

# VAT Reform, Regional Ownership Structure, and Industrial Upgrading

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# VAT Reform, Regional Ownership Structure, and Industrial Upgrading: Evidence From Firms in Northeast China

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Junguo Shi<sup>1</sup> , Xinyi Yuan<sup>2</sup> , Bert M. Sadowski<sup>3</sup>, Kou Kou<sup>4</sup>,  
 Xuhua Hu<sup>1</sup>, Sihan Li<sup>5</sup>, and Shanshan Dou<sup>6</sup> 

## Abstract

We estimate the extent of the moderating effect of varying regional ownership structures on the relationship between the VAT reform and industrial upgrading in a panel differences-in-differences framework, using a natural experiment of the China's 2004 value-added tax (VAT) reform pilot that introduces a permanent 17%-tax credit for fixed investment in six industries in the North-eastern regions. Results reveal that the VAT reform helps firms increase their capital-to-labor ratio, labor input, and labor productivity, indicating the positive effect of VAT reform on fixed asset renewal and industrial structure upgrading in the region. As for the role of regional ownership structure, the positive effects of the VAT reform on labor input and labor productivity are significantly suppressed in areas with large market shares of state-owned enterprises. In another words, the VAT reform significantly promotes industrial upgrading in areas with market-sensitive economies.

## Keywords

VAT reform, regional ownership structure, industrial upgrading, DID estimator, Northeast China

## Introduction

Within the discussion on the effects of tax reforms on industry structure (e.g., Cai & Harrison, 2021), research has rarely focused on the regional ownership structure and the changes in labor input of companies operating in an heterogenous industry structure in China. Conventionally, it has been assumed that the market generally determines the law of industrial structure evolution. However, in reality, governments will consciously to accelerate industrial upgrading through appropriate fiscal policies to meet the needs of economic development strategies. An effective policy tool to affect company growth has been via taxation policies. Tax reforms can alleviate government burden and reduce the possibility of “picking losers” (Dechezleprêtre et al., 2016), thus are more market-friendly and have become more widespread for accelerating R&D investment in numerous countries (Boeters et al., 2010; Kosonen, 2015; Manente & Zanette, 2010; OECD, 2014), including China (e.g., Jia & Ma, 2017; Lin, 2008; Sun et al., 2020; Yang, 2016). In 2004, the Chinese Ministry of Finance and the State Administration of Taxation issued the regulation on certain issues concerning the expansion of the scope of VAT deduction in the Northeast region (Finance and Tax [2004] No. 156). As a value-added tax (VAT) can provide advantages to firms, a taxation reform has

been an effective tool in promoting industrial transformation and upgrading (Keen & Lockwood, 2010). This regulation allows firms qualifying for such tax relief to deduct the input tax of new purchases of fixed assets, such as machinery and equipment in certain industries in Heilongjiang, Jilin and Liaoning Provinces (the main part of Northeast China). After a successful implementation in the pilot stage, the central government officially extended the VAT reform across the country on January 1, 2009. This event also marked the formal shift from production-based to consumption-based VAT in China. Consequently, the effects of the VAT reform and the factors influencing its effectiveness have attracted considerable scholarly attention (e.g., Jia & Ma, 2017; Lin, 2008; Sun et al., 2020; Yang, 2016).

<sup>1</sup>Jiangsu University, Zhenjiang, China

<sup>2</sup>Universidad Carlos III de Madrid, Spain

<sup>3</sup>Eindhoven University of Technology, The Netherlands

<sup>4</sup>Beijing Foreign Studies University, China

<sup>5</sup>Polytechnic University of Valencia, Spain

<sup>6</sup>Inha University, Incheon, Korea

## Corresponding Author:

Shanshan Dou, Inha University 100 Inha-Ro, Michuhol-Gu, Incheon 22212, Korea.

Email: [shansdou@outlook.com](mailto:shansdou@outlook.com)



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With its traditional industrial base, Northeast China has a serious historical path-dependency problem with a large share of state-owned enterprises (SOEs; P. Zhang, 2008). The reform of SOEs as a crucial part of the strategy was aimed at revitalizing the region and has attracted much attention in the literature. Many studies have compared the effect differences of the VAT reform across different forms of ownership, demonstrating that its effects are likely to be differently distributed between SOEs and private firms (e.g., Jia & Ma, 2017; Liu & Lu, 2015; L. Zhang et al., 2018). Given that SOEs bear more soft budget constraints and cannot provide cash support for the large investment expenditures triggered by the tax relief, the VAT reform provided fewer incentives to these firms. By contrast, non-SOEs have large cash flows and can provide timely feedback in response to policy incentives and are therefore more sensitive to the VAT reform (L. Zhang et al., 2018). However, most studies have examined the effects of policy incentives at the firm level and failed to consider the determinants of regional differences. The reform process and the role of SOEs differ a lot across regions, so their proportion also varies greatly. Improving the effectiveness and precision of macro-fiscal policy requires targeted regulation for different regions. In this context, the research question addressed in this paper is whether the tax reform and regional ownership structure has an effect on company growth in different industries in China. In particular, we study to what extent tax policies had an impact on capital-labor ratio, labor input, and labor productivity in these companies. As industries in China have for historical reasons a different structure based on a variety of ownership forms, we will control for the role of state-owned enterprises in effecting company growth which has recently received some attention in the literature (Shi et al., 2020).

