ERIA Discussion Paper Series

No. 337

The Value-Added Tax Reform and Labour Market Outcomes: Firm-Level Evidence from China

Yuxiang YANG

Yokohama National University, Japan

Hongyong ZHANG[#§]

Research Institute of Economy, Trade and Industry, Japan

August 2020

Abstract: *The tax incentives designed to stimulate firm investment may have a large impact on labour market outcomes. Using a comprehensive data set containing more than 1 million Chinese manufacturing firms during the period 2000–2013 with a difference-in-difference approach, we examine the impact of the value-added tax reform in 2004–2008 on the firm-level labour market outcomes. We find that firms in eligible industries and regions (treated firms) enjoying lower costs of purchasing fixed assets under the reform tended to increase capital investment and reduce employment relative to firms that did not have tax incentives (the control firms). Compared with the control firms, the treated firms became more capital intensive and had an increase in average wage but a decline in labour income share. We also provide evidence that the substitutions of labour input by capital input is associated with increases in firm productivity and the share of skilled workers, but not imported capital goods.*

Keywords: Tax reform, labour market, factor intensity

JEL Classification: H20, J01, O53

[#] Corresponding author: Hongyong Zhang, address: 1-3-1 Kasumigaseki, Chiyoda-ku, 100-0013 Tokyo, Japan. E-mail: zhang-hong-yong@rieti.go.jp

[§] This research was conducted as a part of the project of the Economic Research Institute for ASEAN and East Asia (ERIA), 'Technology and Jobs in East Asia'. The authors are deeply indebted to the members of this project for their invaluable suggestions. The opinions expressed in this paper are the sole responsibility of the authors and do not reflect the views of ERIA.

1. Introduction

With significant progress in automation, robots, and artificial intelligence, the question on whether machines will take our jobs away was revisited in both developed and developing countries. This is not a new concern but because of the rising anxiety and concerns in our society, both policymakers and academic researchers desire to understand the consequence of the adoption of such new technology. A vast literature argues the possible future scenarios. However, there are only a few empirical studies on the impact of technology adoption on the labour market to date, especially in the case of developing countries.

In this study, we investigate how the tax incentives simultaneously affect investment and technology adoption of Chinese firms as well as labour market outcomes. Firm investment, technology adoption, and hiring are all obviously endogenous to firms. Moreover, the relationship between investment and employment could be either substitutive or complementary. Capital investment, imports of capital goods, and research and development activities can help firms gain core competency and production efficiency and may lead to a decreased demand for low-skilled workers and routine jobs, particularly in labour-intensive and competitive industries. On the other hand, if investment and technology adoption help firms expand their production and market, then these may imply an increasing demand for workers and jobs. How does capital investment affect the jobs in Chinese firms? This is an open research question and we empirically explore it in this study.

To examine the causal effects of capital investment on labour market outcomes, we utilise China's value-added tax (VAT) reform, which started in 2004 and completed in 2009, to conduct a quasi-experimental analysis using a difference-in-difference

(DID) approach. It was a major reform for capital taxation in China and it introduced permanent tax incentives for firms' investment in fixed assets. We take advantage of both the industrial and regional variations of this policy change to identify the causal effect of firm investment on labour market outcomes. Using comprehensive data of over 1 million Chinese manufacturing firms during the period 2000–2013, we find that the VAT policy change stimulated firms' intensive capital investment, which led to increases in the capital–labour ratio and the average wage, but resulted in the decline in the number of total employees and labour income share (total wage bill to total sales). The effects are associated with the positive effect of investment on productivity and demand for more skilled workers. Furthermore, our placebo test shows that the increase of capital investment is associated with the purchase of domestic machines and equipment rather than imported capital goods. China is an excellent setting for the study on this topic since it experienced large and fast growth in capital investment, foreign direct investment (FDI), and imports of capital goods in the 2000s. And due to increasing labour costs, the labour-intensive sectors in China had come to an end. To evaluate the impact of this policy change, we carefully control for other policy changes and factors that may affect the labour market, such as FDI liberalisation, the reform of state-owned enterprises (SOEs), and the growth of labour costs.

Our study is closely related to Liu and Lu (2015) and Liu and Mao (2019) which utilised the same VAT tax reform to test its impacts on investment, productivity, and exporting of Chinese firms. Liu and Lu (2015) found that after the reform in 2004, firm investment significantly and substantially increased the likelihood of exporting, and this effect was largely due to the positive effect of investment on productivity. Utilising a unique data set containing firms in both the manufacturing and service sectors, Liu and Mao (2019) found that the reform significantly increased investment

and productivity of the firms belonging to the targeted industries and regions relative to those firms in the industries and regions not targeted by the tax incentives. Our study contributes and complements the literature by examining a wide range of firm-level labour market outcomes, including the number of employees, average wage, labour income share, and the share of skilled workers. This paper also contributes to the literature in the following aspects. First, the previous studies mostly focused on the effect of tax incentives in developed countries (e.g. Cummins et al., 1996; Devereux and Griffith, 1998; Desai and Goolsbee, 2004; Edgerton, 2010; Mertens and Ravn, 2012; Yagan, 2015; and Maffini et al., 2016). Our study supplements evidence on the effectiveness of tax incentives using data from the largest developing country in the world. Second, the identification strategy in our study is based on the variation of timing of reform in different industries and regions. The previous research studies, which were based solely on regional or industrial policies (e.g. Desai and Goolsbee 2004; House and Shapiro, 2008; Edgerton, 2010; and Zwick and Mahon, 2017), may suffer from endogeneity problem. Tax incentives may occur in some regions or industries at the same time as other policy shocks (Maffini et al., 2016; Zwick and Mahon, 2017). The regional industry-specific reform exploited in our study avoids such concern.

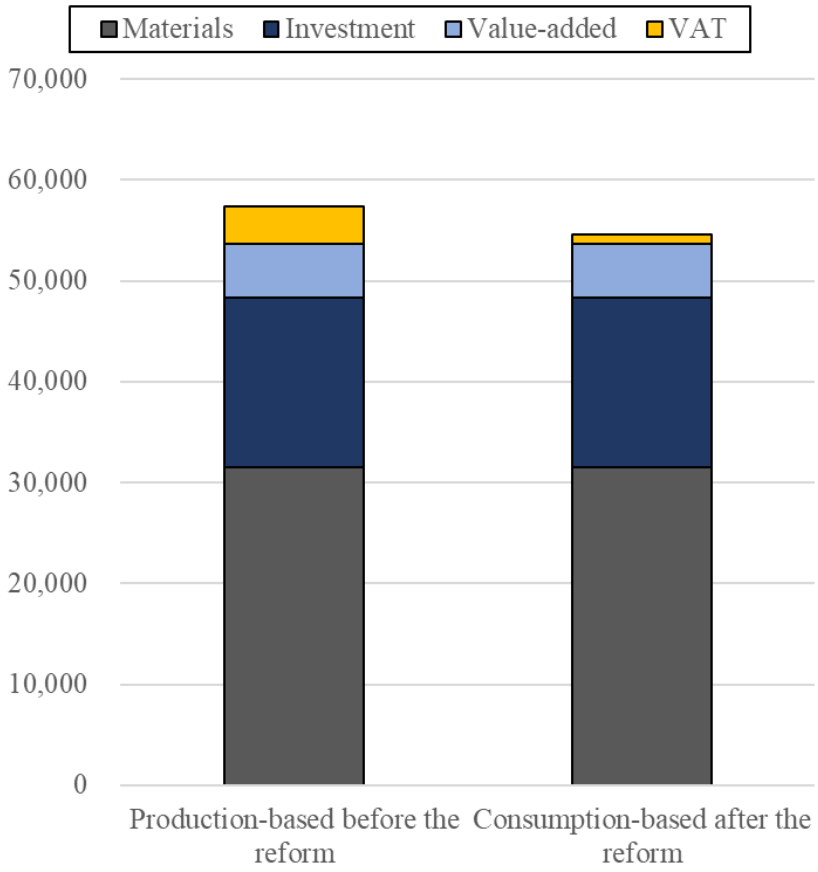
The rest of the paper is organised as follows. Section 2 describes China's VAT reform and our empirical strategy. Section 3 describes our data and main variables. We report our empirical results on the impact of tax reform on labour market outcomes and discuss the underlying mechanism in Section 4. Concluding remarks are in Section 5.

2. Background and Empirical Strategy

2.1. Value-Added Tax Reform in China

China introduced VAT nationwide in its 1994 fundamental tax reform, and the standard tax rate was 17%. Since its introduction, VAT has become the major source of tax revenue for the government. VAT revenue was RMB230 billion (about US$27 billion) in 1994, taking up 45% of total tax revenue in that year; it reached RMB6,152 billion (about US$929 billion) in 2018, accounting for 39% of the total tax revenue. In many countries, VAT is levied on the consumption base, which means all purchases of capital goods from other firms can be deducted from the tax base. However, in China, VAT was initially levied on the production base where only the raw materials used in production can be deducted. Figure 1 shows the difference between production-based and consumption-based VAT system based on a real firm in our data set. Under the production-based system, VAT equals output tax less input tax, which means that only raw materials can be deducted and VAT is levied on value added plus investment. If VAT is levied on the consumption base, investment is also regarded as input, in which case VAT is levied only on the added value. VAT on production base was RMB3.76 million (before the reform) and decreased to RMB0.9 million for consumption base (after the reform). Firms obviously must pay more tax under the production-based VAT system.

