China Economic Review 77 (2023) 101890

Contents lists available at ScienceDirect

China Economic Review

journal homepage: www.elsevier.com/locate/chieco

How does people's liberation army related business closure affect the local economy?☆

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ARTICLE INFO

JEL classification:
F52
P26
R11

Keywords:
PLA related business
PLA hospitals
Difference in differences
China economy

ABSTRACT

People's Liberation Army (PLA) related business was rampant in China in the 1980s and 1990s, and they significantly disrupted the local economy. However, due to limited data about PLAs, this issue is rarely investigated and thus the negative impact is hardly measured. In this paper we introduce a new proxy for measuring the approximate level of PLA related business in a specific city, PLA hospital score, to identify cities that are more affected by PLA related business closure. We then employ a difference-in-differences (DID) framework and show that PLA related business closure does bring positive effects to China's local economy, about a 2% increase in GDP growth per year. We also find that this effect is more significant in cities with median economic size and cities that rely more on secondary and tertiary sectors. We finally provide a possible channel of this effect, which mainly works through providing a more efficient and competitive market to local private firms as well as an investment-friendly environment that attracts foreign investments.

1. Introduction

The rapid economic growth in China after the Reform and Opening Up has been discussed extensively for so long. While we are amazed at China's economic boom, some serious problems also arose during that period, which dampened the economic development in some areas. From the point of view of Allen, Qian, and Qian (2005), the economic and financial system of China is still undeveloped, and these serious problems still need to be solved. Among these, the emergence and the closure of People's Liberation Army (PLA) related business from the 1980s to 1990s caught our attention.

PLA related business started in the 1980s when President Deng Xiaoping announced a huge cut in military expenditures. He then announced that PLAs are allowed to operate profitable enterprises to cover some daily military costs. Since then this type of business grew quickly and became an important part of China's economy. As Bickford (1994) illustrates, these enterprises covered many areas of daily economic life. PLA related business did, to some degree, increase PLA's budgets, but it also led to corruption, smuggling, monopoly, and other inefficiencies, thus bringing a negative impact on the local economy. Therefore in July 1998 President Jiang Zemin officially declared to stop all the PLA related business.

☆ We thank the editor Sandra Poncet and two anonymous referees for their comments and feedback. We also thank Kaihua Deng, Meng Miao, Jiawei Mo, Mingzhi Zhang, Wanli Zhao, and seminar participants at Peking University and Renmin University of China for their fruitful comments. All errors are our own.

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https://doi.org/10.1016/j.chieco.2022.101890
Received 4 March 2022; Received in revised form 8 October 2022; Accepted 12 November 2022
Available online 17 November 2022
1043-951X/

While we are investigating whether PLA related business closure brings positive effects to the local economy, we find it difficult to acquire all the relevant information about PLA related business, which remains secret now for some reason. Therefore we propose one novel and intuitive proxy: the proportion of PLA hospitals in one specific city. The basic intuition is that a higher proportion of PLA hospitals might indicate that more troops are stationed in this city, and more PLA related activities as well. Hence there is a higher probability for PLA related enterprises to locate there and influence the local economy.

Following this logic, we begin by collecting city-level hospital data in China and other relevant city-level data. We then use our built weighted proportion of PLA hospitals to distinguish between cities in the treated and control group and use a difference-in-differences (DID) framework to analyze the effect of PLA related business closure.

Our empirical results show that, after PLA related business closure in 1998, cities in the treated group exhibited higher GDP and real GDP growth compared to cities in the control group, about 2% per year. Our main results are still robust when we use different measures to build up treated and control groups, use another economic indicator instead of GDP growth, and use subsamples to exclude some other potential biases. We also perform parallel trend tests and placebo tests, and they support the validity of our DID strategy. These tests together provide evidence that PLA related business had negative effects on the local economy, and thus the closure is rather beneficial.

One might be cautious whether our results are caused by sample selection bias and other unobserved factors that raise the issue of endogeneity. We thus also employ a propensity score matching (PSM) method, along with an instrument variable (IV) method. These tests further indicate that our results are insensitive to endogeneity.

We also attempt to investigate deeper to see which cities will be affected more. Our heterogeneity tests indicate a larger effect on cities with median economic size and cities that rely more on secondary and tertiary sectors. We argue that large cities already built a relatively complete economic structure, while small cities are too small to attract much PLA related business. Hence cities with median economic size are more prone to this negative effect. What is more, PLA enterprises are mainly in secondary and tertiary sectors, so cities that rely more on these sectors are more influenced.

We finally attempt to exploit potential channels that link PLA related business closure with better development of the local economy. We find that (1) cities in the treated group show a higher number of signed foreign investment contracts, as well as the investment amount after the closure; (2) cities in the treated group have higher growth in the number of local industrial enterprises, as well as the total EBITs of these firms. These results together indicate that after PLA related business closure, the local economy gradually transforms into a more efficient, competitive market, which benefits other local firms, as well as an investment-friendly environment that attracts foreign investments. They together promote the development of the local economy.

Our research contributes to the literature along different dimensions. First, our research contributes to the studies on the relationship between military and economics, which is seldom studied before in academia. Previous studies include Abell (1994) and Sun and Yu (1999) who study the determinants of military spending and its impact on income inequality. Acemoglu, Ticchi, and Vindigni (2010) theoretically analyzes the emergence and the impact of military dictatorships. In a more recent study, Sheremirov and Spirovska (2022) uses the data of international military spending to study the fiscal multipliers in different countries. Some papers start from a relatively individual level, such as Benmelech and Frydman (2015) which analyzes the CEO's military background and its effect on corporate performance, and Hou, Liu, and Wang (2020) which focuses on individuals' earnings after retiring from military service. Our research is different from them mainly because we focus on the effect of PLA related business and its closure, which stands from an intermediate level. Besides, this PLA related business closure is indeed rare in other countries, so to the best of our knowledge, this is the first paper that uses quantitative methods to analyze this question.

Second, our research contributes to the studies that discuss the recent significant events in China's development during the past forty years. These significant events include the process of privatization since 1990s (Sun & Tong, 2003; Jefferson & Su, 2006; Bai, Lu, & Tao, 2009; Li, Wang, Cheung, & Jiang, 2011; Gan, Guo, & Xu, 2017), China's four-trillion-yuan stimulus package in 2009 (Chen, He, & Liu, 2019; Cong, Gao, Ponticelli, & Yang, 2019), and the recent heatedly discussed anti-corruption starting from 2012 (Lin, Morck, Yeung, & Zhao, 2016; Pan & Tian, 2017; Xu & Yano, 2017; Zhang, 2018). As it is mentioned in the latter part of the article, China's previous leader Jiang Zemin regarded PLA related business closure as one of the most important achievements in his career, the same as continuing the Reform and Opening Up. Thus we believe that this is also an important event during China's economic development, but unfortunately, up to now, it is rarely investigated. Our paper is the first study to address this event quantitatively and hopes to shed some light on future research on this topic.

Third, our research contributes to another strand of literature that investigates the impact of different ownerships of enterprises, especially the inefficiency of state-owned enterprises (SOEs). While there are a large number of studies that focus on the inefficiency of a company's operation, little research provides a more border view to discuss the negative externality or the spillover effects that SOEs bring to other firms and the whole economy. Lin, Wan, and Morgan (2016) provides a brief discussion on the privileges SOEs enjoy. They enjoy privileged access to capital, a lower interest, and a monopolistic position so these SOEs distort market competition, and bring a negative impact on China's economic growth. Brandt and Zhu (2010) empirically finds that inefficient SOEs absorb more than 50% fixed investments, and this misallocation impedes the growth of private firms, as well as the whole of China's economy. Brandt, Tombe, and Zhu (2013) further measures the TFP losses due to this misallocation, and finds that it also leads to an increase in capital market distortions. Liu and Shi (2010) provides another explanation that SOEs enjoy a soft budget constraint (SBC), where they receive government subsidies that are indeed from other private firms. This SBC not only results in inefficiency but also hinders other private firms. Our research provides a more specific example where, as we mention later, PLA related business can be regarded as a special kind of SOE. They indeed enjoy more privileges than typical SOEs, thus creating a larger market distortion. Our empirical results coincide with previous research that this special kind of SOEs does harm the local economy.

The rest of the paper is organized as follows. Section 2 introduces the whole history of PLA related business. Section 3 detailedly explains our designed proxy for PLA related business. Section 4 illustrates and further explains our hypothesis. Section 5 presents our empirical work. Finally, we conclude our research and discuss some weaknesses and extensions of our research.

2. The history of PLA related business: emergence and closure

The history of PLA related business can date back to the 1980s. In the 1980s, China started to change its focus from "class struggle" back to economic development. Along with the implementation of the famous Reform and the Opening Up, China experienced rapid changes in almost every aspect of society. Among those, one particular change related to PLAs is to decrease military expenditure. Although there is no data before the 1990s, one can still see a decreasing tendency of the proportion of military expenditure on the GDP of China in Fig. 1.