To answer this research question, we utilized the Annual Report of Industrial Enterprise (ASIF) Statistics database and the so-called DID method. This firm-level database contains ownership information which can help us to distinguish between SOEs and non-SOEs (Shi et al., 2020). To test the effect of VAT reform by difference-in-difference (DID) method, scholars mainly used the dataset of firms in the whole country (e.g., Cai & Harrison, 2021; Howell, 2016; Liu & Lu, 2015). By treating those companies in the Northeast region as the treatment group and the rest of the country as the control group, they dismissed a series of economic reforms in other regions accompanying the VAT reform in Northern China (e.g., the Western Development Plan, the Plan to Encourage the Development of the Eastern Region and the Central Rising Plan). Hence, they could not accurately observe the effects of the VAT reform. Considering that the VAT reform has been implemented nationwide since 2009, and the reformed industries have been expanded accordingly, in the present study, we set the examination period from 2000 to 2008 and discuss the effectiveness of the VAT reform in terms of industrial upgrading using a dataset of manufacturing firms in Northeast China. Due to the

available data, we have been able to examine the effects of the tax reform on a range of variables addressing company growth such as capital-to-labor ratio or labor productivity of firms which allows to provide more in-depth results on this relationship. This is the first contribution of this paper from the statistical point of view, we use a control group in the DID procedure, which should not be influenced by other relevant policies.

The second contribution of this study is to provide a theoretical reference for an in-depth understanding of the moderating effect of varying regional ownership structures on the relationship between the VAT reform and industrial upgrading in the North-eastern regions. Most studies examine the effects of policy incentives at the firm level and fail to consider the determinants of regional differences. As far as we know, this paper is the first endeavor to examine the regional ownership structure, calculating the share of SOEs in each region. This will add new insights to understand the development of Northeast revitalization of China and the supply-side structural reform like VAT reform. The study shows that the positive effects of the VAT reform on labor input and labor productivity are significantly suppressed in areas with large market shares of state-owned enterprises. In another words, the VAT reform significantly promotes industrial upgrading in areas with market-sensitive industry structures. This result contributes to the understanding of how institutional structure at regional level interacts with the R&D tax incentive policy.

The reminder of the paper is organized as follows. Section 2 provides background information on VAT reform in China. Section 3 describes the data set and statistic description. Section 4 presents the main results and conclusion and discussion are present in section 5.

## Background and Research Hypothesis

### *VAT Reform in Northeast China*

The value added tax (VAT) has been a commonly adopted as a type of taxation in a variety of country across the world. Due to low administration cost and minor market distortions, more than 130 countries have chosen VAT regimes and raised an estimated 20% of their tax revenues on average based on their respective tax regime (e.g., Liu & Lu, 2015; Zhang et al., 2018). China has introduced the VAT reform in all sectors since 1994 with a standard rate of 17%, a reduced rate of 13%, and a zero rate for exports. It has since its introduction been the main source of government tax revenue.

However, before the 2004 VAT reform, China's VAT differed from the normal consumption type of VAT in other nations. In this framework, firm's fixed assets were taxed twice: first as final products to their producers and second as intermediate inputs to their users. This kind of so-called production type VAT was regarded as a tool for Chinese government to increase tax payment and confined a firm's

investment in fixed assets. With the stable growth of taxation, policy makers began to become concerned about these hindrances to investment due to these double levies.

On September 12, 2004, it was formally announced that the Chinese government would impose VAT reform in six relevant industries (i.e., equipment manufacturing, petroleum and chemical manufacturing, metallurgy, ship building, automobile manufacturing, and agricultural product processing industries) in three Northeastern provinces (i.e., Liaoning, Jilin, and Heilongjiang). This was the first time in Chinese industrial history that taxation was shifted from the former production type VAT to the typical consumption type VAT. With this new model, VAT could be deducted from the tax base when buying fixed assets, which was aimed at causing a significant reduction of firm budgets related to fixed assets (e.g., by 13%–17%). Finally, in January 2009, this consumption type of VAT policy was implemented nationwide in all industries including mining, manufacturing, and electricity and utility sectors to act as a stimulus against the backdrop of the emerging global economic crisis.

