subsidy, gross industrial output value, and export delivery value). The main component of the sample is manufacturing firms, including 30 categories (two-digit industry code) such as agricultural and sideline foods processing, food manufacturing, textile manufacturing, and machinery and equipment manufacturing, which correspond to China Standard Industrial Classification System (GB/T4754-2002) entry 13-43 (except 38).

CIED is the largest available firm-level database. During the sample period from 2000 to 2006, CIED contains more than 1.55 million observations, with the number of sample firms growing from 161 thousand in 2000 to 300 thousand in 2006. It is an unbalanced panel: 550 thousand firms are included in the sample, but only 46 thousand firms (8% of the whole sample) operate continuously during the sample period. The sample size of firms increased significantly in 2004. According to first the national economic consensus in 2004, the total sales revenue of the sample firms accounted for 89.5% of the total sales revenue of all industrial enterprises in China, which makes the database representative enough.
3.4.2 China Customs Import-Export Database

China Customs Import-Export Database is established by the General Administration of Customs of China in 2000. It contains product-level statistics on import and export transactions between China and more than two hundred countries and areas in the world. It collects detailed information on the product HS code (eight-digit), local customs, company code (ten-digit), company location (city), type of trade, country of origin, marketing destination, routing area, transportation method, quantity, value, value per unit, company type of each transaction. During the sample period from 2000 to 2006, Customs Database covers more than 12,000 products, and the sample sizes (monthly data) are 106, 127, 138, 166, 197, 228, 257 billion in each year from 2000 to 2006, respectively.

I merge the CIED and the Customs Database to create a new panel data at the product-firm-country-year level. To do this, I use a concordance code which matches the firms in the CIED (identified by the firm legal person code) and the firms in the Customs Database (identified by the ten-digit company code).

3.4.3 The World Bank Open Data

I supplement the panel data with information on destination country characteristics from the World Bank Open Data. The World Bank Open Data provides information on the income level of the destination countries, such as GDP, GDP per capita, GNI (Gross National
Income), and GNI per capita. I merge the panel data generated from the CIED and the Customs Database with the World Bank Open Data at the country level, using the three-digit ISO 3166-1 country code.

In addition to the three databases described above, I also compile data on export tax rebate program from the yearly Export Tax Refund Rates Library from 2000 to 2006, issued by the State Administration of Taxation. I merge the export tax rebate data with the product-firm-country-year panel, and create the final product-firm-country-year level panel used in the empirical analysis.

3.4.4 Summary Statistics

To examine the effects of export subsidies at the firm level, I aggregate the product-firm-country-year level data to the firm-year level across all countries and products for each firm in each year, in order to generate average export tax rebate rate a firm is faced with and its total export value, average destination income, average export price.

I clean the final panel data at the product-firm-country-year level and at the firm-year level using the following rules: (1) keep exporting firms only among all firms; (2) exclude all products that have a export quantity less than 1 or a trade value less than 300 RMB; (3) exclude all extreme or rare products (observations), i.e., products that have less than 100
observations; (4) after aggregating to the firm level, exclude all firms that have less than 3 years’ observations during the sample period. The final sample size is 98,396 at the firm level. The number of firms is 8,572, 11,135, 13,922, 17,156, 16,606, 15,971, and 15,034 in each year from 2000 to 2006. Table 3.2 shows the summary statistics of the estimation sample from 2000 to 2006, aggregated at the firm level.

### Table 3.2: Summary Statistics at the Firm Level

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross industrial output value</td>
<td>137327</td>
<td>137459</td>
<td>149325</td>
<td>167207</td>
<td>205828</td>
<td>242626</td>
<td>294789</td>
</tr>
<tr>
<td>New product output value</td>
<td>23705</td>
<td>24926</td>
<td>23595</td>
<td>26476</td>
<td>41306</td>
<td>63137</td>
<td></td>
</tr>
<tr>
<td>Industrial value-added</td>
<td>33372</td>
<td>33633</td>
<td>41773</td>
<td>45621</td>
<td>55127</td>
<td>64515</td>
<td>76448</td>
</tr>
<tr>
<td>Sales revenue</td>
<td>134804</td>
<td>134043</td>
<td>145109</td>
<td>167132</td>
<td>206647</td>
<td>242303</td>
<td>296522</td>
</tr>
<tr>
<td>Gross profit</td>
<td>6892</td>
<td>6240</td>
<td>10441</td>
<td>12125</td>
<td>15145</td>
<td>17597</td>
<td>21552</td>
</tr>
<tr>
<td>Sales profit</td>
<td>6053</td>
<td>5427</td>
<td>9860</td>
<td>14700</td>
<td>17665</td>
<td>21265</td>
<td></td>
</tr>
<tr>
<td>Export delivery value</td>
<td>69024</td>
<td>66604</td>
<td>70826</td>
<td>77496</td>
<td>101637</td>
<td>118478</td>
<td>150470</td>
</tr>
<tr>
<td>Export share (%)</td>
<td>72</td>
<td>70</td>
<td>69</td>
<td>68</td>
<td>69</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Export subsidy</td>
<td>285</td>
<td>378</td>
<td>319</td>
<td>333</td>
<td>398</td>
<td>431</td>
<td>425</td>
</tr>
<tr>
<td>Advertisement investment</td>
<td>.</td>
<td>529</td>
<td>.</td>
<td>.</td>
<td>754</td>
<td>732</td>
<td>798</td>
</tr>
<tr>
<td>R&amp;D investment</td>
<td>.</td>
<td>486</td>
<td>.</td>
<td>.</td>
<td>486</td>
<td>1192</td>
<td>1887</td>
</tr>
<tr>
<td>Training investment</td>
<td>.</td>
<td>64</td>
<td>.</td>
<td>.</td>
<td>70</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>Firm age</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Number of employees</td>
<td>662</td>
<td>614</td>
<td>586</td>
<td>573</td>
<td>596</td>
<td>619</td>
<td>655</td>
</tr>
<tr>
<td>Share of firms in economic development zone (%)</td>
<td>17.59</td>
<td>18.64</td>
<td>18.49</td>
<td>19.69</td>
<td>7.35</td>
<td>6.79</td>
<td>22.88</td>
</tr>
<tr>
<td>Share of firms in high-tech zone (%)</td>
<td>0.28</td>
<td>0.36</td>
<td>0.57</td>
<td>0.75</td>
<td>0.63</td>
<td>0.61</td>
<td>1.12</td>
</tr>
<tr>
<td>Avg. GDP of destination (trillion)</td>
<td>3.11</td>
<td>3.03</td>
<td>2.99</td>
<td>2.97</td>
<td>2.98</td>
<td>3.12</td>
<td>3.15</td>
</tr>
<tr>
<td>Avg. GDP per capita of destination</td>
<td>26542</td>
<td>25948</td>
<td>25739</td>
<td>25890</td>
<td>26279</td>
<td>27013</td>
<td>27319</td>
</tr>
<tr>
<td>Avg. distance to destination</td>
<td>6383</td>
<td>6442</td>
<td>6503</td>
<td>6613</td>
<td>6714</td>
<td>6890</td>
<td>6973</td>
</tr>
<tr>
<td>N (firms)</td>
<td>8572</td>
<td>11135</td>
<td>13922</td>
<td>17156</td>
<td>16606</td>
<td>15971</td>
<td>15034</td>
</tr>
</tbody>
</table>