While the huge cut in military expenditure helped China show a peaceful gesture to the world, there was gradually a gap between military expenditure and financial demand from PLA troops. As a result, at the Enlarged Conference of the Central Military Commission in 1985, there was an official announcement that PLAs were allowed to engage in business. Immediately following this decision, different sectors of PLAs started to operate various types of business activities. For instance, PLA troops in Guangdong Province started to operate businesses including manufacturing, hospitality, real estate, aviation industry, etc. These enterprises together contributed more than 20 million yuan in 1991 and even doubled in three years.[1] Similar examples happened in Shandong Province, where PLA troops there started garment factories, pharmaceutical companies, metal and plastic factories, etc. They together made a profit near 100 million yuan in 1987.[2] These examples show that PLA related business was distributed all over the country, and in almost every economic sector. They consisted an important part of China's economy in the 1990s. Data shows that at the end of 1990, all the PLA related enterprises had a total of 17.2 billion yuan in fixed assets and working capital, and 850,000 employees. The total gross profit of PLA related enterprises was 19.7 billion yuan in 1989, with an after-tax net profit of 3.9 billion yuan.[3]

PLA related business did cover part of the deficits of military expenditure. However, it also had other negative impacts on PLA itself, and the whole economy. For one, paying too much attention to operating business disrupted PLA's daily training and weakened its combat power. This can be seen in a speech by President Jiang Zemin,

During recent years, almost every sector of PLA engaged in business activities, and some units paid too much attention to the business. It distracts PLA's daily military training, weakening our combat power, which is completely contradictory to the PLA's prior and rudimentary function.[4]

For another, during the development of PLA related business, some issues have also been found that disrupt the market order. Monopoly, corruption, and smuggling activities were connected to PLA enterprises in the 1990s. Several examples of serious corruption started from this period, including the notorious Guo Boxiong,[5] Xu Caihou,[6] Gu Junshan,[7] etc. These people were later the representative targets of the famous "taking out tigers and swatting files", China's anti-corruption actions since 2012. One can also see the severity of PLA related smuggling from former Prime Minister Zhu Rongji's speech,

> "*Smugglings are found in companies run or affiliated to⋯local Communist Party of China (CPC) and PLA sectors are especially serious and harmful.⋯It is most important to investigate smuggling in these companies and the shielding behind these companies from related local CPC and PLA sectors.*"[8]

The situation became even worse after 1990, and the Central Military Committee (CMC) decided to gradually restrict, and later close some PLA enterprises in 1993. After two years, there was a decrease in the number of PLA enterprises. Later, CMC focused on coastal areas and special economic zones in 1995 and focused on non-combat troops in 1998. However, the actions above are still not enough to solve the issue completely.[9]

Therefore at the PLA Anti-Smuggling Work Conference on July 20, 1998, President Jiang Zemin eventually officially announced that PLAs should rely solely on the Communist Party (Chi Huang Liang), and thus all the PLA related business should be stopped.[10] It was then CPC began to close most PLA enterprises or transfer them to the local government. According to the official, by the end of

[1] Guangdong Province Chronicle: Military Chronicle, 1999.
[2] Shandong Province Chronicle: Military Chronicle, 1996.
[3] Troops and Armed Police Will No More Engage in Trade, Military Economic Research, 1999.
[4] PLA Conference of Production and Operation, 1993.
[5] Guo Boxiong Was sentenced to Life Imprisonment in the First Instance, 2016,https://www.court.gov.cn/fabu-xiangqing-33131.html.
[6] The Central Committee Decide an Expulsion from the Party to Xu Caihou, 2014,http://politics.people.com.cn/n/2014/0630/c1001-25220218.html.
[7] Gu Junshan Was Sentenced to Death with a Two-year Reprieve, 2015,https://www.court.gov.cn/zixun-xiangqing-15158.html.
[8] China National Anti-smuggling Conference, 1998,http://www.people.com.cn/item/ldhd/zhurongj/1998/jianghua/jh0002.html.
[9] There might be a concern about our empirical settings of using 1998 as an exogenous shock since these previous actions might indicate PLA related business is a gradual process. We argue that (1) From the tongue of the official, they usually use July 1998 and December 1998 as the starting and the ending point, respectively. There is also an implicit change in the attitudes of the official. For example, the official usually uses words like "constrain", "reform" or "rectify" before 1998, but use "no longer allowed", "stop", and "closed" afterward; (2) the 1998 official announcement by President Jiang Zemin and the subsequent actions are significantly different from the previous ones, which can be seen from some official documents. See Zhang Wannian Biography, 2011, and Hu Jintao's Speech on undoubtedly implementing the decision from the Central Committee, People's Daily, October 8, 1998, etc.
[10] Selected Works of Jiang Zemin, 2006.

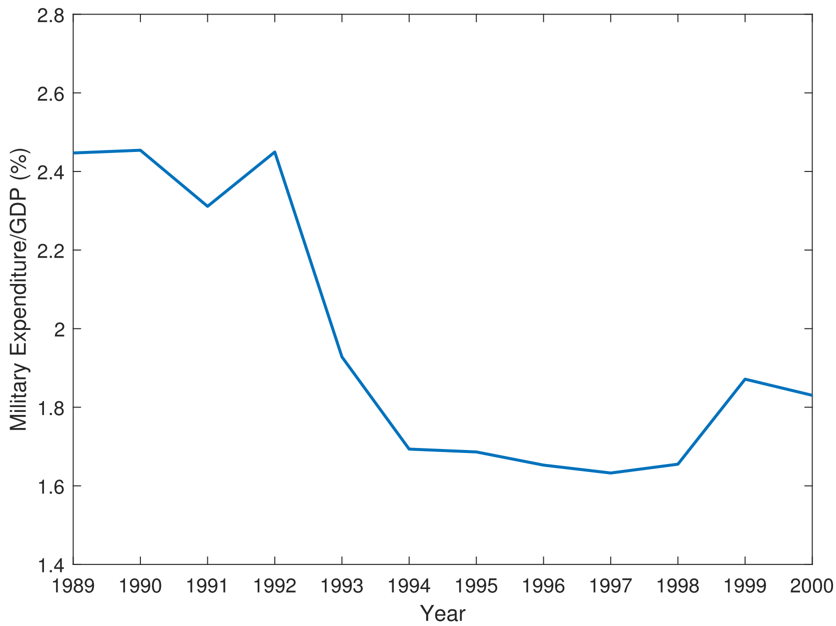


Fig. 1. Military expenditure/GDP of China, 1989 to 2000.

1998, PLAs altogether transferred 2937 enterprises to the central or local governments, with 80.4 billion yuan of total assets, and closed 3928 enterprises, with 15.1 billion yuan of total assets.[11] There were about 1000 remaining enterprises and organizations called "Military Paid Service", which mainly includes PLA hospitals, colleges, and research institutions, which are less like profitable firms.[12] Therefore we believe that the official announcement of PLA related business closure in 1998 largely kept PLAs away from business activities.

3. Proxies for PLA related business

3.1. PLA hospitals

PLA Hospitals mainly include People's Liberation Army (PLA) hospitals (Jie Fang Jun Yi Yuan) and Chinese People's Armed Police (PAP) hospitals (Wu Jing Yi Yuan).[13] PLA hospitals were initially built to serve soldiers but since the 1980s they began to open to the public and gradually became an important component of the Chinese medical system.

Fig. 2 shows the distribution of PLA hospitals in China in terms of absolute numbers and proportions, respectively. We also highlight the headquarters of the previous Seven Military Regions (Qi Da Jun Qu, now rearranged into Five Theater Commands, Wu Da Zhan Qu) in yellow[14] and the headquarters of eighteen army groups in blue.[15] As the figures show, PLA hospitals are distributed unevenly among regions. They are mostly located in the headquarters, for instance, Beijing, Guangzhou, Chengdu, etc. There are more PLA hospitals located in coastal areas and places near the border. This might be because China is facing the biggest military threats from these directions, so there will be more military activities, and of course, more PLA troops in these areas. Another notable characteristic is that there are also many PLA hospitals in Northwest China, the Xinjiang Autonomous Region because there is a special troop called Xinjiang Production and Construction Corps. It is not hard to see that PLA hospitals are more likely to locate in places where military activities are more frequent and, of course, where more PLA troops are stationed.

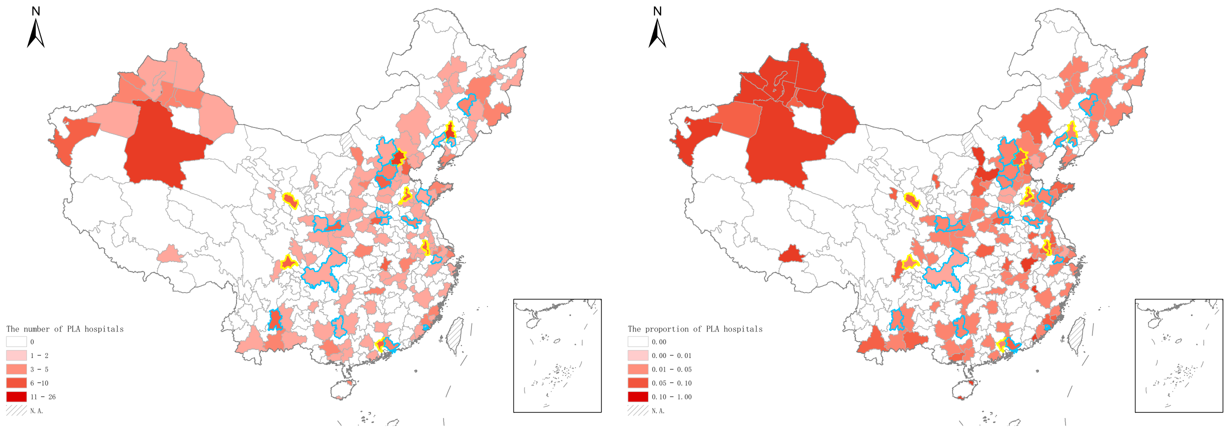
[11] Zhang Wannian Biography, 2011.