The VAT reform eliminated double taxation and reduced the cost of fixed assets purchased by firms. Hence, it facilitated incentive for firms to expand their scale of investment in fixed assets, to eliminate backward production capacity, to accelerate the renewal of production lines, to make up for production capacity deficiencies as well as to increase productivity and product quality (Howell, 2016; Lin, 2008; Liu & Lu, 2015). The effect of the VAT reform on labor input was intended to lead to two major effects: the substitution effect and the output effect. The substitution effect indicated that the VAT reform was aimed at reducing the tax burden amongst firms if they wanted to acquire fixed assets, resulting in higher labor costs compared to capital costs. Consequently, firms were able to replace labor with capital and reduce labor input. The output effect that would encourage firms to lower production costs, to stimulate their production and investment behavior, to expand the demand for capital and labor, and to increased employment opportunities. These two effects were considered as mutually exclusive, so it became necessary to study their joint influence on labor input. From the discussion, we derived the following hypothesis:

Hypothesis 1: VAT reform can promote industrial upgrading of each region.

### *The Role of Regional Ownership Structure*

Extant research evidently points out that there remain noticeable regional differences in the industrial structure in terms of productivity growth, new firm creation, and so on (e.g., Armington & Acs, 2002; Chen, 2007; Ganau & Rodríguez-Pose, 2019; Giacinto & Nuzzo, 2006). These studies have stimulated research into regional determinants of industrial upgrading. As firm behavior is shaped by

routines in each region. Different firms from different regions would have a different response to industrial policy owing to their regional innovation regime and the institutional structure. As SOEs have shown an ability to efficiently adapt in specific ways to the needs in a particular location or specific industry, they have been able to survive and even prosper (Bruton et al., 2015). SOEs might even be crucial to regional growth and the establishment of new enterprises in lagging regions.

In recent decades, China has developed a very specific type of market economy characterized by government control alongside the arrival of a private sector comprising of Chinese indigenous firms and foreign-funded companies (Shi et al., 2020). In parallel to the emerging private sector, the Chinese government has also supported and even boosted its state sector, changing the industry structure from a traditional state-owned economy to a market economy. Private firms are allowed to operate in an unrestricted market environment, although the state has been very active in the economy with respect to undertaking a variety of economic activities.

With its traditional industrial base, Northeast China has a serious historical path-dependency problem with a large share of state-owned enterprises (SOEs) contributing to the industry (P. Zhang, 2008). The reform of SOEs has been a crucially important to stimulate growth in different regions. Many studies have compared the differences in the effects of the VAT reform across different forms of ownership, demonstrating that its effects are likely to be heterogeneous in industries where there are SOEs and private firms (e.g., Jia & Ma, 2017; Liu & Lu, 2015; L. Zhang et al., 2018). Given that SOEs bear more soft budget constraints and cannot provide cash support for the large investment expenditures triggered by the tax relief, the VAT reform provides fewer incentives to these firms. By contrast, non-SOEs have larger cash flows and can provide timely feedback in response to policy incentives and are therefore more sensitive to the VAT reform (L. Zhang et al., 2018). However, most studies examine the effects of policy incentives at the firm level and fail to consider the determinants of regional differences. The reform process and the role of SOEs differ a lot across regions, so their impact also varies. Research has revealed that SOEs tend to be more active in terms of innovation decision and R&D investment but are less efficient in term of innovation output and labor productivity (e.g., Shi et al., 2020). Different from SOEs, private companies always face budget constraints and capital restrictions. The shift in the VAT reform from production-based to consumption-based would save a lot of costs to firms. Several recent contributions using natural experiments have shown that a reduction of a firms' financial constraints promotes its investment and innovation activities (e.g., Amore et al., 2013). By linking VAT reform in Northeast China, firms would response slowly to this VAT reform in cities with higher SOEs shares, like Anshan city. However, the VAT reform can significantly



promote industrial upgrading in areas with market-sensitive economies with capital change and new recruitment. Therefore, the following hypothesis can be formulated:

Hypothesis 2: The share of state-owned companies negatively moderates the relationship between VAT reform and industrial upgrading.

## Data, Model, and Variables

### Data

The VAT reform in Northeast China has an obvious exogenous nature, as the treatment and control groups are a random selection of firms. This exogenous selection can well avoid the endogeneity problem of the sample grouping, so it can be considered a “natural experiment” (Rosenzweig & Wolpin, 2000). In this study, we examined the effect of the VAT reform on industrial upgrading on the basis of this natural experiment. We used a difference-in-difference (DID) method to construct a dual difference statistic reflecting the effect of the policy for the comparison of the difference between the control and treatment groups before and after the policy implementation. Considering that the VAT reform was piloted in Northeast China in 2004 and extended nationwide in 2009 with the industry scope expanded, we chose the data of firms from 2000 to 2008. Unlike most existing studies that used data of manufacturing firms in the whole country as a sample, we only selected firms located in Northeast China as our sample. The DID method assumes that the control group should not be able to undergo other experimental treatments. However, similar studies still used firms outside the region as a control group, ignoring the other relevant fiscal policies adopted in the other provinces or regions during the initial implementation of the VAT reform. The assessment of policy effects might be significantly reduced or even erroneous if the control group adopted other kinds of policy treatment. To avoid this statistical error, we only selected manufacturing firms in Northeast China as our sample. In this way, the industries that experienced the VAT reform are the treatment group, and those outside the region are the control group. The tax reform in Northeast China focused on the VAT reform during this period, allowing for a credible assessment of the policy effects.