Notes: The table is generated using the estimation sample at the firm level generated using the CIED, the Customs Database, and the World Bank Open Data. The sample period is from 2000 to 2006.
3.5 Results

3.5.1 The Effects on Investment Behaviors

Following the steps described in Section 3.3.1, I first estimate the effect of direct export subsidy (Section 3.3.1.1) and average export tax rebate (Section 3.3.1.2) on firms’ investment behaviors.

Table 3.3 shows the regression results using direct export subsidy as the main independent variables. If direct export subsidy increases by 1%, R&D investment per unit of output value will increases by 0.0001%. Direct export subsidy has a positive but insignificant impact on advertising investment per unit of output value and training investment per employee. The magnitude of the coefficients are very small as the scale of investment in advertising, R&D and training is much smaller than the output value. However, the coefficients should be interpreted with cautions as the direct export subsidy may be endogenous.

Table 3.4 shows the regression results using average export tax rebate as the main independent variable. Since export tax rebate rate is determined by the central government, independent of firm characteristics, a causal effect of export tax rebate on firm behaviors can be estimated. It shows that export tax rebate rate has a significantly positive impact on investment in advertising, R&D activities, and human capital accumulation. Specifically, if average export tax rebate rate a firm is faced with increases by 1%, advertising investment per unit of output value will increase by 0.004%, R&D investment per unit of
Table 3.3: The Effects of Direct Export Subsidy on Investment Behaviors

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnSubsidy</td>
<td>1.53e-05</td>
<td>0.000118**</td>
<td>0.000936</td>
</tr>
<tr>
<td></td>
<td>(1.85e-05)</td>
<td>(4.75e-05)</td>
<td>(0.00154)</td>
</tr>
<tr>
<td>proc</td>
<td>-1.87e-07</td>
<td>0.000201</td>
<td>0.0189**</td>
</tr>
<tr>
<td></td>
<td>(0.000116)</td>
<td>(0.000197)</td>
<td>(0.00962)</td>
</tr>
<tr>
<td>age</td>
<td>5.69e-05</td>
<td>-0.000249**</td>
<td>-0.00346</td>
</tr>
<tr>
<td></td>
<td>(6.92e-05)</td>
<td>(9.77e-05)</td>
<td>(0.00359)</td>
</tr>
<tr>
<td>age2</td>
<td>-3.35e-07</td>
<td>4.27e-06***</td>
<td>6.94e-05*</td>
</tr>
<tr>
<td></td>
<td>(8.73e-07)</td>
<td>(1.61e-06)</td>
<td>(3.91e-05)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.000750</td>
<td>0.00393***</td>
<td>0.135***</td>
</tr>
<tr>
<td></td>
<td>(0.000695)</td>
<td>(0.000893)</td>
<td>(0.0379)</td>
</tr>
<tr>
<td>Observations</td>
<td>57,923</td>
<td>40,038</td>
<td>57,928</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.758</td>
<td>0.539</td>
<td>0.402</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Notes:* Each column represents a regression: $y_{jt} = a \ln Subsidy_{jt} + \gamma X_{jt} + \phi_j + \lambda_t + \epsilon_{jt}$. All variables are explained in Section 3.3.1.1. The investment outcome variables are not in log. The unit of observation is firm-year. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

output value will increase by 0.006%, and training investment per employee will increase by 0.18 Yuan. Compared to Table 3.3, the coefficients in Table 3.4 are significant for all investment outcomes. It suggests that there is indeed endogeneity problem with the direct export subsidy. The coefficients in Table 3.4 are also larger in magnitude, as the independent variable, average export tax rebate rate, is in actual value (ranging from 0 to 0.17).
Table 3.4: The Effects of Export Tax Rebate on Investment Behaviors

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>avg_rebate</td>
<td>0.00368*</td>
<td>0.00644**</td>
<td>0.178*</td>
</tr>
<tr>
<td>proc</td>
<td>9.01e-06</td>
<td>0.000221</td>
<td>0.0190**</td>
</tr>
<tr>
<td>age</td>
<td>5.63e-05</td>
<td>-0.000250**</td>
<td>-0.00371</td>
</tr>
<tr>
<td>age2</td>
<td>-3.25e-07</td>
<td>4.26e-06***</td>
<td>7.33e-05*</td>
</tr>
<tr>
<td>Constant</td>
<td>0.000299</td>
<td>0.00325***</td>
<td>0.116***</td>
</tr>
</tbody>
</table>

Observations: 57,946 40,060 57,951
R-squared: 0.758 0.538 0.402
Firm FE: Yes Yes Yes
Year FE: Yes Yes Yes

Notes: Each column represents a regression: $y_{jt} = \beta_{Avg\_Rebate_{jt}} + \gamma_{X_{jt}} + \phi_{t} + \lambda_{j} + \epsilon_{jt}$. All variables are explained in Section 3.3.1.2. The investment outcome variables are not in logs. The unit of observation is firm-year. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

3.5.2 The Effects on Export Performances

Following the steps described in Section 3.3.2, I estimate the effect of direct export subsidy and average export tax rebate on firms’ export performance outcomes.