[12] What is Military Paid Service, Beijing Times, April 17, 2015.

[13] In general there is no significant difference between PLA hospitals and PAP hospitals in China, thus we use PLA hospitals to represent all the PLA and PAP hospitals for ease.

[14] Seven Military Regions existed from 1985 to 2016. The seven headquarter cities are Beijing, Chengdu, Guangzhou, Jinan, Lanzhou, Nanjing, and Shenyang. Starting in 2016, they are rearranged into Five Theater Commands, and the five headquarters are Beijing, Chengdu, Guangzhou, Nanjing, and Shenyang.

[15] These eighteen cities are Baoding, Baoji, Huzhou, Huizhou, Jinzhou, Kaifeng, Kunming, Liaoyang, Liuzhou, Shijiazhuang, Weifang, Xi'an, Xinxiang, Xuzhou, Zhangjiakou, Changchun, and Chongqing.



(a) Numbers **(b)** Proportions

Fig. 2. Distribution of PLA hospitals in China.

3.2. Plausibility of the proxies

In this part, we mainly explain the logic behind our proposed proxy.

One of the biggest obstacles in front of our research is that the relevant data about PLA related business is insufficient, some even remaining secret. For example, if we want to investigate the effect of PLA related business closure on the local economy, we need to know exactly about the distribution of these PLA enterprises, so that we can determine which cities suffer more. However, to the best of our knowledge, there is no detailed information on this special kind of enterprise released. Another natural guess will be, that if more PLA troops are stationed in one city, then there is a higher probability that PLA enterprises are located there. It is an intuitive and straight method, but we need to know the location of all the division, brigade, and regimental level troops to use it as a proxy. However, it is impossible to gather such detailed information about specific troops because it is military secrets that link to China's national security. To some extent, PLA related business itself is a secret as well.

To address this problem as much as we can, we consider the logic below. If there are more PLA troops in a specific city, then there is a higher probability that PLA enterprises are located there. At the same time, we propose that there will be more PLA hospitals in the same city. The reasons are the following. For one, more PLA troops in a city result in higher demand for PLA hospitals as they originally serve soldiers only. For another, although less profitable, PLA hospitals still belong to "Military Paid Service", which is also one special type of PLA enterprise. Thus we expect that there is a positive correlation between PLA hospitals and PLA related business. Another advantage of using PLA hospitals is that data on PLA hospitals are relatively less secret and thus it is not difficult to obtain relevant information.

Therefore following what we propose above, we gather the information on PLA hospitals and use a weighted score of PLA hospitals in one city as a proxy for PLA related business.[16]

Table 1 reports the descriptive statistics of PLA hospitals in different cities. We can see that there are substantial differences among different cities. About half of the cities have no PLA hospitals at all, while in Larsa, PLA hospitals consist of more than 10% of Hospitals. On average, there are about 2% of PLA hospitals in a city. Since the distribution of PLA hospitals is highly heterogeneous among cities, we then employ a difference-in-differences (DID) strategy to identify the effect. We define the treated group as cities whose weighted score of PLA hospitals ranks top 25%.[17]. The intuition is that in these cities there are more PLA enterprises, and these cities will be more influenced by PLA related business closure. Other cities are regarded as cities in the control group. We will further delineate our DID setting in later sections.

4. Hypotheses

In this section, we formulate our hypotheses to test the effect of PLA related business on the local economy.

One of the crucial assumptions of our paper is that PLA related business closure in 1998 is relatively exogenous so we can employ the DID strategy. We believe that this policy is from China's top leaders that we think for individual cities, it could be considered as an exogenous and aggregate shock. What is more, from our previous discussion, PLA related business closure was a nationwide policy that affected all the cities in China. This aggregate shock was widespread and so fast that we believe for one individual PLA enterprise, there

[16] In China, hospitals are divided into three classes, wherein in each class, there are three grades and an extra grade for the highest class. We give each grade a different score (1 to 10) to distinguish between large and small hospitals.

[17] In robustness checks, we use other identification strategies, and the results are all robust.

Table 1
Descriptive statistics of PLA hospitals among cities.

Variables	N	Mean	S.D.	Min	Med	Max
Number of PLA Hospitals	286	1.06	2.29	0.00	0.00	26.00
Proportion of PLA Hospitals	286	0.02	0.03	0.00	0.00	0.13
PLA Hospital Score	286	0.02	0.03	0.00	0.00	0.15

*This table reports the summary statistics of city-level PLA hospitals in different measures.**Number**measures the number of PLA hospitals in one city.**Proportion**measures the proportion of PLA hospitals among all hospitals in one city.**Score**measures the ratio between PLA hospital score and the score of all hospitals in one city, where we give different scores to different hospital grades.*

was no chance and also no incentive to relocate to mitigate the impact. Therefore, we believe when PLA enterprises in one city were shut down, it affects most on the local economy. While we admit that there might be spillover effects from one city to another, it is relatively small compared to the direct effect. Therefore in this paper, we focus solely on the effect of this event on the same city.

As mentioned above, PLA related business can also be regarded as a special kind of SOEs, while they enjoy even more privileges than typical SOEs do. PLA related business is always accompanied by monopoly, corruption, and smuggling activities. They dampen the local economy mainly by disrupting competition and disturbing the market order, as the analysis of typical SOEs in Lin, Wan, et al. (2016). After PLA related business closure, the local economy will benefit from it because it encourages the development of local enterprises, especially local private firms through promoting a more competitive market and a more efficient capital allocation. The local government will also benefit from the closure because one huge external bargaining power is removed so that they can better formulate and implement their economic policies with fewer constraints. What is more, the local economic environment will improve so that it can attract foreign investments. Under these considerations, we propose the first hypothesis we bring to the data:

Hypothesis 1. After PLA related business closure, cities in the treated group will exhibit higher economic growth than cities in the control group.

If our first hypothesis can be verified, then a natural question will be Which cities will be more affected? We assume that medium-sized cities will benefit most from PLA related business closure, mainly for two reasons. For one thing, large-sized cities might already have a relatively mature and advanced economic market, so compared with smaller cities, PLA enterprises might not have dominant market power. For another, the market in small-sized cities might be too weak to experience such a dramatic improvement after PLA related business closure. The negative impact of PLA enterprises might only be a minor factor that affects the local economy. Thus according to the discussion, we raise our second hypothesis.

Hypothesis 2. After PLA related business closure, cities in the treated group with medium economic size will exhibit higher economic growth.

Moreover, we find that PLA related business relates more to secondary and tertiary sectors. For example, in coastal areas, many PLA enterprises were foreign trading companies, while in central regions, PLA enterprises engaged mainly in the mining, manufacturing, real estate, and other service industry. Therefore we believe that PLA related business closure will mostly affect secondary and tertiary sectors, and thus, have a more significant impact on cities that rely more on secondary and tertiary sectors.

Hypothesis 3. After PLA related business closure, cities in the treated group that rely more on secondary and tertiary sectors will exhibit higher economic growth.

How can PLA related business closure improve the local economy? To better answer this question, we propose and exploit two possible channels. Our first channel is that, as discussed previously, privileged PLA enterprises are usually connected with capital misallocation and market distortions, which has a negative externality to other local firms. After PLA related business closure, we assume that there will be a more efficient and competitive market so that other local firms, especially local private firms can benefit from this. We believe it can be seen from more enterprises entering the market, as well as an increase in the profits of local enterprises, and the increase will be more significant in those cities in the treated group. Another potential channel is that PLA related business closure improves the economic environment, making it a more investment-friendly economy that will attract foreign investments. These foreign investments also provide more capital and technology needed for China's subsequent economic development. Thus we assume that foreign investments will experience a higher increase in cities in the treated group. To conclude, we propose our final two hypotheses.

Hypothesis 4. After PLA related business closure, cities in the treated group will exhibit higher growth in the number of firms as well as the EBIT of firms growth than cities in the control group.

Hypothesis 5. After PLA related business closure, cities in the treated group will exhibit a higher increase in foreign investments than cities in the control group.

5. Empirical results

5.1. Data

5.1.1. Hospital data

We first hand collect all the hospital data in China from A + Medical Encyclopedia (www.a-hospital.com). This dataset contains all the relevant information about China's hospitals and other health service providers at the city level. In the interest of our paper, we next delete certain types of service providers, including community healthcare centers, health stations, and school hospitals, getting 14698 hospitals in our final sample. Then we use several keywords to distinguish between PLA hospitals and others. These keywords include PLA, PAP, Navy, Air Force, etc. We get a total of 360 PLA hospitals, about 2.4% of the total sample. We finally use their addresses and postal codes to specify in which city these hospitals are located respectively.

In China's hospital system, hospitals are evaluated according to their size, professionality, and numbers of patients, and then graded into three classes and ten grades, with the highest called Class III Grade A (San Ji Jia Deng), and the lowest called Class I Grade C (Yi Ji Bing Deng), and an extra grade for the highest class (San Ji Te Deng).[18] We thus give them different scores by their grades, 10 for the highest and 1 for the lowest, respectively. We believe this scoring method can better describe the exact scale of PLA hospitals in one specific city. But as discussed in later sections, we also consider a pure proportion of PLA hospitals, and the results largely remain unchanged.

5.1.2. City data

We collect economic data from 286 cities in China between 1993 and 2005 from China Stock Market & Accounting Research (CSMAR). This dataset includes GDP, foreign direct investments, EBITs of local enterprises, etc. We also collect city-level nighttime light data from the Chinese Research Data Services Platform (CNRDS) and use it as a robustness check. Descriptive statistics of all key variables are reported in Table 2.