We use the well-accepted Chinese Industrial Enterprise Database to examine the effect of VAT in Northeast China. Following existing studies (e.g., Shi et al., 2020) we defined inclusion criteria to ensure the reliability of the study results. Specifically, we omitted sample observations with (i) missing indicators, (ii) less than eight employees, and (iii) outliers in main financial indicators, such as total assets were less than net fixed assets. Moreover, given the revision of the National Economic Classification of Industries in 2002, the industry codes have been uniformly adjusted to the 2002 version (GB/T 4754-2002). Accordingly, we also matched some

data manually following the main business products at the four-digit level sector. Finally, we checked missing or wrong city codes in the dataset (such as writing the city code as the province code).

### Regression Model

In this study, we used the DID method. We regarded the industries under the VAT reform during the pilot implementation as the treatment group and the remaining industries as the control group.  $VAT$  is a dummy variable for whether the firm participated in the VAT reform initial implementation, which is an interaction term between the treatment group and the event year,  $treat_{i,t} * year_i$ . The variable  $treat_{i,t}$  is a dummy variable indicating whether the firm is in a pilot industry and depicts the difference between the treatment and control groups if the VAT reform does not exist. It takes a value of 1 if the firm is in a pilot industry; otherwise, it is equal to 0. The variable  $year_i$  has been used as a dummy variable indicating whether the firm is in a pre or post-reform period and portrays the difference between the pre and the post-reform period. It takes a value of 1 if the firm is in the post-reform period; otherwise, it is equal to 0. Given that we omitted the effect of the “pre-reform difference” between the treatment and control groups, the interaction term ( $treat_{i,t} * year_i$ ) is an accurate measure of the net effect of the policy on the treatment group. Thus,  $VAT_{i,t} = 1$  denotes the dual characteristic that the firm is in the post-reform period and in the pilot industry. The pilot industries include machine and equipment manufacturing, petroleum, chemical and pharmaceutical manufacturing, ferrous and non-ferrous metallurgy, shipbuilding, automobile manufacturing, and agricultural product processing.

The panel DID model is characterized as follows:

$$VAT_{i,t} = treat_{i,t} * year_i$$

$$Y_{i,t} = \beta_0 + \beta_1 VAT_{i,t} + \beta_2 SOE_{i,t} + \beta_3 VAT_{i,t} * SOE_{i,t} + \beta_4 X_{i,t} + \varepsilon_{i,t},$$

where  $Y_{i,t}$  denotes the dependent variable of industrial upgrading, expressed using capital-to-labor ratio, number of employees, and labor productivity.  $SOE_{i,t}$  is a proxy variable for regional ownership structure, indicating the market share of SOEs in each region.  $X_{i,t}$  represents the set of control variables, including year, industry, province, firm age, ownership, and involvement in exporting activities.  $\varepsilon_{i,t}$  is a random perturbation term.

### Variable Selection and Description

**Dependent variables.** Fixed asset development and technological innovation promote capital accumulation and technological progress, improving productivity and increase output. The ensuing substitution and output effects may affect the labor input of firms, resulting in changes in the

capital-to-labor ratio as well as the labor productivity leading to industrial upgrading. Therefore, we selected the capital-to-labor ratio ( $LC$ ), the number of employees ( $\ln L$ ), and the labor productivity ( $LP$ ) as indicators to measure the effect of industrial upgrading. Specifically,  $LC$  is expressed as fixed assets divided by the number of employees.  $\ln L$  is the number of employees, which uses the logarithm format to control heterogeneity.  $LP$  is the ratio of gross industrial output over the number of employees.

**Explanatory variables.** The explanatory variables are VAT and SOE. VAT is a dummy variable that can take the value of 1 if the firm has carried out the VAT reform and 0 otherwise. SOE is the share of sales of SOEs in the region where the firm is located, reflecting regional ownership structure. To examine the effect of regional ownership structure on the VAT reform, we included an interaction term  $VAT \times SOE$  to indicate the relationship between the VAT reform and regional ownership structure.

**Control variables.** We also considered variables that have a great effect on firm behavior like Year, Industry, Province,  $\ln Age$  (age of the firm), Ownership, and Export.