Table 3.5 shows the results using direct export subsidy as the main independent variables. Export tax rebate has a positive impact on total export value, average destination income, and average quality index and a negative impact on average price. All coefficients are significant. Specifically, if direct export subsidy increases by 1%, total export value
will increase by 0.04\%, average destination income will increase by 0.002\%, average price (inverse hyperbolic sine transformed) will decrease by 0.06\%, while average quality index will increase by 0.0003 units.

Table 3.5: The Effects of Direct Export Subsidy on Export Performances

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnSubsidy</td>
<td>0.0381***</td>
<td>0.00192*</td>
<td>-0.0604***</td>
<td>0.0274***</td>
</tr>
<tr>
<td></td>
<td>(0.00227)</td>
<td>(0.00104)</td>
<td>(0.0132)</td>
<td>(0.00209)</td>
</tr>
<tr>
<td>proc</td>
<td>0.445***</td>
<td>0.0431***</td>
<td>0.0957</td>
<td>0.238***</td>
</tr>
<tr>
<td></td>
<td>(0.0178)</td>
<td>(0.00706)</td>
<td>(0.0842)</td>
<td>(0.0162)</td>
</tr>
<tr>
<td>age</td>
<td>0.00181</td>
<td>0.000424</td>
<td>-0.239***</td>
<td>-0.00247</td>
</tr>
<tr>
<td></td>
<td>(0.00739)</td>
<td>(0.00349)</td>
<td>(0.0390)</td>
<td>(0.00613)</td>
</tr>
<tr>
<td>age2</td>
<td>-0.000155</td>
<td>-4.95e-05</td>
<td>0.00396***</td>
<td>-3.87e-05</td>
</tr>
<tr>
<td></td>
<td>(0.000117)</td>
<td>(5.53e-05)</td>
<td>(0.000773)</td>
<td>(9.50e-05)</td>
</tr>
<tr>
<td>Constant</td>
<td>13.93***</td>
<td>10.06***</td>
<td>2.288***</td>
<td>2.665***</td>
</tr>
<tr>
<td></td>
<td>(0.0693)</td>
<td>(0.0302)</td>
<td>(0.346)</td>
<td>(0.0565)</td>
</tr>
</tbody>
</table>

| Observations   | 98,323      | 98,323      | 78,163      | 98,323      |
| R-squared      | 0.807       | 0.799       | 0.641       | 0.814       |
| Firm FE        | Yes         | Yes         | Yes         | Yes         |
| Year FE        | Yes         | Yes         | Yes         | Yes         |

Notes: Each column represents a regression: $y_{jt} = \beta \text{Avg. Rebate}_{jt} + \gamma X_{jt} + \phi_j + \lambda_t + \epsilon_{jt}$. All variables are explained in Section 3.3.2. The outcome variables lnValue and lnAvg_Income are in logs, Avg_Price in the inverse hyperbolic sine transformation, lnAvg_Quality not in log. The unit of observation is firm-year. Robust standard errors are in parentheses. Standard errors are clustered at the firm level.

Table 3.6 shows the results using average export tax rebate as the main independent variable. Export tax rebate has a significantly positive impact on all export performance outcomes except for average destination income. Specifically, if average export tax rebate increases by 1\%, total export value will increase by 0.49\%, average price (inverse hyperbolic
sine transformed) will decrease by 4.95%, while average quality index will increase by 0.0048 units. It is also noteworthy that, average destination income does not respond to export tax rebate. It suggests that firms with an increasing average export tax rebate do not increase their export share to richer destinations.

Table 3.6: The Effects of Export Tax Rebate on Export Performances

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnValue</td>
<td>0.488**</td>
<td>-0.0299</td>
<td>4.951***</td>
<td>0.478**</td>
</tr>
<tr>
<td>lnAvg_Income</td>
<td>(0.238)</td>
<td>(0.107)</td>
<td>(1.280)</td>
<td>(0.222)</td>
</tr>
<tr>
<td>Avg_Price</td>
<td>0.451***</td>
<td>0.0430***</td>
<td>0.0908</td>
<td>0.243***</td>
</tr>
<tr>
<td>Avg_Quality</td>
<td>(0.0179)</td>
<td>(0.00707)</td>
<td>(0.0841)</td>
<td>(0.0163)</td>
</tr>
<tr>
<td>avg_rebate</td>
<td>proc</td>
<td>0.00261</td>
<td>0.000518</td>
<td>-0.239***</td>
</tr>
<tr>
<td>age</td>
<td>(0.00744)</td>
<td>(0.00349)</td>
<td>(0.0391)</td>
<td>(0.00616)</td>
</tr>
<tr>
<td>age2</td>
<td>-0.000165</td>
<td>-5.12e-05</td>
<td>0.00396***</td>
<td>-4.42e-05</td>
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<tr>
<td>Constant</td>
<td>(0.000118)</td>
<td>(5.53e-05)</td>
<td>(0.000769)</td>
<td>(9.54e-05)</td>
</tr>
<tr>
<td>Firms</td>
<td>13.90***</td>
<td>10.07***</td>
<td>1.535***</td>
<td>2.627***</td>
</tr>
<tr>
<td>Observations</td>
<td>(0.0774)</td>
<td>(0.0339)</td>
<td>(0.387)</td>
<td>(0.0648)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.806</td>
<td>0.799</td>
<td>0.641</td>
<td>0.814</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes: Each column represents a regression: \( y_{jt} = \beta Avg\_Rebate_{jt} + \gamma X_{jt} + \phi_j + \lambda_t + \epsilon_{jt} \). All variables are explained in Section 3.3.2. The outcome variables lnValue and lnAvg_Income are in logs. Avg_Price in the inverse hyperbolic sine transformation, lnAvg_Quality not in log. The unit of observation is firm-year. Robust standard errors are in parentheses. Standard errors are clustered at the firm level.