Figure 1: Comparison between Consumption-Based and Production-Based VAT System ('000 RMB)



Note: Yellow parts denote the value-added tax under two different systems. The VAT rates are both 17%. In the left bar, the VAT is imposed on both value-added and investment, while in the right bar, only imposed on value-added.
Source: Authors' calculation based on a real firm in 2006; Annual Surveys of Industrial Firms (ASIF) data set.

At first, the Government of the People's Republic of China adopted a production-based VAT system in 1994 due to the economic environment at that time. In the early 1990s, the government was facing the continuing decline of government revenue share. Adopting a consumption-based VAT would lead to a further sharp decrease in tax revenues. Meanwhile, due to China's rapid reform and opening, the high inflation rate and overheated economy became potential threats. A production-based VAT system would help curb excessive firm investment and slow down economic development. For these reasons, the government adopted the production-based VAT system, although

it resulted in double taxation problems and increased the tax burden of firms. However, in the early 2000s, the economic disadvantages of production-based VAT became increasingly significant. VAT discouraged fixed investment, which is harmful to the domestic equipment manufacturing sector. Industry structure adjustment and technology upgrading were also held up by the heavy tax burden.

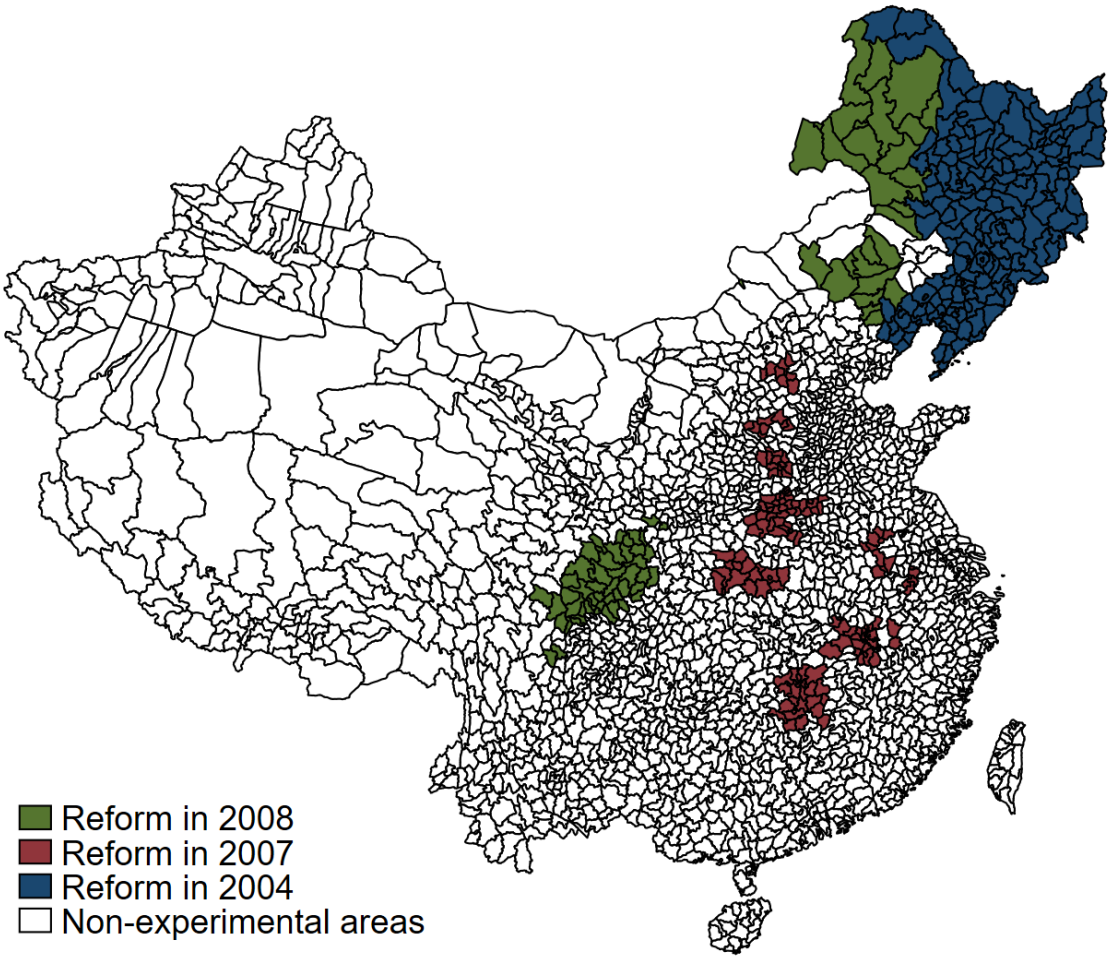
To stimulate investment in fixed assets and promote an equitable market environment, on 12 September 2004, the Chinese Ministry of Finance and the State Administration of Taxation officially announced Chinas reform of its VAT system. The reform was initially implemented on a local pilot basis. The first wave of the reform covered six broadly defined industries – 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) (Table 1 and Figure 2). Under the new VAT system, the purchase of fixed assets (excluding buildings and imported capital goods) could be deducted from the tax base, which would substantially lower the cost of fixed assets. The three northeastern provinces have had a concentration of industrial enterprises – especially in the fields of heavy industries – since the establishment of the new China. Selecting the three northeastern provinces as experimental points for the implementation of the VAT reform also supported the strategy of 'Revitalising the Old Industrial Base in Northeast China'.

Table 1: Pilot Industries under the VAT Reform

Industry	2004	2007	2008
Equipment manufacturing	√	√	√
Petroleum chemical manufacturing	√	√	√
Metallurgy	√	√	√
Ship building	√	×	√
Automobile manufacturing	√	√	√
Agricultural product processing industries	√	√	√

Source: Authors' compilation from relevant official documents.

Figure 2: Pilot Regions under the VAT Reform



Source: Authors' compilation from relevant official documents.

In 2007, the reform was expanded to include another 26 cities in six central provinces (Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan) and mining and electricity industries.[1] Only the 26 cities in the six provinces were selected as experimental points (Figure 2) because they were also industrial bases, like the three northeastern provinces. The decision on experimental points was based on the strategy of the 'Rise of the Central Region'. Furthermore, in 2008, the VAT reform continued to expand and covered eight industries in five cities of Inner Mongolia. After the Wenchuan earthquake in May 2008, the 39 counties in Sichuan province and 17 counties in the other two affected provinces (Gansu and Shaanxi) were included in the VAT reform area to help firms recover from the great disaster. The gradual expansion of the VAT reform was helpful to the stability of the market and government's tax revenue. After accumulating the experience on pilot basis, the reforms were eventually expanded nationwide from 1 January 2009.

In this study, we utilise these three stages of the VAT reform in 2004–2008 to examine its effects on firm-level labour market outcomes through the capital investment channel. It is notable that both the selection of experimental points and the time of the implementation of the reform were confidential to firms. In other words, before the announcement of each wave of reform, firms did not know the pilot industries and regions, and the timing of the reform. For this reason, firms were not motivated to delay their investment action, waiting for the implementation of the VAT reform.

[1] We exclude the mining and electricity sectors and focus on the manufacturing sector only.

2.2. Empirical Strategy

The challenge of identifying the causal effect of firm investment on employment is that both variables are endogenous to a firm. To address this issue, we exploit the VAT reform as a quasi-natural experiment. As we introduced in the background, whether a firm is eligible to deduct the fixed assets investment from the tax base is subject to the exogenous policy change, i.e. pilot industry and region. Based on the three waves of the VAT reform in 2004, 2007, and 2008, we performed the following form of DID regression:

$$y_{i,t} = \alpha + \beta VAT_{i,t} + \gamma X_{i,t} + \theta_i + \varphi_t + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ are the outcome variables such as firm investment, the number of employees, capital–labour ratio, average wage, and labour income share of firm i in year t; $VAT_{i,t} = VAT_i \times Post_{i,t}$ captures the implementation of the VAT reform. For example, for the firms in the 26 cities in the six central provinces and in the pilot industries, VAT_i equals 1, otherwise 0. $Post_{i,t}$ equals 0 before 2007 and it equals 1 in 2007 and the subsequent years. $X_{i,t}$ is a vector of control variables including firm total sales, total assets, firm age, and dummies for state-owned enterprises (SOEs) and foreign-owned enterprises (FIEs); θ_i is firm-fixed effects and φ_t is year-fixed effects to control for macroeconomic shocks such as global financial crises and fiscal stimulus to all firms.