### Descriptive Statistics

We separated our sample into treatment and control groups based on whether or not they participated in the reform. Table 1 shows the summary statistics for the main variables. The treatment group had a significantly higher average level of labor productivity than the control group, as well as slightly higher numbers for the capital-to-labor ratio, the

number of employees, and the share of firms engaged in import/export activities, but it also had a slightly lower market share of SOEs and a slightly younger firm age. Table 2 presents the comparison of the explanatory variables in the treatment group before and after the reform. The capital-to-labor ratio and labor productivity in the treatment group improved more than before the reform, especially labor productivity. The number of employees, on the other hand, was decreased.

We also conducted a correlation coefficient analysis of the variables. No significant collinearity exists between the variables, as shown in Table 3.

## Empirical Results

### Basic Regression Results

Table 4 shows the basic regression results of the effects of the VAT reform, regional ownership structure, and on industrial upgrading, where the dependent variables of models (1) to (3) are the capital-to-labor ratio ( $LC$ ), the number of employees ( $\ln L$ ), and the labor productivity ( $LP$ ), respectively. Models (4) to (6) include all the dependent variables in models (1) to (3) and an additional interaction term,  $VAT \times SOE$ , between the VAT reform and regional ownership structure.

In Models (1) and (4),  $LC$  has a positively and significantly linked to  $VAT$ , indicating that the VAT reform increases the capital-to-labor ratio. The positive effect on capital-to-labor ratio reveals that the VAT reform boosts the scale of fixed assets investment and raises the organic composition of company capital, contributing to industrial upgrading. However, the coefficient of  $SOE$  is not significant, indicating

**Table 1.** Statistics for Main Variables.

Variables	Treatment group (N= 103,828)				Control group (N= 19,962)			
	M	SD	Minimum	Maximum	M	SD	Minimum	Maximum
$LC$	130.6	320.9	0.00237	24,825	123.0	251.7	0.0135	14,153
$\ln L$	4.603	1.201	2.197	11.99	4.527	1.094	2.197	9.512
$LP$	480.9	988.9	0.0114	53,237	390.2	979.0	0.0200	60,157
$SOE$	0.185	0.181	0.00154	0.923	0.202	0.199	0.00154	0.923
$\ln Age$	2.020	0.841	0.693	4.868	2.121	0.903	0.693	5.030
Export	0.180	0.384	0	1	0.132	0.339	0	1

**Table 2.** Comparison for the Treatment Group Pre- and Post-Reform.

Variables	Pre-reform (N= 29,343)				Post-reform (N= 63,315)			
	M	SD	Minimum	Maximum	M	SD	Minimum	Maximum
$LC$	96.60	236.3	0.00395	21,280	149.3	344.0	0.00237	24,825
$\ln L$	4.987	1.253	2.197	11.99	4.423	1.128	2.197	11.68
$LP$	225.9	449.6	0.0175	19,122	620.2	1174	0.100	53,237

**Table 3.** Correlation Coefficient Matrix of the Main Variables.

Variables	LC	InL	LP	VAT	SOE	InAge	Export
LC	1						
InL	-0.0499*	1					
LP	0.2903*	-0.1644*	1				
VAT	0.0687*	-0.1624*	0.1583*	1			
SOE	-0.0408*	0.1215*	-0.1073*	-0.3682*	1		
InAge	-0.0461*	0.2475*	-0.0989*	-0.1646*	0.1391*	1	
Export	0.0034	0.2544*	-0.0146*	-0.0187*	-0.0292*	0.0428*	1

\* is added to correlations significant at 1% level after Bonferroni adjustment.

**Table 4.** Basic Regression Results.

Dependent variable	(1) LC	(2) InL	(3) LP	(4) LC	(5) InL	(6) LP
VAT	10.628** (4.847)	0.043*** (0.011)	70.221*** (15.861)	10.471** (5.080)	0.063*** (0.012)	94.748*** (16.609)
SOE	1.270 (6.875)	0.041** (0.018)	-22.568 (21.772)	0.731 (8.658)	0.108*** (0.022)	62.509** (27.696)
VAT × SOE				1.071 (10.452)	-0.130*** (0.024)	-169.744*** (34.166)
InAge	-11.202*** (1.364)	0.160*** (0.004)	-26.091*** (4.323)	-11.201*** (1.364)	0.160*** (0.004)	-26.224*** (4.323)
Export	-7.171** (3.116)	0.251*** (0.008)	-22.526** (10.052)	-7.172** (3.116)	0.251*** (0.008)	-22.362** (10.051)
Ownership	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Province	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Year	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Industry	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
_cons	126.988*** (7.369)	4.132*** (0.022)	360.740*** (23.132)	127.209*** (7.673)	4.105*** (0.022)	326.022*** (24.162)
R <sup>2</sup>	.035	.174	.087	.035	.174	.087
N	110,302	110,302	110,302	110,302	110,302	110,302

Note. Standard errors in parentheses.