*** p<0.01, ** p<0.05, * p<0.1.
3.5.3 Heterogeneous Effects by Firm Type

To further test whether there are heterogeneous effects of export tax rebate on firms’ investment behaviors and export performances by different types of firms, based on the firm’s property rights structure (ownership) or its technology intensity (whether in Development Zones or High-Tech Zones), I conduct regressions at the firm level by subgroups of firms.

Table 3.7 and Table 3.8 shows the results of heterogeneous effects on investment behaviors and export performances by firm ownership. In Table 3.7, the effect of export tax rebate on firm investment in advertising and training is only significant for non-state-owned firms (including private and foreign-owned firms). This is consistent with the prediction that export tax rebates for state-owned firms may be used for other goals such as increasing employment or maintaining social stability. In Table 3.8, the effect of export tax rebate on export value, average price, and average quality is also only significant for non-state-owned firms.

Table 3.9 and Table 3.10 shows the results of heterogeneous effects on investment behaviors and export performances by firm technology intensity. In Table 3.9, when faced with an increase in average export tax rebate, firms that are outside the Zones spend more on advertising and training, while firms in the Zones are not responding to the change in export tax rebate. In Table 3.10, when faced with an increase in average export tax rebate, firms that are outside the Zones experience a significantly positive increase in export value,
Table 3.7: Heterogeneous Effects of Export Tax Rebate on Investment Behaviors by Firm Ownership

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>avg_rebate</td>
<td>-0.00239</td>
<td>0.00432*</td>
<td>0.0416**</td>
<td>0.00402</td>
<td>-0.0667</td>
<td>0.196*</td>
</tr>
<tr>
<td></td>
<td>(0.00407)</td>
<td>(0.00230)</td>
<td>(0.0196)</td>
<td>(0.00319)</td>
<td>(0.236)</td>
<td>(0.109)</td>
</tr>
<tr>
<td>proc</td>
<td>0.000170</td>
<td>5.71e-06</td>
<td>-0.000551</td>
<td>0.000191</td>
<td>0.0658**</td>
<td>0.0189*</td>
</tr>
<tr>
<td></td>
<td>(0.000450)</td>
<td>(0.000122)</td>
<td>(0.00178)</td>
<td>(0.000196)</td>
<td>(0.0321)</td>
<td>(0.0100)</td>
</tr>
<tr>
<td>age</td>
<td>-0.000285**</td>
<td>7.22e-05</td>
<td>0.000155</td>
<td>-8.88e-05</td>
<td>0.00393</td>
<td>-0.00355</td>
</tr>
<tr>
<td></td>
<td>(0.000140)</td>
<td>(9.53e-05)</td>
<td>(0.000420)</td>
<td>(9.44e-05)</td>
<td>(0.000687)</td>
<td>(0.00422)</td>
</tr>
<tr>
<td>age2</td>
<td>3.81e-06**</td>
<td>-6.44e-07</td>
<td>-9.48e-07</td>
<td>2.01e-06</td>
<td>-7.34e-05</td>
<td>9.50e-05*</td>
</tr>
<tr>
<td></td>
<td>(1.85e-06)</td>
<td>(1.66e-06)</td>
<td>(5.70e-06)</td>
<td>(1.61e-06)</td>
<td>(9.15e-05)</td>
<td>(5.41e-05)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.00550***</td>
<td>0.000115</td>
<td>-0.00179</td>
<td>0.00203**</td>
<td>0.159*</td>
<td>0.105**</td>
</tr>
<tr>
<td></td>
<td>(0.00185)</td>
<td>(0.000841)</td>
<td>(0.00590)</td>
<td>(0.000970)</td>
<td>(0.0925)</td>
<td>(0.0453)</td>
</tr>
</tbody>
</table>

Observations  1,663 55,691 1,041 38,416 1,663 55,696  
R-squared     0.786 0.760 0.722 0.553 0.509 0.402  
Firm FE       Yes Yes Yes Yes Yes Yes  
Year FE       Yes Yes Yes Yes Yes Yes  

Notes: Each column represents a regression: $y_{jt} = \alpha lnSubsidy_{jt} + \gamma X_{jt} + \phi_j + \lambda_t + \epsilon_{jt}$. All variables are explained in Section 3.3.1.2. The investment outcome variables are not in log. Column (1), (3), and (5) represent results for state-owned firms, while column (2), (4), (6) for non-state-owned firms. The unit of observation is firm-year. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. 