The assumption that should be satisfied in our DID method is that the control and treatment groups shared a common trend before and after the VAT reform. It is impossible to directly observe the potential trend for the treated firms if they were not

eligible in the VAT incentives so that we could not test whether the control and treatment groups had a common trend in the post-reform period. By re-estimating the regression (1) and decomposing the indicator $VAT_{i,t}$ by a series of VAT-time dummies, we could test for whether the control and treatment firms shared the same trend in the pre-reform period. If it is the case, the treated firms would still potentially have the same trend as the control firms if the treated firms were not affected by the VAT reform. For this purpose, we ran the regression as:

$$y_{i,t} = \alpha + \sum_{j=\leq -4}^{\geq 3} \beta_j D_{i,t_0}^{j} + \gamma X_{i,t} + \theta_i + \varphi_t + \varepsilon_{i,t} \qquad (2)$$

where D_{i,t_0}^{j} is a series of VAT-time dummies that equals 1 if in j^{th} years for firm i, with $j = \leq -4, -3, -2, 0, 1, 2, \geq 3$. Specifically, when j is negative, D_{i,t_0}^{j} equals 1 in j^{th} years before the VAT reform; when j is positive, D_{i,t_0}^{j} equals 1 in j^{th} years after the VAT reform. To obtain the regression coefficients for each period compared with the year just before the reform was implemented (the base year), we exclude time category $j = -1$. The estimation of β_j provided us information on whether the treated firms shared the same trend with the control firms, which helped verify whether our main results suffered from selection bias.

3. Data and Variables

3.1. Data

Panel Data on Industrial Firms – Our main data set comes from the Annual Surveys of Industrial Firms (ASIF) conducted by China's National Bureau of Statistics for the period 2000–2013. The survey covered all industrial firms that are SOEs, and non-SOEs with sales above RMB5 million.[2] Industry is defined here to include mining, manufacturing, and public utilities. For this study, we focused on manufacturing firms only.

This study required precise information on industry and location of the sample firms. Each firm was classified into an industry following the 4-digit Chinese Industry Classification. However, in 2003, a new classification system for industry codes (GB/T 4754-2002) was adopted to replace the old classification system (GB/T 4754-1994). To make the industry codes comparable across the entire period, we used a harmonised classification that grouped some industries before and after the revision. The data set provided information on the address and regional codes of each firm. During the sample period, however, the administrative boundaries and city codes experienced some changes. New cities might have been established, whilst existing cities might have been combined into larger ones. Therefore, the city codes may not be comparable across years. To address these problems, using the 1999 National Standard (GB/T 2260-1999) as the benchmark codes, we converted the city codes of all the firms into these benchmark codes to achieve consistency for the city codes in the whole sample period.

[2] In 2011, the designated size increased from RMB5 million to RMB20 million.

This data set contains firm-level information on the book value and net value of fixed assets, the number of employees, wage bill, and sales which are important to this study. In 2004, firms also reported the number of workers having professional technical titles (*with* national certificates) and other technicians (in general, *without* national certificates), and the number of workers with a college degree education or higher. We realised firm sales, wage bill, and value-added by two-digit industry level output deflators from the China Statistical Yearbook compiled by the National Bureau of Statistics. One drawback of this data set is that it does not directly provide information on capital investment. Following Song and Wu (2012), Liu and Lu (2015), and Liu and Mao (2019), we used book values of fixed assets and assumed a constant depreciation rate of 5%. During this process, we realised the investment and capital stock using the provincial fixed investment price index from the China Statistical Yearbook. We dropped firms that have missing, zero, or negative values for employment, fixed assets, and sales since the logarithms of these variables are not defined.

The data contains information on ownership: state-owned enterprises (SOEs), private domestic firms, and foreign-invested enterprises. According to the Criteria for Classifications of the Registration of Enterprise Ownership Types issued by the NBS, only enterprises whose foreign capital accounts for no less than 25% of the total registered capital were eligible to be registered as foreign-invested enterprises.[3] In practice, we used the information on firm's registered type to classify ownership into three groups: private domestic firms, SOEs, and FIEs.[4]

[3] Foreign-owned enterprises (FIEs) cover foreign-invested joint-stock corporations, foreign-invested joint venture enterprises, fully FIEs, foreign-invested limited corporations, Hong Kong/Macao/Taiwan (H/M/T) joint-stock corporations, H/M/T joint venture enterprises, fully H/M/T-invested enterprises, and H/M/T-invested limited corporations.

[4] State-owned enterprises (SOEs) include state-owned domestic firms, state-owned joint venture enterprises, state-owned and collective joint venture enterprises, and state-owned limited corporations.

Customs Data on Firm Imports **–** The information on firm imports of capital goods for the period 2000–2012 comes from the annual firm-product-destination-year level transactions collected by China Customs. The data set contains information on trade value and quantity for each trading partner at the 8-digit HS product classification. We aggregated the data to the 6-digit HS product level and used the publicly available concordance tables to make the product codes consistent over time. To implement our analysis, we excluded trading companies and restricted our samples to manufacturing firms.

We divided the imports into capital goods, intermediate inputs, and consumption goods by the Broad Economic Categories classification proposed by the United Nations. According to this classification, capital goods include capital goods (except transport equipment) and transport equipment (industrial). Intermediate goods include industrial supplies not elsewhere specified, fuels and lubricants other than motor spirit, parts and accessories of capital goods, parts and accessories of transport equipment, and food and beverages mainly for an industry.

We further aggregated the original data to firm-year level to obtain the value of imported capital goods. Following Yu (2014), we used firm name, telephone number, postal code, and address to match the Customs data with the ASIF data.

3.2. Variables

Average Wage and Labour Income Share **–** Firm employment, average wage, and labour income share are our main variables of labour market outcomes. Average wage is measured as the wage bill divided by the number of employees. We define a firm's labour income share as the share of wage bill in total sales in our full sample (2000–2013). Ideally, total wage bill should include both wage bill and supplementary

compensation such as bonus and insurance. Unfortunately, the information on supplementary compensation and value added after 2007 is not available in our data set. We used the share of the sum of wage bill and supplementary compensation in value added for the period 2000–2007 as an alternative measure.[5]

Skilled Labour Share – To explore the mechanism that firms adjust labour input, given increased capital investment stimulated by the tax incentives, we estimated the effect of tax incentives on skilled labour share. Our firm-level data, unfortunately, does not provide information on the structure of employment in all years but 2004. Thus, we followed Chen et al. (2017) to calculate the skilled labour share in other years for firms had such information in 2004. The proxy of skilled labour share $\hat{\theta}_{i,t}$ in all years is given by:

$$\hat{\theta}_{i,t} = \eta_{r,t}\theta_{i,2004} \tag{3}$$

where $\eta_{r,t}$ is the provincial skilled labour share in all years; $\theta_{i,2004}$ is the skilled labour share of firm i in 2004.[6]

Chen et al. (2017) defined skilled labour as workers who have a college degree or higher. They investigated the impact of input trade liberalisation on firm-level wage inequality. As firm investment can be associated with not only individual workers' education but also their professional skills and working experience, we used (i) the number of employees having professional technical titles *with* national certificates and (ii) the number of technicians (mainly based on working experience) *without* national certificates as two additional measures for skilled labour.

[5] The results remain robust and are available upon request.
[6] Provincial data on the share of educated workers and skilled workers with national certificates are obtained from the China Labour Statistical Yearbook various years.

Capital Investment – Since the ASIF data set does not directly provide the information on firm investment on fixed assets, following Song and Wu (2012), Liu and Lu (2015), and Liu and Mao (2019), we defined the investment of firm i in year t in this way:

$$Invest_{i,t} = K_{i,t+1} - (1-\delta)K_{i,t} \quad (4)$$

where $\delta = 0.05$ is the assumed constant depreciation rate; $K_{i,t}$ is the reported fixed assets of firm i in year t. In equation (3), $K_{i,t}$ represents the capital stock for firm i in year t. Assuming a constant annual depreciation rate of 5%, the capital stock is calculated by following method:

$$K_{i,t} = (1-\delta)K_{i,t-1} + (BK_{i,t} - BK_{i,t-1})/r_{i,t} \quad (5)$$

where $BK_{i,t}$ is the book value of capital stock for firm i in year t; $r_{i,t}$ is the fixed investment price index at the provincial level. For 2000–2013, our data include information on the book value of capital stock. For the firms founded before 2000, we inferred the capital stock in the founding year, assuming the same growth rate in the two periods:

$$BK_{i,t_0} = BK_{i,t_1}/(1+\sigma_i)^{t_1-t_0} \quad (6)$$

where t_0 represents the founding year, which is reported in the data; t_1 is the initial year when the firm appears in the data; σ_i is the average capital stock growth rate in the period included in our data since year t_1.

In our empirical analysis, we measured the investment in two ways: (i) the logarithm of investment constructed by equation (3), and (ii) the logarithm of investment scaled by lagged capital stock.

Capital Intensity – To investigate whether the firms became more capital intensive after the VAT reform, we used capital–labour ratio to measure the capital intensity of a firm. The capital–labour ratio is the ratio of real capital stock to firm's

total employment, $K_{i,t}/L_{i,t}$, where $K_{i,t}$ is constructed by equation (4) and $L_{i,t}$ is the number of employees of firm i in year t.[7]

Firm Productivity – To examine the impact of tax reform on firm productivity, we used both labour productivity and total factor productivity (TFP). Firm labour productivity is defined as the realised sales divided by firm's total employment. For the TFP, we adopted the approach of Levinsohn and Petrin (2003) to estimate value-added based TFP for firms in each two-digit industry and each year. The intermediate inputs were used as proxies for unobservable productivity shocks to deal with the endogenous input choices. Since the variables on value added and intermediate inputs are missing in the data set after 2007, we used the TFP for the sample period of 2000–2007 only.

[7] As an alternative measure for capital stock, we used the net value of fixed assets deflated by the region-specific investment deflator. The results remain robust and quantitatively similar.