Readers might wonder why we focus on this sample period from 1993 to 2005. For one thing, before 1993, China was suffering from large inflation, and GDP growth before our sample period might be relatively inaccurate, which might significantly distort our results; and for another, we believe as we extend the sample period, there are other more important events (for example, the global financial crisis in 2007) that will bias our results. We also winsorize all the variables at the 1% level because, for example, some cities experience unexpected GDP growth in certain years during our sample period.[19]

5.2. Model specification

As discussed in previous sections, we believe the event of PLA related business closure was exogenous and nationwide. Thus to identify the effects of PLA related business closure on the local economy, we employ a DID framework. The main regression equation is specified as follows:

$$y_{c,t} = \alpha + \beta_1 PLA_c + \beta_2 Post_t + \gamma PLA_c \times Post_t + y_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t} \tag{1}$$

where $y_{c,t}$ are the variables of interest, c denotes cities, p denotes provinces and t indexes years. PLA_c is a dummy variable set equal to 1 for cities in the treated group. In other words, we believe in these cities PLA related business was more rampant. $Post_t$ is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. To best distinguish the potential effect in interest, we add the lag of the dependent variable $y_{c,t-1}$. We also control city fixed effects (μ_c) and province × year fixed effects ($\eta_{p,t}$) to absorb city characteristics and the effect of unobserved time-varying province-level variables. For the sake of statistical inference, following Petersen (2009) we double cluster the standard errors at the province and year level.

To be more precise in explaining our construction on the treated and control groups, in our main regression, we first calculate the weighted score of PLA hospitals in each city, that is:

$$PLA\ Score_c = \frac{\sum_{j \in City_c} score_j \mathbf{I}_{j=PLA}}{\sum_{j \in City_c} score_j} \tag{2}$$

where $score_j$ denotes the score of hospital j in city c, according to the grading system we define previously.

We then sort all the cities according to their weighted PLA hospital scores and set PLA_c equal to 1 for cities ranking top 25% and set to 0 otherwise. In our robustness check, we also consider other measures to distinguish cities in the treated and control group, for example, the ranking of the proportion of PLA hospitals, or a different threshold other than 25%. The results remain mostly unchanged. The dependent variables in our main regression include GDP growth and Real GDP growth, but there are nighttime light levels, EBITs of local enterprises, foreign investment contracts, etc in our subsequent tests.

[18] Measures for Medical Institution Accreditation, 1995,http://www.nhc.gov.cn/fzs/s3576/201808/0415d028c18a46c4a316d8339edcdf44.shtml.

[19] For instance, Neijiang had a 200% GDP growth in 1998.

Table 2
Descriptive statistics of all key variables.

	N	Mean	S.D.	10%	25%	50%	75%	90%
$\Delta lnGDP$	2890	0.221	0.325	0.047	0.084	0.129	0.210	0.393
$\Delta lnGDP(Real)$	2890	0.170	0.287	0.021	0.069	0.104	0.150	0.274
PLA	2890	0.268	0.443	0.000	0.000	0.000	1.000	1.000
$PLA\%$	2890	0.264	0.441	0.000	0.000	0.000	1.000	1.000
PLA_{30}	2890	0.322	0.467	0.000	0.000	0.000	1.000	1.000
PLA_{35}	2890	0.389	0.488	0.000	0.000	0.000	1.000	1.000
ΔDN	2661	0.262	0.436	−0.048	0.024	0.131	0.348	0.727
$\Delta Fict1$	2712	−0.031	1.224	−0.600	−0.120	0.000	0.100	0.540
$\Delta Fict2$	2716	0.452	3.279	−1.005	−0.177	0.065	0.501	2.033
$\Delta lnProfit$	2156	0.054	0.565	−0.579	−0.137	0.117	0.294	0.562
$\Delta lnNumber$	2427	0.065	0.215	−0.112	−0.035	0.030	0.126	0.241
$Population$	2755	4.054	2.851	1.239	2.118	3.456	5.472	7.227
$Income$	2671	8.994	0.495	8.389	8.631	8.967	9.335	9.634
$Education$	2755	0.167	0.066	0.129	0.145	0.166	0.185	0.204
HQ	2890	0.223	0.416	0.000	0.000	0.000	0.000	1.000
RBA_1	2890	0.132	0.213	0.000	0.000	0.000	0.200	0.400
RBA_2	2890	0.177	0.223	0.000	0.000	0.100	0.273	0.500
RBA_3	2890	0.137	0.202	0.000	0.000	0.000	0.222	0.481
RBA_4	2890	0.525	0.332	0.083	0.250	0.500	0.833	1.000

This table reports the summary statistics of all Key variables in our empirical analysis, using the sample period from 1993 to 2005. $\Delta lnGDP$, $\Delta lnGDP(Real)$, $\Delta Fict_1$, $\Delta Fict_2$, $\Delta lnProfit$, $\Delta lnNumber$, $Population$, $Income$, $Education$ *are from CSMAR.* ΔDN *is from CNRDS.* PLA, $PLA\%$, PLA_{30}, *and* PLA_{35} *are from A + Medical Encyclopedia. HQ is from China's State Council.* RBA_1 *to* RBA_4 *are from Zhong Guo Lao Qu Wang.*

5.3. Main result - effects on the local economy

Based on our discussion in Section 4, we first examine Hypothesis 1, which proposes that after PLA related business closure, the local economy will improve because of a more efficient and competitive market, a less constrained policymaker, and a better economic environment that attracts foreign investments. This can be seen in different GDP growth rates of cities in treated and control groups. Therefore we first investigate the effect of PLA related business closure on GDP growth.

Table 3 reports the results of the effect of PLA related business closure on both nominal and real GDP growth. Here we define nominal GDP growth as the natural logarithm of GDP in a current year minus the natural logarithm of GDP in the previous year. We also define real GDP growth as the difference in the natural logarithm of GDP divided by the price index of its province between two consecutive years.

Columns (1) and (5) report our base result for the effect of PLA related business closure on GDP growth. The coefficient γ in Column (1) is 0.021, which is positive and significant at the 1% level. If we instead focus on real GDP growth, the coefficient in Column (5) is also positive and significant. Our base result is robust if we control for other factors. In Columns (2) and (6) we control the lagged GDP growth, i.e. the GDP growth last year, and we find our results largely the same. One might also wonder if this result is due to unobserved time-varying variables, for example, other economic policies in some specific year, so in Columns (3) and (7) we add province × year fixed effect. Lastly, some might also suspect if it comes from city characteristics, for example, geographical or historical factors, so we further add city fixed effects in Columns (4) and (8). Our main results are mostly unchanged and significant at the 5% level.

Based on the discussion above, we find that our regression results are consistent with Hypothesis 1, which assumes that cities in the treated group will exhibit higher GDP growth after PLA related business closure. In terms of economic significance, on average one city in the treated group exhibit 2% higher GDP growth per year, both in nominal and real terms. This is a relatively large magnitude compared to the average growth rate in our sample period, which is 22% and 17%, respectively.

Note that the validity of our DID strategy relies on the parallel pre-trend assumption. This assumption requires that before PLA related business closure, cities in the treated group should exhibit similarly to cities in the control group, i.e. they should have similar GDP growth in the absence of the treatment. To test whether our strategy satisfies this assumption, we estimate the following regression:

$$y_{c,t} = \alpha + \sum_{j=1993}^{1997} \gamma_j PLA_c \times Year_t^j + \sum_{k=1999}^{2005} \gamma_k PLA_c \times Year_t^k + \eta_{p,t} + \mu_c + \varepsilon_{c,t} \quad (3)$$

where $Year_t^j$ ($Year_t^k$) is a set of dummies that are set to 1 if one specific year t is equal to j (k) and 0 otherwise. We then test the significance of γ_j from 1993 to 1997.

Fig. 3 plots the coefficients γ_t from 1993 to 2005 and their corresponding 95% confidence intervals using nominal and real GDP growth, respectively. Here we use the year 1998 as the base year. From the figures we can see that γ_t from 1993 to 1997 are all insignificant, indicating that our strategy satisfies the parallel pre-trend assumption that cities in the treated group and control group exhibit similar GDP growth patterns before PLA related business closure.

One thing worth noting is that in the year 1999, the year right after PLA related business closure, we instead see a significant

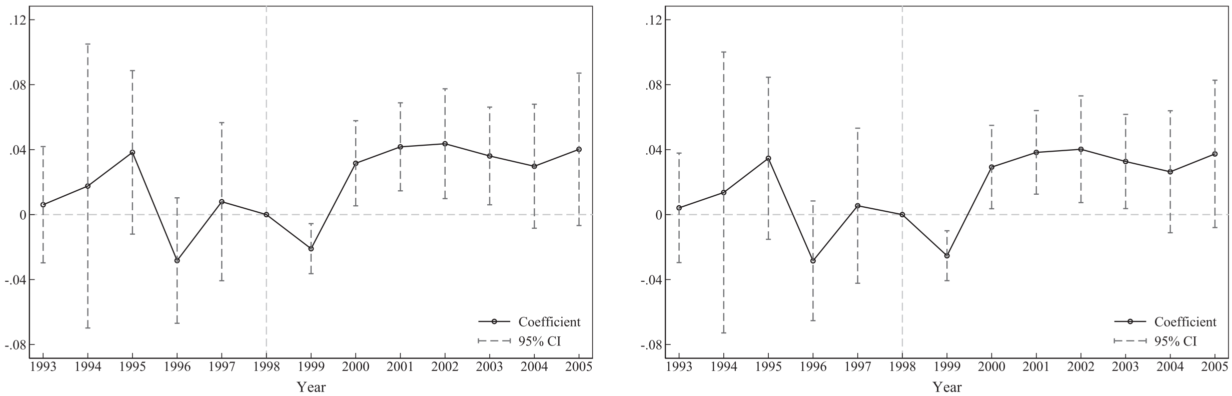
Table 3
Main result: effects of PLA related business closure on GDP growth.