*** p<0.01, ** p<0.05, * p<0.1.

average price, and average quality, while firms in the Zones are not responding to the change in export tax rebate. One possible explanation is, although firms in the Zones are generally more technology-intensive and are better at research and innovation, they may have received financial supports for research, training, and advertising from other sources (which is very likely as firms in the Zones have better access to foreign investments and receive preferential tax treatments). Thus, their investments and export performance outcomes do not rely on export tax rebates as much as firms outside the Zones.
Table 3.8: Heterogeneous Effects of Export Tax Rebate on Export Performances by Firm Ownership

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>lnValue</th>
<th>lnAvg_Income</th>
<th>Avg_Price</th>
<th>Avg_Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>avg_rebate</td>
<td>0.235</td>
<td>0.540**</td>
<td>0.478</td>
<td>-0.0677</td>
</tr>
<tr>
<td></td>
<td>(1.173)</td>
<td>(0.245)</td>
<td>(0.589)</td>
<td>(0.109)</td>
</tr>
<tr>
<td>proc</td>
<td>0.673***</td>
<td>0.431***</td>
<td>0.0474</td>
<td>0.0401***</td>
</tr>
<tr>
<td></td>
<td>(0.0983)</td>
<td>(0.0180)</td>
<td>(0.0429)</td>
<td>(0.00708)</td>
</tr>
<tr>
<td>age</td>
<td>0.0262</td>
<td>0.00466</td>
<td>-0.000589</td>
<td>-0.00187</td>
</tr>
<tr>
<td></td>
<td>(0.0315)</td>
<td>(0.00817)</td>
<td>(0.0150)</td>
<td>(0.00414)</td>
</tr>
<tr>
<td>age2</td>
<td>-3.67e-06</td>
<td>-0.000323**</td>
<td>5.52e-05</td>
<td>-1.24e-05</td>
</tr>
<tr>
<td></td>
<td>(0.000398)</td>
<td>(0.000144)</td>
<td>(0.000185)</td>
<td>(7.81e-05)</td>
</tr>
<tr>
<td>Constant</td>
<td>12.76***</td>
<td>13.92***</td>
<td>9.593***</td>
<td>10.10***</td>
</tr>
<tr>
<td></td>
<td>(0.572)</td>
<td>(0.0758)</td>
<td>(0.283)</td>
<td>(0.0354)</td>
</tr>
</tbody>
</table>

R-squared | 0.810 | 0.808 | 0.809 | 0.765 | 0.803 | 0.529 | 0.651 | 0.818 | 0.816
Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes
Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes
Observations | 3,939 | 3,939 | 3,939 | 93,927 | 93,927 | 93,927 | 2,866 | 74,881 | 3,939 | 93,927

Notes: Each column represents a regression: $y_{jt} = \beta \text{Avg\_Rebate}_{jt} + \gamma \text{X}_{jt} + \phi_j + \lambda_t + \epsilon_{jt}$. All variables are explained in Section 3.3.2. The outcome variables lnValue and lnAvg_Income are in logs, Avg_Price in the inverse hyperbolic sine transformation, lnAvg_Quality not in log. Column (1), (3), (5), and (7) represent results for firms in the Zones, while column (2), (4), (6), and (8) for firms outside Zones. The unit of observation is firm-year. Robust standard errors are in parentheses. Standard errors are clustered at the firm level.

### 3.6 Conclusions

This paper examines the impacts of export subsidies on firms’ investment behaviors and product outcomes. Using the exogenous variation in the export tax rebate program in China from 2000 to 2006 as the identification strategy, this paper shows that export tax rebate has a positive impact on firms’ investment in advertisement, R&D activities, and human capital accumulation, and that it also positively affects total export value, average product price (no significant effect on average destination income). Combined together, these facts seem to be consistent with a quality-upgrading story of export tax rebate, i.e., export tax rebate has a...
Table 3.9: Heterogeneous Effects of Export Tax Rebate on Investment Behaviors by Firm Technology Intensity

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Adv_Output (1)</th>
<th>R&amp;D_Output (2)</th>
<th>R&amp;D_Output (3)</th>
<th>Training_L (4)</th>
<th>Training_L (5)</th>
<th>Training_L (6)</th>
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<tr>
<td>avg_rebate</td>
<td>0.00147</td>
<td>0.00485**</td>
<td>0.0114</td>
<td>0.00636</td>
<td>-0.276</td>
<td>0.248**</td>
</tr>
<tr>
<td></td>
<td>(0.00887)</td>
<td>(0.00238)</td>
<td>(0.0104)</td>
<td>(0.00397)</td>
<td>(0.527)</td>
<td>(0.0982)</td>
</tr>
<tr>
<td>proc</td>
<td>0.000534**</td>
<td>-0.000117</td>
<td>0.000116</td>
<td>0.000276</td>
<td>0.0398</td>
<td>0.0137</td>
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<tr>
<td></td>
<td>(0.000260)</td>
<td>(0.000140)</td>
<td>(0.000845)</td>
<td>(0.000186)</td>
<td>(0.0254)</td>
<td>(0.0101)</td>
</tr>
<tr>
<td>age</td>
<td>0.000415</td>
<td>5.99e-05</td>
<td>-0.000126</td>
<td>-0.000261***</td>
<td>-0.0393**</td>
<td>-0.00146</td>
</tr>
<tr>
<td></td>
<td>(0.000514)</td>
<td>(7.38e-05)</td>
<td>(0.000467)</td>
<td>(9.99e-05)</td>
<td>(0.0194)</td>
<td>(0.00373)</td>
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<tr>
<td>age2</td>
<td>-8.00e-06</td>
<td>-2.57e-07</td>
<td>1.55e-05</td>
<td>3.99e-06**</td>
<td>0.000697**</td>
<td>4.98e-05</td>
</tr>
<tr>
<td></td>
<td>(8.88e-06)</td>
<td>(9.16e-07)</td>
<td>(1.11e-05)</td>
<td>(1.63e-06)</td>
<td>(0.000339)</td>
<td>(4.07e-05)</td>
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<td>Constant</td>
<td>-0.00167</td>
<td>5.22e-05</td>
<td>-0.000359</td>
<td>0.00341***</td>
<td>0.455***</td>
<td>0.0846*</td>
</tr>
<tr>
<td></td>
<td>(0.00472)</td>
<td>(0.000764)</td>
<td>(0.00402)</td>
<td>(0.00111)</td>
<td>(0.160)</td>
<td>(0.0441)</td>
</tr>
</tbody>
</table>

Observations 5,440 49,256 4,006 31,112 5,440 49,261  
R-squared 0.753 0.755 0.648 0.528 0.535 0.404  
Firm FE Yes Yes Yes Yes Yes Yes  
Year FE Yes Yes Yes Yes Yes Yes  
Notes: Each column represents a regression: $y_{jt} = \alpha ln(\text{Subsidy}_{jt}) + \gamma X_{jt} + \phi_j + \lambda_t + \epsilon_{jt}$. All variables are explained in Section 3.3.1.2. The investment outcome variables are not in log. Column (1), (3), and (5) represent results for firms in the Zones, while column (2), (4), (6) for firms outside the Zones. The unit of observation is firm-year. Robust standard errors are in parentheses. Standard errors are clustered at the firm level.