Table 2: Descriptive Statistics

Variable	(1) Reform Firms		(2) Non-reform Firms		(1)-(2)
	mean	s.d.	mean	s.d.	
ln(Invest+1)	7.23	2.22	7.04	2.14	0.1859***
Invest/Lagged capital stock	1.14	2.49	0.93	2.05	0.2164***
ln(employment)	4.86	1.16	4.87	1.12	-0.0118***
ln(Capital labour ratio)	3.02	2.07	2.90	1.97	0.1246***
ln(Average wage)	2.52	0.77	2.65	0.70	-0.1342***
Labour share	8.18	10.32	9.50	10.13	-.0132***
ln(Labour productivity)	5.58	1.08	5.46	0.99	0.1189***
TFP	9.20	0.35	9.16	0.37	0.0288***
ln(Sales)	10.43	1.50	10.32	1.40	0.1046***
ln(Age)	1.96	0.80	2.00	0.75	-0.0413***
Skilled labour share (Education)	69.23	33.14	56.88	35.30	12.3589***
Skilled labour share (Technical)	45.40	42.55	33.90	41.07	11.5013***
SOE	0.07	0.25	0.04	0.20	0.0281***
FIE	0.12	0.32	0.21	0.41	-0.0968***

FIE = foreign-owned enterprise, SOE = state-owned enterprises, TFP = total factor productivity.
Note: *** denotes significance at the 1% level.
Source: Authors' calculation based on the ASIF data set.

Table 2 reports the descriptive statistics of the key variables for two subsamples, firms in and not in the reformed areas and industries. The firms with tax incentives, on average, have more investment, higher capital–labour ratio, labour productivity, sales, and skilled labour share (with national certificate). On the contrary, the firms without tax incentives have more jobs, higher wage, and labour share in their output. The possible explanation for the comparison is that the VAT reform encouraged the treated firms to invest more on capital goods than labour input, further leading to the increase in capital–labour ratio and productivity. Meanwhile, the share of SOEs was higher whilst that of foreign-owned firms was lower in the reformed firms. The possible explanation is that the reform took place in the inland cities, but foreign enterprises

more likely invested in more economically advanced coastal cities in China.

4. Empirical Analysis and Findings

4.1. Graphical Results

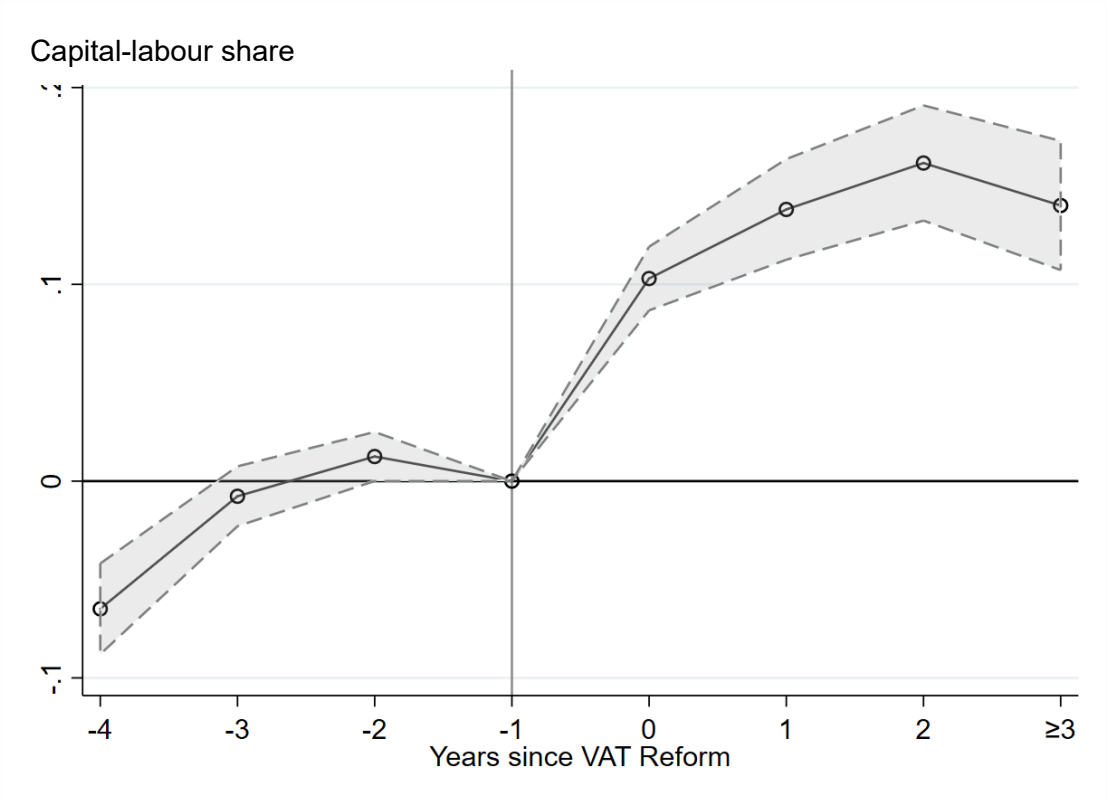
The validity of our main result relies on the assumption that the treated firms shared the same trend with the control firms. By assumption, there should be no difference in the pattern dependent variables of the treated and control firms in the pre-reform period. If it is not the case, the main result will be biased because we cannot tell the effect of the VAT reform from the already-increasing/decreasing trend of policy takers. To test whether this assumption is satisfied, we estimated the dynamic effects of the VAT reform on the dependent variables, using specification (2) where we replaced the VAT reform dummy in specification (1) by a series of dummies that indicate the time away from the VAT reform.

The coefficients of the dummies are jointly shown in Figure 3, with the 95% confidence intervals. Panels A–C show the differences in capital–labour ratio, average wage, and labour income share changes between the treatment and control groups over time, through a plotted set of estimated coefficients from the regressions with all controls in equation (2). These coefficients indicate the dynamic divergences of capital–labour ratio, average wage, and labour income share between the treated and control firms before or after the VAT reform. The point estimates of the coefficients swing around the horizontal line in the pre-reform period and sharply increase in the zero and subsequent periods, which demonstrates no significant different trend of the dependent variables between the treated and control groups before the VAT reform. This confirms the validity of our main results. However, in the post-reform period, the

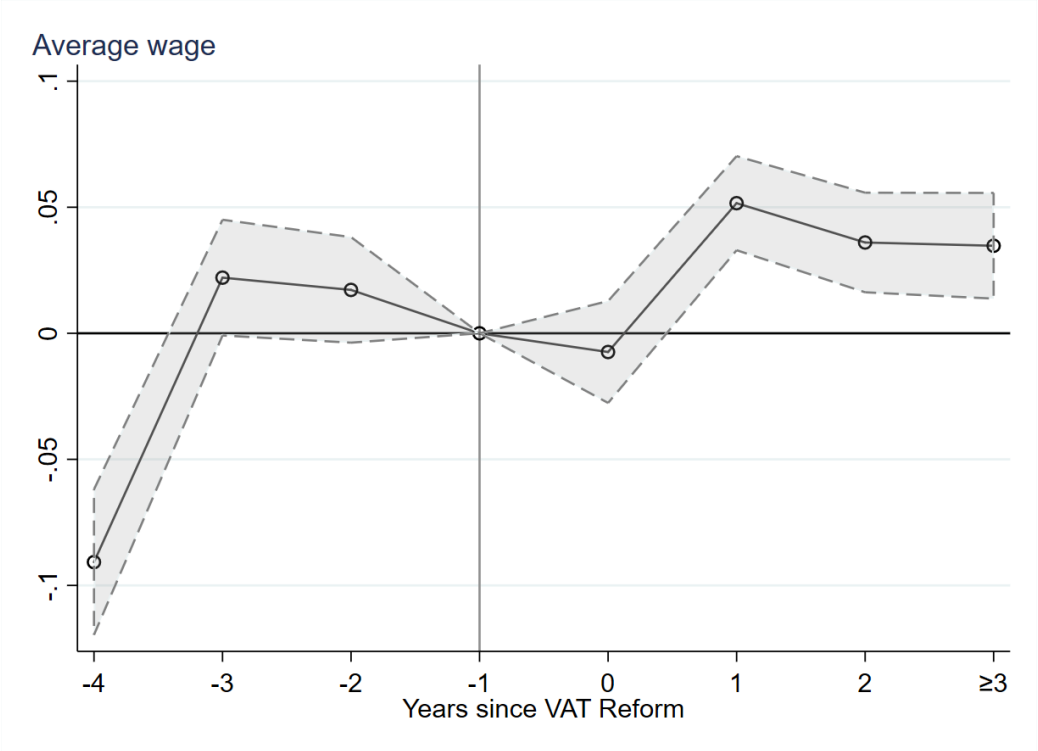
treatment group experienced gradual and persistent increases in capital–labour ratio and average wage but declined in labour income share.

Figure 3: Effects of VAT Reform on Firm Investment and Labour Market

Panel A: Capital–labour ratio



Panel B: Average wage



Panel C: Labour income share

Note: Panels A–C plot the event study estimates and corresponding 95% confidence intervals from regressions of specification (2) for the logarithm of capital–labour ratio, average wage, and labour share.
Source: Authors' compilation based on the ASIF data set.