\* $p < .1$ . \*\* $p < .05$ . \*\*\* $p < .01$ .

that the effect of regional ownership structure on capital-to-labor ratio is not evident. The explanation for this might be that fixed assets have a long useful life and a high unit value, and the acquisition of these resources is limited by the scale of firm production. Firms often choose their personnel numbers based on productivity and operations. As a result, the capital-to-labor ratio is mostly determined by the firm's specific circumstances. The firm's flexibility to adjust its fixed asset structure and staff structure is unaffected by the broader environment of the region in which it is based. The coefficient of  $VAT \times SOE$  in Model (4) is also not significant, indicating that we did not find any evidence to show that the regional ownership structure moderates the effect of the VAT reform on the capital-to-labor ratio.

The regression results of Models (2) and (5) show that the coefficients of  $VAT$  are positive and significant at the .01 level. The VAT reform significantly increases the number of employees in firms, and its output effect on labor input is greater than the substitution effect. Firms increase the use of fixed assets and labor simultaneously without completely replacing labor with capital. Similarly, the coefficient of  $SOE$  is positive and significant, indicating that areas with a high proportion of SOEs employ relatively more employees. The reason for this is that SOEs are key enterprises in several

regions of Northeast China, and other firms have emerged to serve the SOEs. The latter enterprises provide services for the livelihood of SOE employees and offer local jobs but generally suffer from labor redundancy. However, the coefficient of  $VAT \times SOE$  in Model (5) is negative and significant at the .01 level, indicating that the regional ownership structure plays a significantly negative moderating role on the effect of the VAT reform. The market share of SOEs inhibits the effect of the VAT reform on the labor input of firms. Thus, the over-representation of SOEs is not conducive to the VAT reform's goal of expanding regional employment demand.

Industrial upgrading is further reflected in the increase in the productivity of firms. The coefficient of  $VAT$  is positively correlated at .01 significant level, as shown by the results of Models (3) and (6). Hence, the VAT reform significantly increases labor productivity. It stimulates firms to eliminate backward production capacity and increase the proportion of advanced technology equipment. At the same time, the reduced tax burden of firms increases their free cash flow. It also stimulates these firms to increase their investment in R&D and promotes technological progress, which is the main driving force of economic growth and means stronger product competitiveness and higher firm productivity. Yet,

**Table 5.** Parallel Trend Test Results.

Dependent variable	(1) LC	(2) lnL	(3) LP
VAT	34.275*** (9.791)	0.065*** (0.020)	109.809*** (30.775)
SOE	-14.056 (9.304)	0.100*** (0.019)	65.073** (29.243)
<i>Treat</i> × <i>year2001</i>	8.956 (9.371)	-0.025 (0.019)	11.123 (29.454)
<i>Treat</i> × <i>year2002</i>	10.119 (9.585)	-0.016 (0.019)	6.360 (30.125)
<i>Treat</i> × <i>year2003</i>	11.996 (9.870)	-0.009 (0.020)	20.797 (31.021)
<i>Treat</i> × <i>year2004</i>	-26.562*** (7.599)	-0.056*** (0.015)	-60.262** (23.883)
<i>Treat</i> × <i>year2005</i>	-12.440* (7.283)	-0.052*** (0.015)	-16.515 (22.890)
<i>Treat</i> × <i>year2006</i>	-15.968** (6.745)	-0.027** (0.014)	-37.354* (21.200)
<i>Treat</i> × <i>year2007</i>	-8.449 (6.325)	-0.011 (0.013)	1.457 (19.881)
lnAge	-2.101 (2.082)	0.088*** (0.004)	39.724*** (6.544)
Export	-12.915*** (3.734)	0.111*** (0.008)	19.030 (11.737)
Ownership	Controlled	Controlled	Controlled
Province	Controlled	Controlled	Controlled
Year	Controlled	Controlled	Controlled
Industry	Controlled	Controlled	Controlled
_cons	77.987*** (22.895)	4.555*** (0.046)	153.366** (71.960)
R <sup>2</sup>	.014	.029	.054
N	123,713	123,713	123,713

Note. Standard errors in parentheses.

\* $p < .1$ . \*\* $p < .05$ . \*\*\* $p < .01$ .

the most direct effect of the VAT reform is related to the stimulation of investment. The expansion of the amount of investment creates favorable conditions for the realization of economies of scale and lays a foundation for the improvement in productivity. The negative and significant coefficient of  $VAT \times SOE$  in Model (6) indicates that the effect of the VAT reform is reduced in areas with a relatively large share of SOEs. Given the rigid system with a lack of dynamism and the uniform pay incentive mechanism formed by SOEs over the years, low productivity due to the redundancy of employees and labor inefficiency seems to persist. Considering that the substitution effect of the VAT reform may bring new risks to social employment, SOEs may assume part of the responsibility of alleviating unemployment, leading to more rigid layoffs amongst SOE employees than those of other types of firms. Consequently, the redundancy of employees may be more serious, with a larger actual level of employment than the real employment demand leading actually to a reduction in labor productivity.