### Notes:

- 

Positive impact on firm’s choice of product quality. Thus, this paper further provides some evidence on the positive impact of export tax rebate on the self-estimated average product quality index.

The effect of export tax rebate on firm behaviors varies by type of firms. First, by ownership structure, the effect is smaller for state-owned firms than that for private or foreign-owned firms. Export tax rebate to state-owned firms may have other goals than investing in advertising or human capital accumulation. Second, by technology intensity,
### Table 3.10: Heterogeneous Effects of Export Tax Rebate on Export Performances by Firm Technology Intensity

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>lnValue (1)</th>
<th>lnAvg_Income (2)</th>
<th>Avg_Price (3)</th>
<th>Avg_Quality (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>avg_rebate</td>
<td>0.180</td>
<td>-0.288</td>
<td>3.062</td>
<td>0.0683</td>
</tr>
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<td></td>
<td>(0.597)</td>
<td>(0.283)</td>
<td>(3.304)</td>
<td>(0.548)</td>
</tr>
<tr>
<td>1.proc</td>
<td>0.471***</td>
<td>0.052***</td>
<td>-0.0300</td>
<td>0.264***</td>
</tr>
<tr>
<td></td>
<td>(0.0532)</td>
<td>(0.0188)</td>
<td>(0.241)</td>
<td>(0.0478)</td>
</tr>
<tr>
<td>age</td>
<td>0.107**</td>
<td>0.00640</td>
<td>0.360</td>
<td>0.0686</td>
</tr>
<tr>
<td></td>
<td>(0.0528)</td>
<td>(0.00193)</td>
<td>(0.262)</td>
<td>(0.0446)</td>
</tr>
<tr>
<td>age2</td>
<td>-0.00240**</td>
<td>-0.000187</td>
<td>-0.00728*</td>
<td>-0.00159*</td>
</tr>
<tr>
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<td>(0.000968)</td>
<td>(0.000295)</td>
<td>(0.00391)</td>
<td>(0.000863)</td>
</tr>
<tr>
<td>Constant</td>
<td>13.31***</td>
<td>10.11***</td>
<td>1.194***</td>
<td>2.240***</td>
</tr>
<tr>
<td></td>
<td>(0.387)</td>
<td>(0.0818)</td>
<td>(0.319)</td>
<td>(0.0688)</td>
</tr>
</tbody>
</table>

| Observations | 14,066     | 14,066           | 11,066        | 14,066          |
| R-squared    | 0.849      | 0.812            | 0.812         | 0.846           |
| Firm FE      | Yes        | Yes              | Yes           | Yes             |
| Year FE      | Yes        | Yes              | Yes           | Yes             |

**Notes:** Each column represents a regression: $y_{jt} = \beta_{Avg\_Rebate_{jt}} + \gamma X_{jt} + \phi_j + \lambda_t + \epsilon_{jt}$. All variables are explained in Section 3.3.2. The outcome variables lnValue and lnAvg_Income are in logs, Avg_Price in the inverse hyperbolic sine transformation, lnAvg_Quality not in log. Column (1), (3), (5), and (7) represent results for firms in the Zones, while column (2), (4), (6), and (8) for firms outside the Zones. The unit of observation is firm-year. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

The effect of export tax rebate on firms’ investment is stronger for firms outside the Zones. These firms do not receive preferential treatments in financing and tax, and may rely more on the export tax rebate for additional investment, compared to the firms in the Zones. The effect of export tax rebate on product outcomes varies by destination country income. The impact on export value and quality indexes are strongest for products exported to high-income countries, but the impact on product price is only significant for products shipped to middle-income countries.
There are several potential policy implications. First, although this paper does not address the effect of export subsidy or export tax rebate on product quality directly, as there is no direct quality measure available, the results at the firm level appear to indicate that product quality also increases as a result. Investments in advertisement to differentiate products and human capital accumulation are possible channels for quality improvement. It suggests that export subsidization policies aimed at product quality upgrading, or improvement in quality-related investments in a more general sense, will lead to long-run economic growth (Aghion and Howitt, 1998, 2005). This is particularly beneficial for developing countries with imperfect markets or greater market failures. Second, although the effect of export tax rebate is significant for all firms on average, the effect may vary across firms. If the effect is less significant for state-owned firms and firms in the Zones, a more rigorous supervision of subsidy usage and a more adaptable subsidy distribution scheme may be needed to maximize its effect on firms’ investment behaviors and product outcomes.
Bibliography


Appendices
Appendix A

Appendix for Chapter 1

A.1 Data Imputation

One issue with the loan database is that the bank local branch information is not reported exactly at the prefecture level. There are 30% of observations with ambiguous locations that are reported at finer levels (e.g., township, village, and street levels) that may not correspond to a unique prefecture. For these observations, I identify the prefecture by mapping these towns, villages, and streets to the prefectures to which they belong. When the prefecture is not unique, I try to identify the prefecture by tracking the borrowing history of the firm and choose the most likely prefecture in which the local branch. There are also 15% of observations without local branch information. For these missing values, I try to impute the missing location with the following algorithm:

*Step 1:* If firm F only borrows in one prefecture C across all years (possibly from multiple banks, including bank B), then I identify the missing local branch
as being in prefecture C. If firm F borrows from multiple prefectures across all years, then I do not identify the local branch and go to Step 2.