4.2. Main Results

As we introduced in the background part, the reform of VAT allows the experimental firms to deduct their investment on fixed assets from the tax base. As a result, the lower costs of purchasing fixed assets may prompt firms to use capital goods to substitute labour input. Since the labour market is very flexible in China, the adjustment of labour input is much easier than capital input. In this sense, we first estimated specification (1) with the logarithm of capital–labour ratio, employment, and firm investment. The results are reported in Table 3. The dependent variable is the logarithm of capital–labour ratio in columns 1–3, employment in columns 4–6, and investment in columns 7-9, respectively. Only the coefficients of VAT reform were reported with standard errors clustered at the firm level. We control for firm fixed effects and year fixed effects in all regressions.. In columns 1–3, the outcome variable is the logarithm of the capital–labour ratio. The results showed that the VAT reform is strongly positively associated with capital intensity, suggesting that after the reform, the treated firms tended to use more capital, than labour, input and became more capital intensive. The coefficient in column 6 is 0.047, implying that, on average, the capital–labour ratio of the treated firms increased about 4.7% relative to the control firms after the reform. Column 4 shows that the VAT reform is positively associated with firm employment. However, controlling for firm and year fixed effects and firm-level controls in column 5, and further industry trend in column 6, it turns out that the VAT reform has a statistically significant negative impact on employment. In terms of magnitude, the estimated coefficient of -0.0217 (column 3) implies that compared with the control firms, the reform led to an approximately 2.2% decline in employment for the treated firms. This result is consistent with our expectation. Although the VAT

reform was not designed for the labour market, firms tended to reduce their employment under the new tax system. As shown in column 9, relative to the control firms, the VAT reform significantly increases the investment of the treated firms by 16.9 logarithm points.[8] These results are consistent with those of previous studies (e.g. Liu and Lu, 2015; Liu and Mao, 2019).

[8] We alternatively use the ratio of investment in fixed assets to lagged real capital stock to measure firm investment. Consistent with log investment, the result suggests that the VAT reform significantly increases the investment rate by 0.097.

Table 3: Capital-Labour Ratio

Dep. Variable	ln(Capital–Labour Ratio)			ln(Employment)			ln(Investment+1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VAT reform	-0.00298	0.0452***	0.0473***	0.0470***	-0.0193***	-0.0217***	0.236***	0.189***	0.169***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.013)	(0.013)	(0.013)
Num of Obs.	3538805	3497330	3497330	3640259	3597306	3597306	1473977	1465204	1465204
R-squared	0.135	0.185	0.188	0.162	0.289	0.295	0.113	0.118	0.119
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Industry trend	No	No	Yes	No	No	Yes	No	No	Yes

FE = fixed effect, VAT = value-added tax.
Notes: Firm-level controls include total sales, total assets, firm age, SOE and FIE ownership dummies. Industry trend includes two-digit industry dummies and their interactions with quadratic time trends. Standard errors are clustered at the firm level.
***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.
Source: Authors' estimations based on the ASIF data set.

The effects on firm employment and capital–labour ratio provide us a first look at the labour market outcomes of the reform. Next, we further investigated the reform effect on firm-level average wage and labour income share. The premise is that the reform could have some positive effects on average wage and labour income share if firms tended to hire high-skilled workers to complement machines and equipment, and negative effects if firms tended to cut labour input and wages. The results are shown in Table 4. First, we find that compared with the control firms, the treated firms increased their average wage after the tax reform. The results are statistically significant and robust controlling for firm characteristics, such as size and ownership as well as industry trends. On the magnitude of the effect, we rely on the estimate in column 3. The reform leads to a 2.2 log points in average wage, which is approximately an average wage up of 2.2% for the treated firms. This suggests that the treated firms will likely employ high-skilled workers and pay higher wages on average. Second, we find that the tax reform decreased labour income share in total sales. With an estimated coefficient of -0.00528 in column 3, the treated firms reduced labour income share by 0.5% relative to the control firms. Note that it should be considered as the lower bound of the impact on labour income share. The magnitude becomes much larger when we use the share of total wage bill to value added and subsample during the period 1998–2007. The estimated coefficient is around –0.0411, implying an average 4.1% decline in labour income share of treated firms. This is reasonable since the average share of total wage bill to value added is much larger.

Table 4: Average Wage and Labour Income Share

Dep. Variable	ln(Average Wage)			Labour Income Share		
	(1)	(2)	(3)	(4)	(5)	(6)
VAT reform	0.0447***	0.0163***	0.0218***	-0.729***	-0.632***	-0.528***
	(0.00296)	(0.00286)	(0.00280)	(0.0405)	(0.0404)	(0.0417)
Num of Obs	3540735	3522949	3522949	3574629	3558798	3558798
R-squared	0.182	0.204	0.221	0.148	0.156	0.160
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes	No	Yes	Yes
Industry trend	No	No	Yes	No	No	Yes

FE = fixed effect, VAT = value-added tax.
Notes: Firm level controls include total sales (columns 1–3 only), total assets, firm age, SOE and FIE ownership dummies. Industry trend includes two-digit industry dummies and their interactions with quadratic time trends. Standard errors are clustered at the firm level.
***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.
Source: Authors' estimation based on the ASIF data set.

4.3. Discussion

We discuss two channels through which the VAT reform affects labour market outcomes: (i) the productivity-improvement effect of the reform, and (ii) firm adjustment of labour input and skilled workers.

The productivity of Chinese firms significantly increased during the period 1998–2007, especially after China's accession to the World Trade Organization (WTO) in 2001 (Brandt et al., 2012). Liu and Lu (2015) and Liu and Mao (2019) found that the VAT reform raised the capital investment and the TFP of the treated firms. Obviously, growth in investment and productivity should be closely related to firms' labour inputs. Since we used a long panel data than Liu and Lu (2015) and a different data set from Liu and Mao (2019), we conducted additional exercises to estimate the

effects of the tax reform on both labour productivity and the TFP. Table 5 shows that the reform significantly raised the productivity of the treated firms relative to the control firms by about 14.4% in terms of labour productivity (column 3) and 2.2% for the TFP (column 6). The results are in line with the findings in above studies and we confirm that the productivity-improvement effect of the reform is significant.

Table 5: Firm Productivity

Dep. Variable	**Labour Productivity**				**TFP**		
	(1)	(2)	(3)		(4)	(5)	(6)
VAT reform	0.163***	0.147***	0.144***		0.0217***	0.0240***	0.0216***
	(0.004)	(0.004)	(0.004)		(0.007)	(0.006)	(0.006)
Num of Obs	3541146	3525324	3525324		1923618	1908032	1908032
R-squared	0.199	0.226	0.237		0.149	0.176	0.183
Firm FE	Yes	Yes	Yes		Yes	Yes	Yes
Year FE	Yes	Yes	Yes		Yes	Yes	Yes
Firm-level controls	No	Yes	Yes		No	Yes	Yes
Industry trend	No	No	Yes		No	No	Yes

FE = fixed effect, VAT = value-added tax.
Notes: Firm-level controls include total sales (columns 4–6 only), total assets, firm age, SOE and FIE ownership dummies. Industry trend includes two-digit industry dummies and their interactions with quadratic time trends. Standard errors are clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.
Source: Authors' estimation based on the ASIF data set.

Our results in Table 4 show that compared with the control firms, the treated firms tended to pay higher average wages, which is a proxy for high-skilled workers. However, the composition of labour input and mechanism is not clear. It is possible that the treated firms simply became more profitable and paid higher wages. To address this concern, we further provided evidence that the VAT reform is associated with an increase in the share of skilled labour, especially workers with high technical skills rather than high education. We calculated the skilled labour share in all years using 2004 as base year (see equation 3). Specifically, we define skilled labour in three ways: (i) workers with a college degree education or higher (same as Chen et al., 2017), (ii) workers *with* technical national certificates, and (iii) workers *without* technical national certificates (they are categorised as technicians mainly based on their professional working experiences). Surprisingly, the results in Table 6 show that relative to the control firms, the treated firms under the VAT reform tended to have a lower share of workers with college and higher education (columns 1–3). However, the treated firms had higher shares of skilled workers with technical certificates (columns 5–6) and without certificates (columns 7–9). Compared with the effects on investment and wage, these results revealed the mechanism through which tax incentives affected firms' hiring behaviour and choice of labour input. The tax incentives encouraged firms to raise their investment on capital goods such as machines and equipment which require more skilled and experienced workers to operate. Meanwhile, it does not necessarily mean an increasing demand for workers with higher education.

Table 6: Skilled Labour Share

Dep. Variable	College and Above			Technical (Certificate)			Technical (Non-certificate)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VAT reform	-0.769***	-0.776***	-0.877***	0.102***	0.0907***	0.0875***	0.839***	0.800***	0.713***
	(0.062)	(0.062)	(0.062)	(0.013)	(0.013)	(0.013)	(0.028)	(0.028)	(0.028)
Num of Obs	1700295	1684309	1684309	1700295	1684309	1684309	1700295	1684309	1684309
R-squared	0.225	0.222	0.23	0.0142	0.0148	0.0163	0.0422	0.044	0.0538
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Industry trend	No	No	Yes	No	No	Yes	No	No	Yes

FE = fixed effect, VAT = value-added tax.
Notes: Firm-level controls include total sales, total assets, firm age, SOE and FIE ownership dummies. Industry trend includes two-digit industry dummies and their interactions with quadratic time trends. Standard errors are clustered at the firm level in all regression.
***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.
Source: Authors' estimation based on the ASIF data set.