	$\Delta lnGDP$				$\Delta lnGDP(Real)$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PLA × Post	0.021***	0.021**	0.020**	0.022***	0.021**	0.022**	0.018**	0.021***
	(0.005)	(0.007)	(0.007)	(0.002)	(0.007)	(0.007)	(0.007)	(0.002)
PLA	−0.016***	−0.016**	−0.026***		−0.016**	−0.017**	−0.024***	
	(0.004)	(0.006)	(0.001)		(0.005)	(0.005)	(0.002)	
Post	−0.228	−0.226			−0.135	−0.136		
	(0.134)	(0.132)			(0.111)	(0.111)		
Constant	0.346**	0.344**	0.231***	0.227***	0.245**	0.249**	0.178***	0.174***
	(0.133)	(0.130)	(0.002)	(0.004)	(0.111)	(0.110)	(0.002)	(0.003)
Lag Y		Yes	Yes	Yes		Yes	Yes	Yes
City FE				Yes				Yes
Province × Year FE			Yes	Yes			Yes	Yes
R^2	0.116	0.116	0.683	0.696	0.050	0.051	0.597	0.614
Observations	2890	2890	2835	2835	2890	2890	2835	2835

This table reports the effect of PLA related business closure on GDP growth, which uses the sample from 1993–2005:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 PLA_c + \beta_2 Post_t + \gamma PLA_c \times Post_t + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

GDP growth is used in Columns (1) to (4) and Real GDP growth is used in Columns (5) to (8). PLA_c *is a dummy variable set equal to 1 for cities whose PLA hospital score ranks top 25% and set to 0 otherwise.* $Post_t$ *is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. We also control the lagged GDP growth, city fixed effects, and province × year fixed effects to absorb unobserved city characteristics and time-varying province-level variables. Standard errors are clustered at the province and year level.*



(a) GDP Growth (b) Real GDP Growth

Fig. 3. Parallel pre-trend test.

decrease in GDP growth. This might be counter-intuitive at the first glance, but we believe this is because PLA related business closure indeed brings two opposite effects to the local economy. On the one hand, closing these existing PLA related enterprises is like shock therapy that brings immediate negative effects to the local economy. For firms that are not closed but transferred to other owners, they also need to adjust their operations, thus it is not surprising they suffer from a temporary negative shock. On the other hand, as we will mention in the latter section, the closure of these PLA related enterprises brings a more efficient and competitive market to other firms, but it might take time to be in effect. At the very beginning, the negative effect exceeds the latter, and thus in aggregate it displays a negative effect in the first year. But starting from the second year, as the process of transformation continues, the positive effect is generally larger and thus the aggregate effect turns positive. One can also see that this positive effect lasts for about five years until 2004. To some degree, this also indicates PLA related business closure is not an instant shock, but rather it brings a relatively far-reaching effect to the local economy.[20]

We also perform placebo tests to better verify the validity of our DID strategy. To be more specific, we construct 5000 pseudo-treated groups by randomly picking 25% of cities from the sample. We then repeat our previous main regression with lagged

[20] We thank an anonymous referee for raising this discussion on its short-term and long-term effects.

dependent variable, city and province × time fixed effect, to see whether the interaction coefficients γ are significant or not.

Fig. 4 plots the distribution of the t-value of γ using these 5000 pseudo-treated groups, where the dashed line represents the t-value using the real treated group. As one can see, the distribution of the t-value is more like a normal distribution, with the mean close to 0. While using the real treated group we get a highly significant t-value, which is over 10 for both nominal and real GDP growth. This gives us more convincing evidence about the plausibility of our identification strategy.

In short, we find after that PLA related business closure, cities in the treated group on average exhibit 2% higher GDP growth per year than cities in the control group. This provides evidence that PLA related business closure does bring positive effects to the local economy. Subsequent parallel pre-trend tests and placebo tests also indicate that our identification strategy is valid.

5.4. Robustness checks

5.4.1. Changing measures of identifying cities in the treated group

Readers might wonder why we use this specific measure to distinguish between cities in the treated and control group. At the first glance, our measure and the 25% threshold for PLA_c do look somewhat arbitrary. To better mitigate readers' concerns, we use different measures to construct treated groups and control groups. We then use these different treated groups and repeat our main regression.

Table 4 reports the regression results using another three different measures. For *PLA*%, we calculate the simple proportion of PLA hospitals and set it equal to 1 if the city ranks top 25% and 0 otherwise. It is a more direct and intuitive measure. Columns (1) and (4) report the results, and one can find that the estimated coefficients are still significant at the 1% level. In terms of economic magnitude, it is similar to the result in the main regression, 0.022 for GDP growth and 0.021 for real GDP growth, respectively.

Since one might be cautious that our results are sensitive to the threshold chosen, we also change the threshold to other figures. For PLA_{30}, we set the treated dummy equal to 1 if the PLA hospital score of the city ranks top 30% and 0 otherwise. The results are reported in Columns (2) and (5), the coefficients are still significantly positive at the 1% level. Lastly, in Columns (3) and (6), we use a similar construction for PLA_{35}, where we set it equal to 1 for cities whose PLA hospital score ranks top 35% and 0 otherwise. The results are still mostly the same as the main result.

In short, we believe that the construction of our treated and control groups is robust, and our results still hold when we change different methods.

5.4.2. Using city nighttime daylight as a proxy of GDP growth

Another common concern is that the GDP growth of a city cannot fully represent the growth of the local economy, and it might be artificially manipulated as well, especially during the period between the 1990s and 2000s when China's prior focus is economic growth, and local government officials have an incentive to do so. Therefore following Henderson, Storeygard, and Weil (2012) and Storeygard (2016), we replace the dependent variable from the GDP growth with the intensity of nighttime light. The advantage of the intensity of nighttime light is that it is a more objective metric for measuring local economic activities.

Table 5 reports the results, where the dependent variable is the increase of the intensity of nighttime light. Column (1) shows that the coefficient of the interaction term $PLA \times Post$ is still significantly positive, which supports our previous analysis. We also control for lagged dependent variable, province × Year fixed effect, and City fixed effect in Columns (2) to (4), respectively. The results are mostly unchanged. This indicates that the change of the dependent variable also does not affect our result, and thus we rule out the possibility that our results might be driven by manipulation of GDP growth.

5.4.3. Ruling out potential biases

In this part we address another two issues regarding our sample, which might result in other biases. The first concern is about a special area, Xinjiang Autonomous Region, and a special troop, Xinjiang Production and Construction Corps. As is shown in Fig. 2, Xinjiang has an unevenly dense distribution, both in terms of numbers and proportions, and we wonder if this special region will affect our results. Thus we first drop Xinjiang from our sample and repeat the empirical exercise. The results are reported in Columns (2) and (5) in Table 6. The estimated coefficients are still positive and significant at the 1% level, and it is largely unchanged compared with the whole sample case. This indicates that Xinjiang brings little bias to our results.

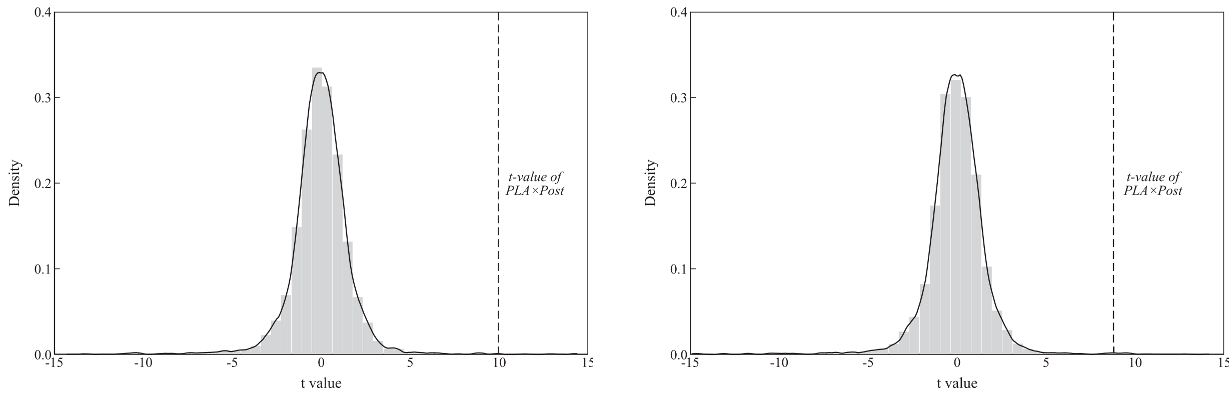
Another more severe concern is that in 1998, there are some other influential national events that might affect the local economy. To be more specific, in 1998, China suffered from a serious flood, which caused severe death and huge economic loss around China. Some might wonder whether this flood and the subsequent flood relief will be an alternative explanation, since they may also lead to the reduction of PLA related business, in addition to the PLA related business closure policy.

To address this concern, we drop four provinces that are most affected by the flood.[21] We then repeat our previous empirical analysis again to see if there are any changes.