**Step 2**: If firm F borrows in several prefectures but only from fixed bank-city pairs (i.e., whenever firm F borrows from a particular bank B, it only borrows from a particular local branch in prefecture C of this bank B), then I identify the missing local branch as being in prefecture C. If it is not true, I go to Step 3.

**Step 3**: If firm F borrows in several cities but only from fixed bank-year-city pairs (i.e., whenever firm F borrows from a particular bank B in a particular year T, it only borrows from a particular local branch in prefecture C of this bank B), then I identify the missing local branch as being in prefecture C. If it is not true, I do not identify the local branch. Note that there could be several loans between one firm and one bank in a year.

Following this algorithm, I extrapolate local branch information for 4,002 observations, which increases my sample size by 8%.

**A.2 Granger Causality Analysis of Zombie Firms**

The original definition of a zombie firm allows for variation in zombie status across years for a firm, which may lead to potential endogenous selection into the zombie group due to loans taken in previous years. To rule out the possibility of loan-induced zombies, a preliminary Granger causality analysis is carried out in order to test the relationship between obtaining loans and being a zombie.

I use the loan dataset and aggregate it to firm level. Notice that each publicly listed firm
may have subsidiaries in multiple prefectures and thus borrow in multiple prefectures in a year. I treat each firm-prefecture pair as a unique business unit of this firm. If the firm is a zombie, then all of its business units are also zombies. The Granger causality tests at the firm level are:

\[
\text{Loan}_{ict} = \sum_{k=1}^{2} \alpha_k \text{Loan}_{i,c,t-k} + \sum_{k=1}^{2} \beta_k \text{Zombie}_{i,c,k} + \mu_{c,j} + \theta_t + \gamma_i + \varepsilon_{ict}
\]

\[
\text{Zombie}_{ict} = \sum_{k=1}^{2} \alpha_k \text{Loan}_{i,c,t-k} + \sum_{k=1}^{2} \beta_k \text{Zombie}_{i,c,k} + \mu_{c,j} + \theta_t + \gamma_i + \varepsilon_{ict}
\]

where \(\text{Loan}_{ict}\) is total loan for firm \(i\) in prefecture \(c\) (or business unit \(ic\)) in year \(t\). \(\text{Zombie}_{ict}\) indicates the business unit \(ic\) being a zombie in year \(t\). \(\mu_{c,j}\) represents prefecture-cycle fixed effects where the subscript \(j\) indicates Party Secretary \(j\). \(\theta_t\) represents year fixed effects. \(\gamma_i\) represents firm fixed effects. Standard errors are clustered at the firm level.

Table A shows the results of Granger causality tests at the firm level. Columns (1) and (3) report the results of regressing current loans on one- and two-year lags of loans and zombie status. The only significant predictor of current loans is loans one year ago, when service year fixed effects are included in the regression as shown in column (3). Zombie status in the previous two years does not affect current loans. Columns (2) and (4) report the results of regressing current zombie status on the same set of
lagged variables. It can be seen that loans in the previous two years are not predictors of current zombie status, which may reduce the concern of loan-induced zombies to some degree. However, zombie status one year ago negatively affects zombie status in the current year when service year fixed effects are included, as shown in column (3), indicating that a firm being a zombie in the last year tends to become non-zombie in the current year, which resonates with the churning pattern of zombie firms in a prefecture-cycle.
Table A.1: Granger Causality Test of Loans and Zombie Status

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loan 1-year lag</td>
<td>0.0144</td>
<td>0.00243</td>
<td>0.0148*</td>
<td>0.00285</td>
</tr>
<tr>
<td></td>
<td>(0.00912)</td>
<td>(0.00205)</td>
<td>(0.00855)</td>
<td>(0.00202)</td>
</tr>
<tr>
<td>Loan 2-year lag</td>
<td>0.0108</td>
<td>-0.00106</td>
<td>0.0117</td>
<td>-0.00102</td>
</tr>
<tr>
<td></td>
<td>(0.00994)</td>
<td>(0.00185)</td>
<td>(0.00943)</td>
<td>(0.00193)</td>
</tr>
<tr>
<td>Zombie 1-year lag</td>
<td>0.0696</td>
<td>-0.263**</td>
<td>0.0807</td>
<td>-0.261**</td>
</tr>
<tr>
<td></td>
<td>(0.379)</td>
<td>(0.110)</td>
<td>(0.383)</td>
<td>(0.110)</td>
</tr>
<tr>
<td>Zombie 2-year lag</td>
<td>-0.319</td>
<td>-0.0720</td>
<td>-0.314</td>
<td>-0.0583</td>
</tr>
<tr>
<td></td>
<td>(0.253)</td>
<td>(0.117)</td>
<td>(0.249)</td>
<td>(0.117)</td>
</tr>
<tr>
<td>Constant</td>
<td>20.59***</td>
<td>0.463</td>
<td>19.88***</td>
<td>1.649***</td>
</tr>
<tr>
<td></td>
<td>(0.905)</td>
<td>(0.393)</td>
<td>(1.344)</td>
<td>(0.551)</td>
</tr>
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</table>

Observations 1,344 1,325 1,325 1,325
R-squared 0.828 0.807 0.828 0.812
Prefecture_Cycle FE Yes Yes Yes Yes
Year FE Yes Yes Yes Yes
Firm FE Yes Yes Yes Yes
Service_Year FE No No Yes Yes

Notes: Each column represents a regression. The coefficients reported are lagged loan and lagged zombie status. The dependent variable is the total loan to a firm in a city in a year for column (1) and (3). The dependent variable is zombie status for a firm in a year in a prefecture for column (2) and (4). All regressions include year and prefecture-cycle fixed effects. Regressions in column (3) and (4) include service year fixed effects as well. Standard errors are clustered at the firm level.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.
Appendix B