4.4. Robustness Checks

4.4.1. Placebo Test

As mentioned in the institutional background, the new VAT system does not encourage purchases of imported machines and equipment; they are not eligible for claiming deductions. However, there are still potential concerns on the effects of imported capital goods on jobs and wage. Imported machines are more technology intensive and labour saving. China entered the WTO in 2001 and the average tariffs on capital goods decreased from 18% in the 1990s to 8% in 2010. Imported capital goods and technology became cheaper. Moreover, imported machines and equipment could be either complements or substitutes to the purchase of domestic fixed assets. Thus, this relationship is not clear-cut. To address these concerns, we conducted a placebo test. Specifically, using matched ASIF-Customs data set, we investigated whether the tax incentives increased the imports of capital goods. We used the logarithm of imported value of capital goods and the share of capital goods imports in total imports as the dependent variables.

As shown in Table 7, the coefficients of the VAT reform are indistinguishable from zeroes in all columns. Note that we restricted firms with imports under the regime of ordinary trade since firms engaging in processing trade produce goods with almost all equipment, materials, and designs provided by foreign companies. These firms are systematically different and may have different production functions. When we included processing importers, we even found some negative effects of the VAT reform on imported capital goods, which suggests the possibilities of substitution between domestic fixed assets and foreign fixed assets. This is not surprising since the machines and equipment made in China – regardless if produced by indigenous firms or foreign-

invested firms – have made great improvement in technology and quality since 2000. Our placebo test confirmed the validity of our empirical design. This is also consistent with Liu and Mao (2019) who used a different data set on Chinese firms in both the manufacturing and service industries during the period 2005–2012.

Table 7: Imported Capital Goods

Dep. Variable	ln(Imported Capital Goods +1)			Imported Capital Goods/ Total Imports		
	(1)	(2)	(3)	(4)	(5)	(6)
VAT reform	-0.00538	-0.00381	-0.00795	-0.000285	-0.000109	-0.000657
	(0.00461)	(0.00459)	(0.00463)	(0.000588)	(0.000586)	(0.000591)
Num of Obs	3351004	3347352	3347352	3351004	3347352	3347352
R-squared	0.00437	0.00627	0.0104	0.000813	0.00187	0.00277
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes	No	Yes	Yes
Industry trend	No	No	Yes	No	No	Yes

FE = fixed effect, VAT = value-added tax.
Notes: Firm-level controls include total sales, total assets, firm age, SOE and FIE ownership dummies. Industry trend includes two-digit industry dummies and their interactions with quadratic time trends. Standard errors are clustered at the firm level in all regression.
***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.
Source: Authors' estimation based on the ASIF data set.

Finally, following Lu et al. (2017) and Liu and Mao (2019), we also implemented a nonparametric permutation test to prevent the potential bias resulting from the self-correlation problem. We randomly assigned the same number of firms – as true treatment firms in each year – as treatment group. In this way, we re-estimated specification (1) with outcome variables capital–labour ratio, average wage, and labour income share. Repeating the simulation test for 500 times, we plotted the coefficient of 'false' VAT reform, as shown in the Appendix Figure A1. As we expected, the

coefficients of placebo VAT reform centred surround zero, illustrating that there is no significant effect of the randomly constructed VAT reform variable.

4.4.2. Additional controls and specifications

We conducted a battery of robustness checks, including controlling for other policy changes and industry–region specific factors during our sample period, using different clustering methods and subsamples. The results are reported in Table 8.

FDI liberalisation and SOE reform – Aside from the VAT reform, other policy changes such as FDI liberalisation and SOE reform are also related to capital formation and labour market outcomes. China became a member of the WTO in December 2001 and China's inward FDI dramatically increased in the 2000s. In 1995, the Chinese government promulgated the 'Catalogue for the Guidance of Foreign Investment Industries', which regulated FDI inflows.[9] Upon its WTO accession, China opened up some manufacturing industries for FDI, and these industries indeed had experienced a surge of FDI since 2002 (Lu et al., 2017). The catalogue was further revised slightly in 2007 and 2011. To control for the effects of FDI liberalisation on investment and the labour market, we constructed variables on FDI regulations at the four-digit industry level to indicate whether FDI was encouraged in an industry between every two waves of modification of the catalogue. The government conducted a series of SOE reforms and privatisation in the 2000s. The employment and output shares of SOEs declined in most of the manufacturing industries (Berkowitz et al., 2017; Wakasugi and Zhang, 2016). We further controlled for the industry-level SOE employment share in the initial year when a firm first appeared in the data because the

[9] The catalogue classified narrowly defined industries and products into four categories: (i) foreign direct investment (FDI) is supported; (ii) FDI is permitted; (iii) FDI is restricted; and (iv) FDI is prohibited.

industries with initial larger shares of SOEs experienced substantial lay-offs of workers during the reform.

Controlling for FDI liberalisation and SOE reform, our results remain robust in panel A of Table 9. It suggests that the nature of the VAT reform is an industrial and regional specific shock, which is not likely to be correlated with other policy changes.

Minimum Wage –Du and Wang (2019) conjectured the rapidly increasing labour cost in China would force firms, especially labour-intensive ones, to adjust their investment strategy. Given the concern that labour cost would affect firm investment and employment, we further controlled for the city-specific minimum wage in our regression. In this specification, the minimum wage is defined as the lowest 10% average wage in each city. The results in panel B are robust controlling for local minimum wage.

Wenchuan Earthquake – In our sample used in the baseline results, we included the 51 counties influenced by the 2008 Wenchuan earthquake in the treatment group because they also enjoyed the tax incentives aimed to recover the local economy. There are potential concerns that the natural disaster like earthquake may destroy everything including factors other than tax incentives which directly affect the firm investment and employment. We addressed this issue by employing subsamples removing the 51 counties from our data set. The results in panel C remained robust in the regions purely affected by the VAT reform. Since most of the 51 counties are surrounded by mountains where transport is very inconvenient, not so many firms are in the area. The exclusion of these 51 counties did not affect our estimation results.

Clustering – In the main regression, we assumed the standard error is independent in different firms. To test the robustness of the main results under a looser assumption, we relaxed this assumption so that standard errors can be different

amongst counties; however, in the same county, the standard errors are correlated. The results in panel D confirmed the positive and significant effects of the VAT reform on the capital–labour ratio, wage, and negative effects on labour income share. However, the significant levels of the estimated coefficients on skilled labour share changed a little, compared with those in Table 7, whilst the sign and magnitude are similar.

To sum up, the VAT reform was associated with increases in capital intensity and average wage of the treated firms, relative to the control firms. These effects were accompanied with a decline in labour income share but an increase in the share of skilled labour (technical personnel) in total employment. The results were robust controlling for various policy changes and related factors, using subsamples and alternative specifications.

Table 8: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variables	**Capital Labour Ratio**	**Average Wage**	**Labour Income Share**	**Skilled Labour Share (Education)**	**Skilled Labour Share (Technical 1)**	**Skilled Labour Share (Technical 2)**
Panel A	*Control for FDI liberation & SOE reform*					
VAT reform	0.0493***	0.0219***	-0.518***	-0.878***	0.0873***	0.712***
	(0.00431)	(0.00281)	(0.0420)	(0.0623)	(0.0130)	(0.0281)
Num of Obs	3479943	3505805	3540529	1684309	1684309	1684309
R-squared	0.191	0.221	0.160	0.230	0.0164	0.0540
Panel B	*Control for minimum wage*					
VAT reform	0.0564***	0.0264***	-0.466***	-0.880***	0.0876***	0.713***
	(0.00431)	(0.00283)	(0.0415)	(0.0623)	(0.0130)	(0.0281)
Num of Obs	3497330	3522949	3558798	1684309	1684309	1684309
R-squared	0.192	0.222	0.161	0.231	0.0163	0.0538
Panel C	*Subsample exluding Wenchuan earthquake*					
VAT reform	0.0439***	0.0190***	-0.571***	-0.935***	0.0913***	0.729***

	(0.00449)	(0.00290)	(0.0434)	(0.0622)	(0.0130)	(0.0281)
Num of Obs	3478437	3504214	3539818	1675416	1675416	1675416
R-squared	0.187	0.219	0.160	0.233	0.0163	0.0535
Panel D	*Cluster at county level*					
VAT reform	0.0461***	0.0239**	-0.445*	-0.847*	0.0956	0.735*
	(0.0129)	(0.00873)	(0.197)	(0.396)	(0.0829)	(0.298)
Num of Obs	3417516	3443189	3477441	1649504	1649504	1649504
R-squared	0.192	0.221	0.157	0.231	0.0166	0.0548
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry trend	Yes	Yes	Yes	Yes	Yes	Yes

FE = fixed effect. VAT = value-added tax.
Notes: Firm level controls include total sales (except column 3 in all panels), total assets, firm age, SOE and FIE ownership dummies. Industry trend includes two-digit industry dummies and their interactions with quadratic time trends. Standard errors are clustered at the firm level.
***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.
Source: Authors' estimation based on the ASIF data set.

5. Concluding Remarks

The argument on whether machines and technology will take away jobs and replace human beings was revisited recently. Many policymakers face a double mission – to promote firm investment and create more jobs at the same time. Empirically, it is hard to identify the complements and/or substitutions between capital and labour, as investment and hiring behaviours are endogenous to firms. It depends on the types of capital, technology, as well as the types of workers and jobs.