The results are reported in Columns (3) and (6). The coefficient of the interaction PLA × Post is still positive and significant at the 1% level. In terms of economic magnitude, if we compare the results with the previous main results in Columns (1) and (4), dropping these four most affected provinces slightly increases the coefficients, from 0.022 (0.021) to 0.029 (0.028), which is relatively small and acceptable due to a large loss brought by the flood.

We also redo our parallel pre-trend test to see if the flood is the main cause of the initial surprising drop in 1999. Due to the limit of

[21] These four provinces are Jiangxi, Hunan, Hubei, and Heilongjiang. Report of the Flood Disaster in 1998, China Flood and Drought Management, 1998.



(a) GDP Growth (b) Real GDP Growth

Fig. 4. Placebo test using 5000 pseudo-treated groups.

Table 4
Robustness I: different measures of identifying cities in the treated group.

	$\Delta lnGDP$			$\Delta lnGDP(Real)$		
	(1)	(2)	(3)	(4)	(5)	(6)
$PLA\% \times Post$	0.019***			0.018***		
	(0.003)			(0.004)		
$PLA_{30} \times Post$		0.028***			0.026***	
		(0.003)			(0.003)	
$PLA_{35} \times Post$			0.025***			0.024***
			(0.005)			(0.003)
Constant	0.228***	0.226***	0.225***	0.175***	0.173***	0.172***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
Lag Y	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.696	0.696	0.696	0.614	0.614	0.614
Observations	2835	2835	2835	2835	2835	2835

This table reports the effect of PLA related business closure on GDP growth, which uses the sample from 1993–2005:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 PLA_c + \beta_2 Post_t + \gamma PLA_c \times Post_t + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

GDP growth is used in Columns (1) to (3) and Real GDP growth is used in Columns (4) to (6). in Columns (1) and (4),PLA%is a dummy variable set equal to 1 for cities whose proportion of PLA hospitals ranks top 25%; in Columns (2) and (5),$PLA_{30}$is a dummy variable set equal to 1 for cities whose PLA scores ranks top 30%; and in Columns (3) and (6),$PLA_{35}$is a dummy variable set equal to 1 for cities whose PLA scores ranks top 35%.$Post_t$is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. We also control GDP growth last year, city fixed effects, and province × year fixed effects. Standard errors are clustered at the province and year level.

space, we do not report the result, but the pre-trend is still basically unchanged, where before 1998, we do not see a significant difference between cities in the treated and control group, while starting from 2000 to 2003, there is a significant difference in two treated arms. The surprising decrease in 1999 still appears even after we drop these four provinces.

In short, we believe these results are largely unchanged after we drop these four provinces that are mostly affected by the flood. This helps us further mitigate the concerns that our story is rather driven by the 1998 Flood Relief.

5.4.4. Propensity score matching - difference in differences method

Readers might also wonder whether our result is due to sample selection bias. Therefore we further conduct a PSM-DID test to mitigate this concern. To be more specific, we further collect data on city-level characteristics from CSMAR, including the population, the average income denoted as yuan, and the proportion of college and high school students in a city. We next use a cross-sectional Logit model to estimate the propensity score of each city, using the year 1998,

$$PS_c = \alpha + \beta_1 Population_c + \beta_2 Income_c + \beta_3 Education_c + \beta_4 L.\Delta lnGDP_c + \varepsilon_c \quad (4)$$

After estimating the propensity score, we then employ a 1-to-1 matching strategy to select our subsample. Finally, we use the

Table 5
Robustness II: using city nighttime daylight as a proxy of GDP growth.

	ΔNTD			
	(1)	(2)	(3)	(4)
PLA × *Post*	0.105**	0.092**	0.087**	0.100**
	(0.034)	(0.029)	(0.038)	(0.041)
PLA	0.028	0.004	0.002	
	(0.020)	(0.009)	(0.015)	
Post	0.068	0.090		
	(0.124)	(0.119)		
Constant	0.164	0.067	0.129***	0.190***
	(0.117)	(0.109)	(0.031)	(0.031)
Lag Y		Yes	Yes	Yes
City FE				Yes
Province × Year FE			Yes	Yes
R^2	0.028	0.199	0.625	0.720
Observations	2432	2432	2387	2387

This table reports the effect of PLA related business closure on GDP growth, which uses the sample from 1993–2005:

$$\Delta NTD_{c,t} = \alpha + \beta_1 PLA_c + \beta_2 Post_t + \gamma PLA_c \times Post_t + \Delta NTD_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

ΔNTD, the change of the nighttime daylight is used in Columns (1) to (4).$PLA_c$is a dummy variable set equal to 1 for cities whose PLA hospital score ranks top 25% and set to 0 otherwise.$Post_t$is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. We also control lagged dependent variable$y_{c,p,t-1}$, city fixed effects, and province × year fixed effects. Standard errors are clustered at the province and year level.

Table 6
Robustness III: ruling out potential biases.

	$\Delta lnGDP$			$\Delta lnGDP(Real)$		
	(1)	(2)	(3)	(4)	(5)	(6)
	Whole Sample	Drop Xinjiang	Drop Most Flooded Prov.	Whole Sample	Drop Xinjiang	Drop Most Flooded Prov.
PLA × *Post*	0.022***	0.022***	0.029***	0.021***	0.021***	0.028***
	(0.002)	(0.002)	(0.009)	(0.002)	(0.002)	(0.008)
Constant	0.227***	0.228***	0.229***	0.174***	0.175***	0.176***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Lag Y	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Province × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.696	0.696	0.694	0.614	0.614	0.614
Observations	2835	2809	2341	2835	2809	2341

This table reports the effect of PLA related business closure on GDP growth, which uses the matching sample from 1993–2005:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 PLA_c + \beta_2 Post_t + \gamma PLA_c \times Post_t + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

GDP growth is used in Columns (1) to (3) and Real GDP growth is used in Columns (4) to (6). In Columns (1) and (4), we paste the results fromTable 3; in Columns (2) and (5), we drop Xinjiang Autonomous Region; in Columns (3) and (6), we drop four most affected provinces by the flood in 1998, which are Jiangxi, Hunan, Hubei, and Heilongjiang.$PLA_c$is a dummy variable set equal to 1 for cities whose PLA hospital score ranks top 25% and set to 0 otherwise.$Post_t$ is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. We also control the lagged GDP growth, city fixed effects, and province × year fixed effects to absorb unobserved city characteristics and time-varying province-level variables. Standard errors are clustered at the province and year level.

matching sample to repeat our main regression to see if the result is unchanged.

Table 7 report the PSM-DID results. Columns (1) and (2) show that, before matching, there is a significant difference in the variable *Income*, indicating cities in the treated and the control group have a different average income, while after matching, no significant differences remain between two treated arms. Columns (4) and (5) report the regression results using the matching sample, where the estimated coefficient for the interaction term *PLA* × *Post* is still positive and significant at the 5% level. This indicates that our result are still robust even we consider the potential sample selection bias.

In short, our PSM-DID test shows that the previous main result is not due to sample selection bias.

Table 7
Robustness IV: propensity score matching - difference in differences method.

	Mean Difference		PSM-DID	
	(1) Pre	(2) Post	(4) $\Delta lnGDP$	(5) $\Delta lnGDP(Real)$
$PLA \times Post$			0.067**	0.035**
			(0.025)	(0.015)
Population	−53.360	14.030	0.000***	0.001***
			(0.000)	(0.000)
Income	−0.150***	0.012	0.058	0.023
			(0.088)	(0.052)
Education	−0.011	−0.006	1.318**	1.399***
			(0.554)	(0.436)
$\Delta lnGDP_{-1}$	0.022	−0.007	−0.135*	
			(0.065)	
$\Delta lnGDP(Real)_{-1}$	0.017	−0.009		−0.129
				(0.076)
City FE			Yes	Yes
Province × Year FE			Yes	Yes
R^2			0.787	0.730
Observations	200	104	1147	1168

This table reports the effect of PLA related business closure on GDP growth, which uses the matching sample from 1993–2005:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 PLA_c + \beta_2 Post_t + \gamma PLA_c \times Post_t + X_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

At the PSM stage, a cross-sectional Logit regression is employed using the sample in 1998:

$$PS_c = \alpha + \beta_1 Population_c + \beta_2 Income_c + \beta_3 Education_c + \beta_4 L.\Delta lnGDP_c + \varepsilon_c$$

and then a 1-to-1 matching is employed to determine the subsample.
At the DID stage, GDP growth is used in Column (4) and Real GDP growth is used in Column (5). PLA is a dummy variable set equal to 1 for cities whose PLA hospital score ranks top 25%, and o otherwise.$Post_t$*is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. Population is the population of a city, Income is the average income of a city, Education is the proportion of college and high school students in a city, and*ΔGDP_{-1}*is the city's last year GDP growth, all of which are based on year 1998. We also control GDP growth last year, city fixed effects, and province × year fixed effects. Standard errors are clustered at the province and year level.*

5.4.5. *Instrument variable method*

Last but not least, another potential source of bias that might affect our results is the endogeneity issue, for instance, whether the PLA related business in a city is correlated with a city's economy or characteristics, which could in turn affect future economic growth, or whether there are some unobserved contemporaneous factors in 1998 (for example, some other policy shocks), that might affect our result. Therefore As a final robustness check, we introduce additional instrument variables and employ an IV method based on that.