Appendix for Chapter 2

Performance of Privatized SOEs (in 2004) and Non-privatized SOEs

Privatized SOEs show dramatic improvement in productivity, profitability, and operation scale, relative to non-privatized SOEs. As an alternative to Figure 1, Figure A here illustrates the performance of SOEs that are privatized in 2004, compared to non-privatized SOEs. The control group (non-privatized SOEs) are the same as in Figure 1. The treated group is SOEs privatized in 2003 in Figure 1 and SOEs privatized in 2004 in Figure A. These two cohorts show similar results: there is an increasing gap in productivity (Panel a) and profitability (Panel b) between privatized and non-privatize SOEs and a decreasing gap in their operation scale (Panel c).
(a) Productivity

(b) Profitability
Figure B.1: Performance of Privatized SOEs (in 2003) and Non-privatized SOEs

Notes: Each plot shows the performance of privatized SOEs and non-privatized SOEs during the sample period from 1998 to 2007. The blue solid line represents SOEs that are privatized in 2004. The red dash line represents SOEs that are not privatized during the whole sample period.
Appendix C

Appendix for Chapter 3

Product Quality Index

As a direct measure of product quality does not exist in the available data, I establish a partial equilibrium model to calculate the product quality of heterogeneous firms. Building on the framework of Dixit and Stiglitz (1977), Melitz (2003), and Bastos et al. (2014), assume in each country $k$, the utility function of the representative consumer over final product varieties is given by:

$$U_k = \left\{ \left[ \int_{i \in \Omega_k} (q(i)^{\mu_k} x(i))^\frac{\sigma-1}{\sigma} di \right]^\frac{\sigma}{\sigma-1} \right\} Z^{1-\beta}$$

where $i$ indexes varieties of the final products; $\Omega_k$ is the set of all differentiated (heterogeneous) product varieties in country $k$; $q(i)$ and $x(i)$ represent the quality and quantity of product variety $i$ consumed respectively; $Z$ represents the quantity of homogeneous products
consumed; $\sigma$ is the elasticity of substitution between product varieties; $\mu_k$ reflects consumer’s preference or valuation for product quality in country $k$; $\beta$ and $(1 - \beta)$ represent the expenditure share on heterogeneous and homogeneous final products respectively. In addition, assume that the (quality-adjusted) aggregate price index in country $k$ is given by:

$$P_k = \left[ \int_{i \in \Omega_k} \left( \frac{p(i)}{q(i)^{\mu_k}} \right)^{1-\sigma} q(i)^{\mu_k} - \sigma \right]^{1/(1-\sigma)} \sum Z^{1-\beta}$$

Solving the representative consumer’s utility maximization problem subject to the budget constraint, the demand for a given product variety $i$ can be written as:

$$x(i) = \beta p(i)^{-\sigma} q(i)^{\mu_k(\sigma-1)} \frac{E}{P_k^{1-\sigma}}$$

where $E$ is the total expenditure of consumers in country $k$. It indicates that the demand for product variety $i$ depends on both the product quality $q(i)$ and product price $p(i)$, i.e., the cost-effectiveness. Thus, for a given kind of product variety $i$, the quantity that firm $j$ exports to destination country $k$ in year $t$ is given by:

$$x_{ijkt} = \beta p_{ijkt}^{-\sigma} q_{ijkt}^{\mu_k(\sigma-1)} \frac{E_{kt}}{P_{kt}^{1-\sigma}}$$

Take logs on both sides, and the log demand for product variety $i$ can be written as:

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\[\ln x_{ijkt} = \ln \beta - \sigma \ln p_{ijkt} + M_{kt} + \varepsilon_{ijkt}\]

where \(M_{kt} = \ln E_{kt} - (1 - \sigma)\ln P_{kt}\) can be seen as a destination-time dummy, which is time-destination-variant. \(M_{kt}\) can be used to control for variables that only change with destinations, such as the geographical distance between home country and the export destination, or variables that only change with time, such as the exchange rate regime or arrangements, or variables that change with both destination and time, such as GDP per capita of the destination country. \(p_{ijkt}\) is the export price of product variety \(i\) of firm \(j\) to destination country \(m\) in year \(t\). In this paper, I do not control for destination effects \((M_{kt})\) when calculating residuals for quality index. Instead, I regress \(\ln x_{ijkt}\) on \(\ln p_{ijkt}\), and take the residual as the product quality of product variety \(i\) from firm \(j\) to destination \(k\) in year \(t\) indirectly. Product quality is modeled here as a demand shifter. It captures all attributes of a product other than prices that consumer value.

For simplicity, assume \(\mu_k\), which is consumer’s valuation for product quality in country \(k\), is homogeneous across countries and equals 1. Define the quality index of product variety \(i\) of firm \(j\) to destination \(k\) in year \(t\) as:

\[\text{quality}_{ijkt} = \ln \hat{q}_{ijkt} = \frac{\varepsilon_{ijkt}}{\sigma - 1} = \frac{\ln x_{ijkt} - \ln \hat{x}_{ijkt}}{\sigma - 1}\]
The quality index can be further standardized as:

\[
s - quality_{ijkt} = \frac{quality_{ijkt} - min_{j,k,t} quality_{ijkt}}{max_{j,k,t} quality_{ijkt} - min_{j,k,t} quality_{ijkt}}
\]

where \(min_{j,k,t}\) and \(max_{j,k,t}\) represent taking the minimum and maximum quality of product variety \(i\) across all exporting firms, to all destinations, and through all years respectively. The advantage of normalizing the quality index is to restrict the standard quality index to vary in the range of \([0, 1]\), and thus make the quality of different products exported to different countries in the same year and the quality of the same product exported to the same country in different years more comparable.