Utilising the arguably exogenous policy change of the VAT reform in China, we examined the impact of the tax incentives designed for firm investment on labour market outcomes. Under the new tax system, manufacturing firms in eligible industries and regions were allowed to lower the costs of purchases of fixed assets, such as machines and equipment (the treated firms), whilst others encountered no change in tax incentives (the control firms).

We found that the treated firms experienced a significant increase in capital investment, capital intensity, and average wage, but a significant reduction of the number of employees and a decline in labour income share. Our results suggest that purchases of domestic fixed assets, rather than imported capital goods, combined with a significant productivity growth account for the reductions and substitutions of labour inputs. Importantly, we also provided evidence that the treated firms in eligible industries and regions were associated with higher-skilled worker share. Though the employment size of the treated firms became smaller, their productivity, capital intensity, average wage, and skill intensity increased substantially. This suggests that the VAT reform in China was quite effective and successful and it contributed to industry development and firm growth towards more capital-intensive and skill-intensive ones.

References

Berkowitz, D., H. Ma, and S. Nishioka (2017), 'Recasting the Iron Rice Bowl: The Evolution of China's State-Owned Enterprises', *Review of Economics and Statistics*, 99(4), pp.735–47.

Brandt, L., J. Van Biesebroeck, and Y. Zhang (2012), 'Creative Accounting or Creative Destruction? Firm-Level Productivity Growth in Chinese Manufacturing', *Journal of Development Economics*, 97, pp.339–51.

Chen, B., M. Yu, and Z. Yu (2017), 'Measured Skill Premia and Input Trade Liberalization: Evidence from Chinese Firms', *Journal of International Economics*, 109, pp.31–42.

Cummins, J.G., K.A. Hassett, and R.G. Hubbard (1996), 'Tax Reforms and Investment: A Cross-Country Comparison', *Journal of Public Economics*, 62(1–2), pp.237–73.

Desai, M.A. and A.D. Goolsbee (2004), 'Investment, Overhang, and Tax Policy', *Brookings Papers on Economic Activity,* 34(2), pp.285–338.

Devereux, M.P. and R. Griffith (1998), 'Taxes and the Location of Production: Evidence from a Panel of US Multinationals', *Journal of Public Economics,* 68(3), pp.335–67.

Du, P. and S. Wang (2020), 'The Effect of Minimum Wage on Firm Markup: Evidence from China', *Economic Modelling*, 86, pp.241–50.

Edgerton, J. (2010), 'Investment Incentives and Corporate Tax Asymmetries', *Journal of Public Economics,* 94(11–12), pp.936–52.

House, C.L, and M.D. Shapiro (2008), 'Temporary Investment Tax Incentives: Theory with Evidence from Bonus Depreciation', *American Economic Review,* 98(3), pp.737–68.

Levinsohn, J. and A. Petrin (2003), 'Estimating Production Functions Using Inputs to Control for Unobservables', *Review of Economic Studies,* 70(2), pp.317–41.

Liu, Q. and Y. Lu (2015), 'Firm Investment and Exporting: Evidence from China's Value-Added Tax Reform', *Journal of International Economics*, 97, pp.392–403.

Liu, Y. and J. Mao (2019), 'How Do Tax Incentives Affect Investment and Productivity? Firm-Level Evidence from China', *American Economic Journal: Economic Policy*, 11(3), pp.261–91.

Lu, Y., Z. Tao, and L. Zhu (2017), 'Identifying FDI Spillovers', *Journal of International Economics*, 107, pp.75–90.

Maffini, G., J. Xing, and M.P. Devereux (2016), 'The Impact of Investment Incentives: Evidence from UK Corporation Tax Returns', *Oxford University Centre for Business Taxation Working Paper* 1601. Oxford: Oxford University.

Mertens, K. and M.O. Ravn (2012), 'Empirical Evidence on the Aggregate Effects of Anticipated and Unanticipated US Tax Policy Shocks', *American Economic Journal: Economic Policy,* 4(2), pp.145–81.

National Bureau of Statistics, *China Statistical Yearbook*, 2000–2013. Beijing: China Statistics Press.

Song, Z. and G. Wu (2012), A Structural Estimation on Capital Market Distortions in Chinese Manufacturing, *mimeo*, University of Chicago.

Wakasugi, R. and H. Zhang (2016), 'Impacts of the WTO Accession on Chinese Exports', *Journal of Chinese Economic and Business Studies,* 14, pp.347–64.

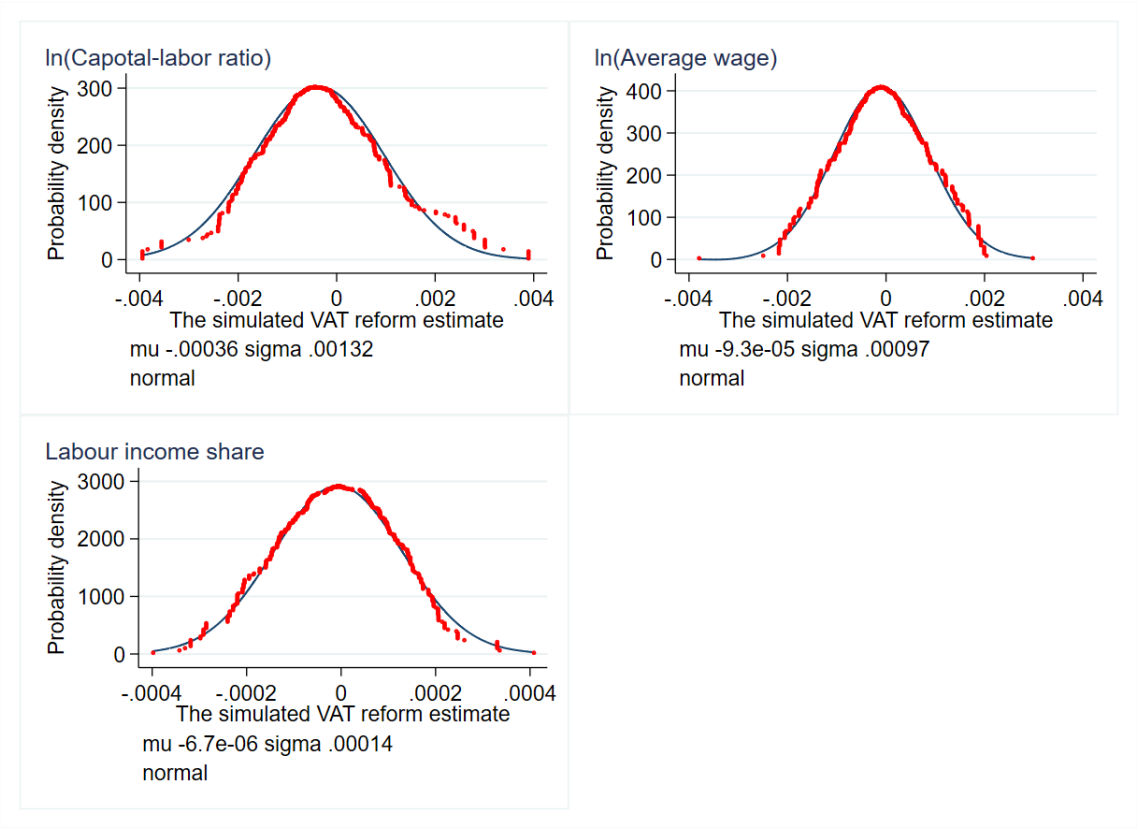
Yagan, D. (2015), 'Capital Tax Reform and the Real Economy: The Effects of the 2003 Dividend Tax Cut', *American Economic Review*, 105(12), 3531–63.

Yu, M. (2014), 'Processing Trade, Tariff Reduction, and Firm Productivity: Evidence from Chinese Firms', *The Economic Journal*, 125, pp.943–88.

Zwick, E. and J. Mahon (2017), 'Tax Policy and Heterogeneous Investment Behavior', *American Economic Review,* 107(1), pp.217–48.

Appendix

Figure A1: The Distribution of Estimates for the 'False' VAT Reform Variable



Note: The figure plots the density of the estimated coefficients of the 'false' VAT reform variable from the 500 simulation tests using the specification in column (3) of Table 2. The vertical red lines present the treatment effect estimates reported in column (3) of Table 2.
Source: Authors' estimation based on the ASIF data set.