To be more specific, we introduce two instrument variables here. The first instrument *HQ*, is a dummy variable set to 1 for cities that are headquarters of seven military regions and major army, air-force, and navy troops. The establishment of these seven military regions can date back to 1985.[14] There is another set of instrument variables, from RBA_1 to RBA_4, which are the proportion of different grades of the historical Revolution Base Areas in one city, respectively.[22] These revolution base areas can be further dated back to the period of the Agrarian Revolutionary War in the 1920s and the War of Resistance Against Japanese Aggression in the 1930s.[23] We believe that the instruments we choose are predetermined before the year 1998 so they should be uncorrelated with unobserved contemporaneous factors in 1998.

We employ a two-stage least square method, and the results are reported in Table 8. Here we report both the original setting where we divide all the cities into treated group and control group and the continuous setting where we treat the PLA hospital score as a continuous treatment. At the first stage, *HQ* is significantly positive at the 1% level. *RBA* is less significant, but still all positive in terms of the sign. At the second stage, the IV estimate is still positive at the 5% level under both discrete and continuous settings. The IV method further improves the robustness of our main result, which shows that our main results are not driven by unobserved contemporaneous factors.

To conclude, we perform several robustness checks, including changing our measures of identifying the treated and control group and the dependent variable, as well as a PSM-DID method and an IV method. These tests further rule out some other potential stories

[22] According to the official standard, a county belongs to first grade RBA if it contains more than 90% RBA townships, second grade RBA if it contains 50–89% RBA townships, second grade RBA if it contains 10–49% RBA townships, and four grade RBA if it contains less than 10% RBA townships.

[23] Revolution Base Areas are constructed by the Communist Party of China during the period of the Agrarian Revolutionary War in the 1920s and the War of Resistance Against Japanese Aggression in the 1930s. In these areas, there is a political and military organization led by the Communist Party, along with a relatively independent regime system. Seehttp://www.zhongguolaoqu.com for more details.

Table 8
Robustness V: instrument variable method.

	First-stage		Second-stage			
	(1)	(2)	(3)	(4)	(5)	(6)
	PLA	*Score*	$\Delta lnGDP$		$\Delta lnGDP(Real)$	
$\widehat{PLA} \times Post$			0.085**		0.084**	
			(0.037)		(0.038)	
$\widehat{Score} \times Post$				1.233**		1.209**
				(0.519)		(0.531)
HQ	0.513***	0.034***				
	(0.072)	(0.004)				
RBA_1	0.143	0.009				
	(0.153)	(0.012)				
RBA_2	0.295*	0.022*				
	(0.164)	(0.011)				
RBA_3	0.006	0.005				
	(0.164)	(0.011)				
RBA_4	0.177	0.009				
	(0.131)	(0.008)				
Lag Y			Yes	Yes	Yes	Yes
City FE			Yes	Yes	Yes	Yes
Province × Year FE			Yes	Yes	Yes	Yes
R^2	0.202	0.170	0.697	0.697	0.615	0.615
Observations	286	286	2835	2835	2835	2835

This table reports the effect of PLA related business closure on GDP growth using the instrument variable method, which uses the sample from 1993–2005:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 \widehat{PLA}_c + \beta_2 Post_t + \gamma \widehat{PLA}_c \times Post_t + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 \widehat{Score}_c + \beta_2 Post_t + \gamma \widehat{Score}_c \times Post_t + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

where $\widehat{PLA}_c$ *and* $\widehat{Score}_c$ *are estimated by a cross-sectional regression using the sample in 1998:*

$$y_c = \alpha + \beta_1 HQ_c + \beta_2 RBA_1 + \beta_3 RBA_2 + \beta_4 RBA_3 + \beta_4 RBA_4 + \varepsilon_c$$

At the first stage, HQ is a dummy variable set equal to 1 for cities that are headquarters of seven military regions and major troops, RBA_1 *to* RBA_4 *are the proportion of different grades of revolution base areas in a city based on their areas, respectively. At the second stage, GDP growth is used in Columns (3) and (4) and Real GDP growth is used in Columns (5) to (6).* $\widehat{PLA}$ *and* $\widehat{Score}$ *are the estimated value from the first stage regression.* $Post_t$ *is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. We also control GDP growth last year, city fixed effects, and province × year fixed effects. We use robust standard errors at the first stage, and clustered standard errors at the province and year level at the second stage.*

Table 9
Heterogeneity test I: different effects on cities with different economic size.

	$\Delta lnGDP$		$\Delta lnGDP(Real)$	
	(1)	(2)	(3)	(4)
$PLA \times Post \times Med_{GDP}$	0.062***	0.016***	0.063**	0.018***
	(0.018)	(0.001)	(0.022)	(0.002)
$PLA \times Post$	−0.014	0.010***	−0.014	0.009**
	(0.010)	(0.003)	(0.010)	(0.003)
Lag Y	Yes	Yes	Yes	Yes
City FE		Yes		Yes
Province × Year FE		Yes		Yes
R^2	0.118	0.697	0.055	0.615
Observations	2890	2835	2890	2835

This table reports the effect of PLA related business closure on GDP growth, which uses the sample from 1993–2005:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 PLA_c \times Post_t + \beta_2 Post_t \times Med_c^{gdp} + \gamma PLA_c \times Post_t \times Med_c^{gdp} + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

GDP growth is used in Columns (1) to (2) and Real GDP growth is used in Columns (3) to (4). PLA_c *is a dummy variable set equal to 1 for cities whose PLA hospital score ranks top 25% and set to 0 otherwise.* $Post_t$ *is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise.* Med_c^{gdp} *is a dummy variable set equal to 1 for cities whose GDP in year 1998 ranks between 25 to 75% among all cities and 0 otherwise. We also control lagged dependent variable* $y_{c,p,t-1}$*, city fixed effects, and province × year fixed effects. Standard errors are clustered at the province and year level.*

and strengthen the validity of our result.

5.5. Heterogeneity tests

Having Known the positive effect of PLA related business closure on the local economy, our next step is to investigate which kind of cities will most benefit from that. Thus in this part, we further perform two heterogeneity tests.

Our first heterogeneity test focuses on the economic size of the cities. As we discuss before in the hypotheses part, we propose that the effect of PLA related business closure should be most prominent in median-sized cities, while in large and very small cities, the effect might be milder. Therefore we estimate the following equation:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 PLA_c \times Post_t + \beta_2 Post_t \times Med_c^{gdp} + \gamma PLA_c \times Post_t \times Med_c^{gdp} + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t} \quad (5)$$

where we sort all the cities based on their GDP level in the year 1998 and set Med_c^{gdp} equal to 1 for cities ranking between 25 to 75% and 0 otherwise.

Table 9 reports the results for both nominal and real GDP growth. The estimated coefficient in interest γ is positive and significant, which coincides with our hypothesis that median-sized cities in the treated group do exhibit higher GDP growth than other cities. This difference remains after we control city and province × year fixed effect. Although it might look somehow ambiguous at a first glance, we believe that the reason is the following. Compared with other cities, large cities have a relatively mature and complete economy and thus PLA related business might have less monopolistic power and rather play a less significant role. And thus the benefit from the closure is smaller compared with smaller cities. On the other hand, however, the positive effect in small-sized cities is also attenuated because PLA related business might only be one of the many factors that hinder the local economic growth. After PLA related business closure, there are still other issues remained and thus it is hard to witness a dramatic improvement in these small-sized cities.

Another heterogeneity test attempts to investigate the difference among cities with different proportions of secondary and tertiary sectors. Here we estimate the regression equation below:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 PLA_c \times Post_t + \beta_2 Post_t \times Low_c^{pri} + \gamma PLA_{c,p} \times Post_t \times Low_c^{pri} + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

where we sort all the cities according to their proportion of primary sector in the year 1998 and set Low_c^{pri} equal to 1 for cities ranking bottom 50% and 0 otherwise.

Table 10 reports the regression results. The interaction coefficient γ is positive and significant, meaning that cities in the treated group with a lower proportion of primary sector in 1998 will have higher subsequent GDP growth, both in nominal and real terms. Again, this result is still robust if we further include city and province × year effect. The intuition here is that PLA related business mainly focuses on secondary and tertiary sectors, it is obvious that after PLA related business closure, secondary and tertiary will benefit the most from this event. Thus for cities that rely heavily on the manufacturing and service industry, the benefit to the local economy must be more significant. That is the reason why we see a more significant and positive effect for these cities after PLA related businesses were closed down.

Table 10
Heterogeneity test II: different effects on cities with different reliance on secondary and tertiary sectors.

	$\Delta lnGDP$		$\Delta lnGDP(Real)$	
	(1)	(2)	(3)	(4)
$PLA \times Post \times Low_{pri}$	0.052**	0.038**	0.052**	0.038**
	(0.020)	(0.016)	(0.019)	(0.017)
$PLA \times Post$	−0.037*	−0.023	−0.037*	−0.024
	(0.020)	(0.018)	(0.017)	(0.018)
Lag Y	Yes	Yes	Yes	Yes
City FE		Yes		Yes
Province × Year FE		Yes		Yes
R^2	0.123	0.701	0.062	0.620
Observations	2890	2835	2890	2835

This table reports the effect of PLA related business closure on GDP growth, which uses the sample from 1993–2005:

$$\Delta lnGDP_{c,t} = \alpha + \beta_1 PLA_c \times Post_t + \beta_2 Post_t \times Low_c^{pri} + \gamma PLA_{c,p} \times Post_t \times Low_c^{pri} + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

GDP growth is used in Columns (1) to (2) and Real GDP growth is used in Columns (3) to (4).$PLA_c$is a dummy variable set equal to 1 for cities whose PLA hospital score ranks top 25% and set to 0 otherwise.$Post_t$is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise.$Low_c^{pri}$is a dummy variable set equal to 1 for cities whose proportion of primary sector in year 1998 ranks bottom 25% among all cities and 0 otherwise. We also control lagged dependent variable$y_{c,p,t-1}$, and province × year fixed effects. Standard errors are clustered at the province and year level.