The VAT reform has aided industrial upgrading by encouraging businesses to upgrade their fixed assets by lowering the tax burden on equipment investment, boosting technical innovation, increasing production, enhancing productivity, and generate employment. The regression results in models (1) to (6) show that the coefficients of  $VAT$  are all positive and significant. The VAT reform has a positive effect in revitalizing the traditional industrial base of Northeast China and achieving industrial restructuring. The coefficients of  $VAT \times SOE$  in models (5) and (6), on the other hand, are negative and significant. In comparison to other enterprises, the

SOE system is less sensitive to policy due to its intrinsic uniqueness. SOEs have a lot of economic and social obligations, and their ability to change production factors on their own is restricted. As a result, regions with larger market shares of SOEs are less efficient in taking advantage of the VAT reform's chance to optimize industrial structure than regions where these industries are highly sensitive to market fluctuations.

### Parallel Trend Test

The parallel trend assumption is employed in the DID approach to determine if the treatment and control groups had a consistent evolutionary trend before the policy was implemented in 2004. We conducted a parallel trend test to exclude the possibility that the policy effect might be caused by the differences between the treatment group and the control group prior to the policy implementation. Specifically, we defined an interaction term between the dummy variables of each year and the variable *treat* and added it to the regression models. If the estimated interaction coefficients between the dummy variables and *treat* in each year prior to the VAT reform implementation are not significant, then the parallel trend assumption is valid. The estimated coefficients of  $treat \times year2001$ ,  $treat \times year2002$ , and  $treat \times year2003$  are not significant in these models, as shown in Table 5. Thus, no significant difference exists between the treatment group and the control group in terms of the capital-to-labor ratio, the number of employees, and labor productivity prior to the



**Table 6.** Placebo Test Results.

Dependent variable	(1) LC	(2) InL	(3) nLP
VAT	-3.756 (6.500)	-0.012 (0.023)	32.356 (20.393)
SOE	3.165 (5.292)	0.045** (0.019)	-82.016*** (16.604)
InAge	-13.117*** (1.102)	0.272*** (0.004)	-55.096*** (3.458)
Export	-4.885* (2.637)	0.803*** (0.009)	-40.035*** (8.273)
Ownership	Controlled	Controlled	Controlled
Province	Controlled	Controlled	Controlled
Year	Controlled	Controlled	Controlled
Industry	Controlled	Controlled	Controlled
_cons	139.589*** (6.073)	3.939*** (0.021)	452.393*** (19.054)
R <sup>2</sup>	.034	.198	.092
N	123,713	123,713	123,713

Note. Standard errors in parentheses.

\* $p < .1$ . \*\* $p < .05$ . \*\*\* $p < .01$ .

VAT reform implementation, indicating that the sample fits the parallel trend assumption.

### Placebo Test

We performed a placebo test, following Topalova (2010), by utilizing a fictitious date for the VAT policy. We carried out a regression analysis, assuming that the VAT reform took place in 2002. When the coefficients are similar to those estimated with the actual pre- and post-reform data, the estimates are likely to be biased. The reason is that the conclusions can still be consistent with the basic regression even if we used the year in which the policy did not occur. In this case, the effect of industrial upgrading may not be affected by the VAT reform but by other policy changes or random factors. The estimated coefficients after the change of policy year are not significant, as shown in Table 6. This finding is inconsistent with the results of the basic regression, indicating that the findings in Table 4 are reliable. The VAT reform can increase the capital-to-labor ratio, the number of employees, and labor productivity of firms.

### Discussion and Conclusion

As the paper has demonstrated, the VAT reform has played a crucial role in increasing labor productivity of companies and encouraged firms to upgrade their fixed assets by reducing their tax burden on investment in equipment. With respect to regional ownership structures characterized by a number of traditional SOEs, these effects are prevalent even if they are smaller. Therefore, the VAT reform policy has been important in the development and progress of Chinese firms and the transformation of the industrial structure and economic growth. Hence, it is a policy initiative which provided many advantages to firms promoting further reforms of the national tax system. In this study, we explored the effect of the VAT reform on industrial upgrading. Then, we

examined the mechanism of regional ownership structure using the data of manufacturing firms in Northeast China from 2000 to 2008 through the “natural experiment” of the VAT reform taking place in 2004. Our findings have been as follows: the VAT reform significantly improves the capital-to-labor ratio, labor input, and labor productivity of firms. The reform has also aided the renewal of fixed assets and the upgrading of the region’s industrial structure. The VAT reform’s output effect on labor input was larger than the substitution effect, resulting in an increase in local employment. On the one hand, there has been a positive effect on labor input and labor productivity, which is significantly suppressed in areas with a large market share of SOEs due to the institutional characteristics of these firms. On the other hand, the more sensitive the industry was to market changes, the more industrial upgrading impacts may be identified.