ERIA Discussion Paper Series

No.	Author(s)	Title	Year
2020-09 (no. 336)	Juthathip JONGWANICH, Archanun KOHPAIBOON, Ayako OBASHI	Technological Advancement, Import Penetration, and Labour Markets: Evidence from Thai Manufacturing	August 2020
2020-08 (no. 335)	Duc Anh DANG, Thu Thu VU	Technology Imports and Employment in Developing Countries: Evidence from Viet Nam	August 2020
2020-07 (no. 334)	Hiroaki ISHIWATA, Hiroyuki WADA, Koji SUZUKI, Makoto IKEDA, Naoto TADA	A Quantitative Analysis of Disaster Risk Reduction Investment Effects for Sustainable Development: Indonesia Case Study	June 2020
2020-06 (no. 333)	Dao Ngoc TIEN, Nguyen Quynh HUONG	Assessment of Industrial Cluster Policies in Viet Nam: The Role of Special Economic Zones in Attracting Foreign Direct Investment	June 2020
2020-05 (no. 332)	Ayako OBASHI, Fukunari KIMURA	New Developments in International Production Networks: Impact of Digital Technologies	June 2020
2020-04 (no. 331)	Upalat KORWATANASAKUL, Youngmin BAEK, Adam MAJOE	Analysis of Global Value Chain Participation and the Labour Market in Thailand: A Micro-level Analysis	May 2020
2020-03 (no. 330)	Ha Thi Thanh DOAN, Huong Quynh NGUYEN	Trade Reform and the Evolution of Agglomeration in Vietnamese Manufacturing	April 2020
2020-02 (no. 329)	Kazunobu HAYAKAWA, Tadashi ITO, Shujiro URATA	Labour Market Impacts of Import Penetration from China and Regional Trade Agreement Partners: The Case of Japan	April 2020
2020-01 (no. 328)	Fukunari KIMURA, Shandre Mugan THANGAVELU,	Pandemic (COVID-19) Policy, Regional Cooperation, and the Emerging Global Production Network	April 2020

	Dionisius A. NARJOKO, Christopher FINDLAY		
2019-41 (no. 327)	Lurong CHEN	Improving Digital Connectivity For E-commerce: A Policy Framework and Empirical Note for ASEAN	March 2020
2019-40 (no. 326)	DAO Ngoc Tien and Huong Qyunh NGUYEN	Tariff Policies and Wages in Manufacturing Industries: New Evidence from Viet Nam	March 2020
2019-39 (no. 325)	Kazunobu HAYAKAWA, Nuttawut LAKSANAPANYAKUL, Toshiyuki MATSUURA	Do Regional Trade Agreements Really Help Global Value Chains Develop? Evidence from Thailand	March 2020
2019-38 (no. 324)	Venkatachalam ANBUMOZHI, Peter WOLFF, Xianbin YAO	Policies and Financing Strategies for Low-Carbon Energy Transition: Overcoming Barriers to Private Financial Institutions	February 2020
2019-37 (no. 323)	Deborah WINKLER	Global Value Chain Participation and the Relative Demand for Skilled Labour in East Asia	February 2020
2019-36 (no. 322)	Duc Anh DANG and Hai Anh LA	The Effects of the Temporary Protection on Firm Performance: Evidence from the Steel Industry in Viet Nam	February 2020
2019-35 (no. 321)	Kazunobu HAYAKAWA, Hayato K ATO, Toshiyuki MATSUURA, Hiroshi MUKUNOKI	Production Dynamics in Multi-Product Firms' Exporting	February 2020
2019-34 (no. 320)	Chin Hee HAHN, Yong-Seok CHOI	Learning-to-Export Effect as a Response to Export Opportunities: Micro-Evidence from Korean Manufacturing	February 2020
2019-33 (no. 319)	Samuel NURSAMSU, Dionisius NARJOKO, Titik ANAS	Input Allocation Behaviour on Tariff Changes: The Case of Indonesia's Manufacturing Industries	February 2020
2019-32 (no. 318)	Toshiyuki MATSUURA, Hisamitsu SAITO	Foreign Direct Investment and Labour Market Dynamics in a Developing Country: Evidence from Indonesian Plant-Level Data	February 2020
2019-31 (no. 317)	Nobuaki YAMASHITA, Isamu YAMAUCHI	Exports and Innovation: Evidence from Antidumping Duties Against Japanese	February 2020

		Firms	
2019-30 (no. 316)	Juthathip JONGWANICH, Archanun KOHPAIBOON	Effectiveness of Industrial Policy on Firms' Productivity: Evidence from Thai Manufacturing	February 2020
2019-29 (no. 315)	Chin Hee HAHN, Ju Hyun PYUN	Does Home (Output) Import Tariff Reduction Increase Home Exports? Evidence from Korean Manufacturing Plant–Product Data	February 2020
2019-28 (no. 314)	Thi Ha TRAN, Quan Hoan TRUONG, Van Chung DONG	Determinants of Product Sophistication in Viet Nam: Findings from the Firm–Multi-Product Level Microdata Approach	February 2020
2019-27 (no. 313)	Venkatachalam ANBUMOZHI, Matthew LOCASTRO, Dharish DAVID, Dian LUTFIANA, Tsani Fauziah RAKHMAH	Unlocking the Potentials of Private Financing for Low-carbon Energy Transition: Ideas and Solutions from ASEAN Markets	January 2020
2019-26 (no. 312)	Takashi HONGO, Venkatachalam ANBUMOZHI	Building the Banking Sector's Capacity for Green Infrastructure Investments for a Low-Carbon Economy	January 2020
2019-25 (no. 311)	Peter A. PETRI, Meenal BANGA	The Economic Consequences of Globalisation in the United States	January 2020
2019-24 (no. 310)	Kaliappa KALIRAJAN, HUONG Thi Thu Tran, Yochang LIU	Scalling up Private Investment in Low-Carbon Energy Systems through Regional Cooperation: Market-Based Trade Policy Measures	January 2020
2019-23 (no. 309)	VO Tri Thanh	Enhancing Inter-Firm Linkages through Clusters and Digitalisation for Productivity Growth	January 2020
2019-22 (no. 308)	Archanun KOHPAIBOON, Juthathip JONGWANICH	Economic Consequences of Globalisation: Case Study of Thailand	December 2019

2019-21 (no. 307)	Cassey LEE	Globalisation and Economic Development: Malaysia's Experience	December 2019
2019-20 (no. 306)	Christopher FINDLAY, Kostas MAVROMARAS, Zhang WEI	Economic Consequences of Globalisation: The Australian Framework for Reforms	December 2019
2019-19 (no. 305)	Md Abdullah AL MATIN, Shutaro TAKEDA, Yugo TANAKA, Shigeki SAKURAI, Tetsuo TEZUKA	LCOE Analysis for Grid-Connected PV Systems of Utility Scale Across Selected ASEAN Countries	November 2019
2019-18 (no. 304)	Miaojie YU, Huihuang ZHU	Processing Trade, Trade Liberalisation, and Opening Up: China's Miracle of International Trade	November 2019
2019-17 (no. 303)	Thanh Tri VO, Duong Anh NGUYEN, Thien Thi Nhan DO	Economic Consequences of Trade and Investment Liberalisation: The Case of Viet Nam	November 2019
2019-16 (no. 302)	Masahiko TSUTSUMI, Masahito AMBASHI, Asuna OKUBO	FTA Strategies to Strengthen Indonesian Exports: Using the Computable General Equilibrium Model	November 2019
2019-15 (no. 301)	Shujiro URATA, Youngmin BAEK	Does Participation in Global Value Chains Increase Productivity? An Analysis of Trade in Value Added Data	November 2019
2019-14 (no. 300)	Keiko ITO	The Impact of Economic Globalisation on Firm Performance and the Labour Market: Evidence from Japan	October 2019
2019-13 (no. 299)	Markus NORNES	Exporting 'Content' in the Face of Indifference	September 2019
2019-12 (no. 298)	Trinh W. LONG, Matthias HELBLE, Le T. TRANG	Global Value Chains and Formal Employment in Viet Nam	September 2019
2019-11 (no. 297)	Makoto TOBA, Atul KUMAR, Nuwong CHOLLACOOP, Soranan NOPPORNPRASITH, Ad	Evaluation of CO_2 Emissions Reduction through Mobility Electification	September 2019

	hika WIDYAPARAGA, Ruby B. de GUZMAN, Shoichi ICHIKAWA		
2019-10 (no.296)	Anne MCKNIGHT	Words and Their Silos: Commercial, Governmental, and Academic Support for Japanese Literature and Writing Overseas	August 2019
2019-09 (no.295)	Shinji OYAMA	In the Closet: Japanese Creative Industries and their Reluctance to Forge Global and Transnational Linkages in ASEAN and East Asia	August 2019
2019-08 (no.294)	David LEHENY	The Contents of Power: Narrative and Soft Power in the Olympic Games Opening Ceremonies	August 2019
2019-07 (no.293)	DUC Anh Dang	Value Added Exports and the Local Labour Market: Evidence from Vietnamese Manufacturing	August 2019
2019-06 (no.292)	Premachandra ATHUKORALA, Arianto A. PATUNRU	Domestic Value Added, Exports, and Employment: An Input-Output Analysis of Indonesian Manufacturing	August 2019
2019-05 (no.291)	Sasiwimon W. PAWEENAWAT	The Impact of Global Value Chain Integration on Wages: Evidence from Matched Worker-Industry Data in Thailand	August 2019
2019-04 (no.290)	Tamako AKIYAMA	A Spark Beyond Time and Place: Ogawa Shinsuke and Asia	August 2019
2019-03 (no.289)	Naoyuki YOSHINO, Farhad TARGHIZADEH-HESARY	Navigating Low-Carbon Finance Management at Banks and Non-Banking Financial Institutions	August 2019
2019-02 (no.288)	Seio NAKAJIMA	The Next Generation Automobile Industry as a Creative Industry	June 2019
2019-01 (no.287)	Koichi IWABUCHI	Cool Japan, Creative Industries and Diversity	June 2019

ERIA discussion papers from the previous years can be found at:

http://www.eria.org/publications/category/discussion-papers