5.6. Potential channels

As our final empirical exercise, we want to investigate how PLA related business closure comes into effect. Thus in this part, we attempt to propose and exploit some potential channels.

Our first proposed channel comes mainly through better performance of local firms, especially local private firms. As we introduce previously, one can regard PLA related enterprises as one special kind of SOEs. They enjoy even more privileges than typical SOEs and result in capital misallocation and market distortion. After PLA related business closures, other firms, especially most private firms will benefit from a more efficient and competitive market. They should thus have a better performance in subsequent periods.

To analyze whether our proposed channel holds, we use two indicators measuring the profitability of local enterprises as our dependent variables and still use the DID framework. The first indicator, $\Delta lnLEP_1$ is the growth of the number of local industrial firms. The second indicator, $\Delta lnLEP_2$ is the growth of the money amount of the profits of these firms, measured in EBITs.

Table 11 reports the results, where we control for lagged dependent variable, city and province × year fixed effect as before. One slight difference compared to previous analyses is that since these indicators are also correlated with the GDP growth of a city, we also control for lagged GDP growth. As Columns (1) and (2) show, the coefficient for the interaction term $PLA \times Post$ is positive and significant, indicating that cities in the treated group do experience higher growth in the number of local industrial firms. Columns (3) and (4) instead focus on the money amount of profits, and the result is mostly unchanged. Thus the results support our hypothesis that after PLA related business closure, compared with the control group, the cities in the treated group have more firms entering the market, and the firms also exhibit higher EBIT growth. This to some extent provides some evidence that the local economy becomes more efficient and competitive so that it promotes the development of local enterprises.

Our second potential channel focuses on foreign investments. As we mentioned in previous sections, PLA related business are frequently linked to corruption, smuggling, and other issues that damage the local economic environment. After PLA related business closure, the local economic environment becomes better gradually and it helps to attract foreign investments. To verify this, we use two indicators related to foreign investments as our dependent variable. They are $\Delta Fict_1$, an increase in the number of foreign investment contracts signed, and $\Delta Fict_2$, an increase in the money amount of foreign investment contracts signed. We still employ the previous DID framework and control for lagged dependent variable, lagged GDP growth, as well as city and province × year fixed effect.

Table 12 reports the results. The coefficients of the interaction term are still both positive and significant. Adding city and province × year fixed effect does not change our result. The result provides support for our hypothesis that cities in the treated group exhibit a higher increase in foreign investments than cities in the control group. To some extent, this indicates that cities in the treated group have a better local economic environment after PLA related business closure.

6. Conclusions and discussions

The event of PLA related business closure is one of the most influential economic and political events during the development of China in the 1990s. However, up to now little research focuses on this specific event and to the best of our knowledge, no research uses quantitative methods to analyze it. In this paper, we try to address this important event and use quantitative methods to investigate the effect of PLA related business closure on the local economy. To tackle the problem that most information related to our research is secret or vague, we first introduce a weighted PLA hospital score for each city as our proxy, then employ a DID framework to quantitatively analyze the effect of PLA related business.

Our empirical results show that, after PLA related business closure, cities in the treated group exhibit higher GDP growth than cities in the control group. This indicates that the closure does bring positive effects to the local economy. In terms of economic significance, on average cities in the treated group have about 2% higher GDP growth per year, both in nominal and real terms. This is relatively significant compared to our sample mean, 22% and 17%, respectively. Our DID strategy survives the parallel pre-trend test and the placebo test. Our results are also robust when we change measures to identify the treated and the control group, or when we perform a PSM and an IV test, which helps us rule out some other potential possibilities and confounders. We also find that this positive effect is more significant in cities with median economic-sized cities, and cities that rely more on secondary and tertiary sectors. Lastly, we attempt to investigate some potential channels of this effect. We find that cities in the treated group exhibit higher profit growth of local enterprises, as well as a higher increase in foreign investments. We thus infer that (1) after PLA related business closure, there is a more efficient and competitive market that promotes the development of local enterprises, especially private firms; (2) after PLA related business closure, the local economic environment becomes more foreign-investment-friendly so that it is more attractive to foreign investments.

In conclusion, we believe our results support that PLA related business closure brings positive effects to China's local economy. This policy later proved to be of great importance to the development of PLA and the whole China, which can be seen from a speech by President Jiang Zemin said in one unofficial conference,

> *"During my services as the President of China, I finished three important things⋯If mentioning other achievements, I will say it is that all military troops are not allowed to do business. This is very important to the fate of military troops."*[24]

To the best of our knowledge, this is the first paper that uses quantitative methods to investigate the event of PLA related business

[24] Jiang Zemin visiting the Second Academy of Sinomach, 2009,https://www.youtube.com/watch?v=lsZjnO4NwYw.

Table 11
Potential channels I: effects of PLA related business closure on the development of local enterprises.

	$\Delta lnLEP_1$		$\Delta lnLEP_2$	
	(1)	(2)	(3)	(4)
PLA × *Post*	0.027**	0.028**	0.074***	0.058**
	(0.011)	(0.012)	(0.017)	(0.019)
PLA	−0.039***		−0.039**	
	(0.010)		(0.012)	
Constant	0.093***	0.085***	0.067***	0.069***
	(0.009)	(0.010)	(0.008)	(0.012)
Lag Y	Yes	Yes	Yes	Yes
Lag GDP Growth	Yes	Yes	Yes	Yes
City FE		Yes		Yes
Province × Year FE	Yes	Yes	Yes	Yes
R^2	0.281	0.356	0.398	0.446
Observations	1945	1945	1869	1869

This table reports the effect of PLA related business closure on the increase of the profits of local enterprises, which uses the sample from 1993–2005:

$$\Delta lnLEP_{c,t} = \alpha + \beta_1 PLA_c + \beta_2 Post_t + \gamma PLA_c \times Post_t + \Delta lnLEP_{c,t-1} + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

The growth in the number of local industrial enterprises, $\Delta lnLEP_1$ *is used in Columns (1) to (2), and the growth of local industrial enterprises' profits,* $\Delta lnLEP_2$ *is used in Columns (3) to (4).* PLA_c *is a dummy variable set equal to 1 for cities whose PLA hospital score ranks top 25% and set to 0 otherwise.* $Post_t$ *is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. We also control lagged dependent variable* $y_{c,p,t-1}$*, lagged GDP growth, city fixed effects, and province × year fixed effects. Standard errors are clustered at the province and year level.*

Table 12
Potential channels II: effects of PLA related business closure on foreign investment.

	$\Delta Fict_1$		$\Delta Fict_2$	
	(1)	(2)	(3)	(4)
PLA × *Post*	0.413***	0.404**	0.990***	0.929***
	(0.129)	(0.141)	(0.238)	(0.249)
PLA	−0.373***		−0.314***	
	(0.114)		(0.088)	
Constant	−0.090***	−0.189***	0.233*	0.217***
	(0.013)	(0.035)	(0.109)	(0.069)
Lag Y	Yes	Yes	Yes	Yes
Lag GDP Growth	Yes	Yes	Yes	Yes
City FE		Yes		Yes
Province × Year FE	Yes	Yes	Yes	Yes
R^2	0.338	0.374	0.302	0.392
Observations	2399	2395	2406	2402

This table reports the effect of PLA related business closure on the increase of foreign investment, which uses the sample from 1993–2005:

$$\Delta Fict_{c,t} = \alpha + \beta_1 PLA_c + \beta_2 Post_t + \gamma PLA_c \times Post_t + \Delta Fict_{c,t-1} + \Delta lnGDP_{c,t-1} + \eta_{p,t} + \mu_c + \varepsilon_{c,t}$$

The increase in the number of foreign investment contracts signed, $\Delta Fict_1$ *is used in Columns (1) to (2), and the increase of money amount of foreign investment contracts signed,* $\Delta Fict_2$ *is used in Columns (3) to (4).* PLA_c *is a dummy variable set equal to 1 for cities whose PLA hospital score ranks top 25% and set to 0 otherwise.* $Post_t$ *is also a dummy variable set equal to 1 for years after 1998 and 0 otherwise. We also control lagged dependent variable* $y_{c,p,t-1}$*, lagged GDP growth, city fixed effects, and province × year fixed effects. Standard errors are clustered at the province and year level.*

closure. Our novel proxy, PLA hospital score, also sheds some light on future research. This might provide another plausible way of studying this important event.

However, we also have to admit that we only provide a very preliminary analysis on this huge event. Future research can continue investigating PLA related business closure and its impact from various directions.

First, due to limited data resources, we can only perform empirical tests at the city level. We believe if there is enough firm-level data in the 1990s, researchers can have a more detailed analysis to reveal individual firm behaviors after PLA related business closure. This can provide more evidence of how this event comes into effect to individual firms. Second, more detailed heterogeneity tests can be conducted. For instance, one can focus on the difference between coastal cities and inland cities, since coastal cities may suffer more from rampant smuggling activities, and thus they might benefit more from PLA related business closure. Third, as we mention in the paper, PLA related business closure might have both short-term and long-term effects, are there any ways to distinguish two different effects, so that one can better explain the somewhat surprising finding that the effect is negative first but turns positive? We believe answering these questions can give us a more comprehensive view on this far-reaching event.

Data availability

Data will be made available on request.

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