Theoretically, this study contributes to the literature in the following ways: (i) It allowed to determine whether the VAT reform in China promoted industrial upgrading under different forms of regional ownership structure. Until recently just a few studies have focused on the role of ownership structure on tax reform without addressing the regional aspect of the industry. Moreover, comparisons of differences in the VAT reform across firms with a different ownership type have rarely been undertaken. Thus, the differences in ownership structures across varying regions required further investigation. In the present study, we introduced a new indicator describing the market share of SOEs in a region to examine the role of regional ownership structure. We found that the effects of the VAT reform under different regional ownership structures vary significantly. This conclusion can be utilized as a starting point for developing more targeted industrial policy. Accordingly, the government should carry out targeted reform measures on the basis of the characteristics of ownership structures in different regions to improve the precision and effectiveness of policy implementation. (ii) As the debate on whether the output effect of the VAT reform on

labor input of firms is greater (or lesser) compared to the substitution effect has failed to reach a consensus, our research results showed that these effects can vary depending on the scope of the sample, the period, and the research methods. To address this issue, we used data of manufacturing firms in Northeast China from 2000 to 2008, avoiding the effects of policies in other regions. Different with Cai and Harrison (2021), Our findings reveal that the output effect of the VAT reform on labor inputs is bigger than the substitution effect, implying that the policy has had a beneficial impact on employment. We believe that a more accurate methodology could enhance the credibility of research result. In this context, we should not ignore the policy practice in other regions during the VAT reform in Northeast China. This is a strong assumption for DID method. However, a lot of research based on China' VAT 2004 reform has ignored this requirement.

As discussed in modern evolutionary economics, business decision making among different types of firms follows distinct behavioral patterns termed "routines," which plays the role as being played by genes in biological evolutionary theory (Nelson & Winter, 1982). Previous research has shown different types of companies, in term of firm ownership, have different behavior modes (Shi et al., 2020). In this vein, the present paper proves that VAT reform can work as one kind of gene therapy to activate functions within firms to stimulate their innovation decision. However, this paper also discusses the role of regional ownership, which shows that the positive effect of VAT on regional upgrading is limited in the area with higher share of SOEs. The policy implication is that it is better to implement marketization tool (like VAT reform) together with administrative measures (like privatization or reform of state-owned companies). The following findings can undoubtedly serve as a guide for policymakers and practitioners in the sector. Our results demonstrate that the implementation effects of the VAT reform differ across regions with varying ownership structures, providing information to develop more targeted VAT policies for certain regions and sectors. In this context, the government should, first and foremost, enhance its support for SOE reform by speeding up the diversification of state-owned capital and increasing the vitality and market competitiveness of these firms. Second, non-SOEs' market access should be increased by exposing new enterprises to market competition, which will lead to more marketization. Improving economic vitality, increasing economic efficiency, and putting pressure on SOEs can all assist non-SOEs change and expand more quickly.

Another point worth mentioning is the geographical patterns of knowledge generation and dissemination, as the process of knowledge production has a particular geography (e.g., Asheim & Gertler, 2005). Indeed, the three provinces that experienced the 2004 VAT reform have similar industrial bases and knowledge characteristics. One drawback is that

the function of regional ownership and the effect of the VAT reform cannot be compared to other parts of China. If the data and research conditions meet the requirement in the future, we urge additional studies to go further into comparison studies, such as on the role of ownership upon different areas with the synthetic or analytical knowledge base. Although we pointed out that the VAT reform had little effect in regions with high market shares of SOEs, the period examined in this study covered the privatization reform efforts of SOEs in Northeast China. We calculated the market shares of SOEs on the basis of the ownership reported by firms for each year. Thus, the privatization reform has been controlled to some extent. We also used the DID method to eliminate the influence of the privatization reform to some extent, but this issue requires further investigations. In this context, our findings may be used as a benchmark for enhancing existing VAT reforms for SOEs in other regions in Northeast China and even those in the western region, whose ownership structure is rather similar.

### Author Contributions

Junguo Shi made substantial contributions to conception and design, data acquisition and analysis, and interpretation of results. He also took the lead in writing the manuscript; Xinyi Yuan performed the statistical analysis and was involved in drafting the first manuscript. Bert M. Sadowski made substantial contribution in paper revision and also work together with Junguo Shi to explore the role of regional ownership structure in economic growth. Kou Kou and Xuhua Hu participated in the design of the study, provided critical feedback, and helped shape the research. Sihan Li revised the manuscript critically for important intellectual content. Shanshan Dou conceived of the study, participated in its design and coordination, and helped to improve the language of the manuscript. All authors discussed the results and commented on the manuscript.

### Availability of Data and Material Code Availability

The final data and Stata code can be access after acceptance of this manuscript.

### Declaration of Conflicting Interests

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## ORCID iDs

Junguo Shi  <https://orcid.org/0000-0001-7214-6867>

Xinyi Yuan  <https://orcid.org/0000-0002-5877-475X>

Shanshan Dou  <https://orcid.org/0000-0002-6912-8729>

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