Revenue-neutral tax reform in China

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Introduction

As China’s decades-long phenomenal economic growth gradually loses momentum, the tension between cutting taxes to promote growth and maintaining fiscal revenue looms large for the country’s governments. From 1978 to 2011, the average growth rate of China’s economy was more than 9 per cent. Since 2012, it has entered the so-called ‘new normal’ of declining growth. Over the past three years, the downward pressure has further strengthened. The new domestic and international economic situation has brought challenges to fiscal and monetary policies. Fiscal and tax reforms characterised by tax and fee reductions (jianfei jiangshui) have emerged as key policies for three reasons. First, expansionary monetary policy is already bounded by global low interest rates. Additionally, monetary policy is expected to remain stable due to concerns about asset bubbles and inflation. Second, conventional fiscal stimulus through public investment is already subject to diminishing marginal effects. Third, the general consensus holds that many businesses in China are suffocating from rising costs and high taxes. Therefore, reducing taxes and fees seems to be an inevitable policy choice for Chinese governments.
To reduce the burden on firms and restore market vitality, the Central Committee of the Chinese Communist Party and the State Council have continued in recent years to introduce policies and measures to cut taxes and fees. However, given the current economic situation and the fiscal and taxation systems, these tax cuts led to a decline in revenue. On 1 May 2018, the value-added tax (VAT) rate for manufacturing and other industries decreased from 17 per cent to 16 per cent and the rate for transportation and other industries decreased from 11 per cent to 10 per cent. The scale of VAT reduction from May to December 2018 was about RMB270 billion. Based on this rough calculation, if the VAT is reduced by 1 percentage point, China’s annual tax revenue will drop by RMB462.86 billion, which is 7.52 per cent of China’s domestic VAT revenue in 2018 and 2.5 per cent of the national general public budget. The amount exceeds the government’s total expenditure on culture, sport and media, and is close to its total expenditure on environmental protection. On 1 April 2019, the Ministry of Finance, the State Taxation Administration and the General Administration of Customs released ‘Circular No. 39 of 2019’, stipulating that, for general VAT taxpayers in China, taxable sales of imported goods would be adjusted from 16 per cent to 13 per cent; tax rates originally applicable at 10 per cent would be adjusted to 9 per cent. In a press conference held by the State Taxation Administration on 23 July 2019, Cai Zili, executive deputy director of the Taxation Reduction Office and director of the Department of Revenue Planning and Accounting, stated that, from April to June 2019, net VAT reductions reached RMB318.5 billion (State Taxation Administration of China 2019b). Based on our calculations, the net reduction of VAT in those three months exceeded total expenditure on energy conservation and environmental protection for the first half of 2019.

The decline in tax revenue may harm the economy. Due to rigid demand for local fiscal expenditure, ‘tax reduction and fee reduction’ may turn into ‘tax reduction and fee increase’. This is not only consistent with the typical response of local governments, but also confirmed by recent tax and non-tax revenue data. If this happens, the policy goal of stimulating business vitality through tax and fee reductions will be difficult to achieve. Guo (2019) believes ongoing tax and fee reductions will see

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1 Especially since 1 April 2019, China’s manufacturing VAT rate has been reduced from 16 per cent to 13 per cent. The VAT rates in construction and other industries have been reduced from 10 per cent to 9 per cent. On 22 March 2019, the Economic Daily asked in the headline to the story about the tariff reduction measures, ‘Unclear: Do we mean “the largest tax cuts in history”?‘ (Sohu Technology 2019).

2 According to the Ministry of Finance’s ‘Financial Revenue and Expenditure in the First Half of 2019’, released on 13 July 2019, national tax revenue in the first half of 2019 increased by 0.9 per cent year-on-year, and non-tax revenue increased by 21.4 per cent year-on-year (State Taxation Administration of China 2019a). On 10 May 2019, Premier Li Keqiang clearly emphasised at the panel discussion on the implementation of the tax reduction and fee reduction policy that ‘[we must] resolutely prevent the use of various names to arbitrarily charge fees, and we must not allow anyone to hinder tax reduction and fee reduction’ (China Network of Court 2019). Guo (2019) shows that in total local government fiscal revenue, the proportion of the general public budget revenue fell from 46.4 per cent in 2015 to 40.5 per cent in 2018, while the proportion of government funding revenue continued to increase, from 22.1 per cent to 29.9 per cent.
the fiscal deficits and revenues of governments at all levels significantly affected and may trigger fiscal risks. Due to a lack of new tax sources, local governments will have to borrow in response to falling fiscal revenues, which may worsen local debt problems. Furthermore, the decline in tax revenue may lead local governments to reduce expenditure on education and public security, resulting in adverse effects on social equity, human capital accumulation and social stability.\(^3\)

The main constraint facing China’s fiscal policy is how to reduce taxes and fees while securing fiscal revenue. Scholars in China have proposed various policy solutions.\(^4\) In this study, we propose a revenue-neutral reform characterised by ‘rate cuts and productivity enhancement’—that is, by reducing the statutory tax rate (‘rate cut’), strengthening tax enforcement and administration, reducing disparities in effective tax rates among firms and improving aggregate production efficiency (‘productivity enhancement’), governments can maintain tax revenue from a greater tax base. This chapter combines the classic Allingham and Sandmo (1972) tax-evasion model, Hopenhayn’s (2014) resource misallocation model and Olley and Pakes’ (1996) productivity theory to analyse the feasibility of revenue-neutral reform. Based on the National Statistics on Prefecture, City, and County Finance for 2000 to 2007 (Ministry of Finance 2000–07), and annual firm-level data from the Annual Survey of Industrial Production (NBS 2000–07), we use the abolition of agricultural taxes in 2005 as a fiscal shock to county governments to study the impact on tax enforcement and subsequent allocation efficiency across firms. Based on the estimated key parameters from the reduced-form regressions, we estimate the lower bound for the VAT rate deduction under the revenue-neutral reform model. We show that improved tax enforcement can reduce the effective tax rate difference between firms and enhance aggregate productivity. The estimation results show that, in an ideal scenario where all firms uniformly pay the statutory tax rate, the rate can be reduced to around 13 per cent without changing tax revenue.

The preconditions of the revenue-neutral reform we propose are that China’s tax enforcement and administration are subject to serious problems. Many empirical studies have provided direct evidence of the discretionary power of local governments, even when it comes to VAT collection, which is usually thought to be very strictly enforced. For example, Chen (2017b) used the abolition of China’s agricultural taxes in 2005 as a quasi-natural experiment and found that the VAT rate of firms in counties with greater fiscal pressure after the reform increased significantly. Lu and Guo (2011) believe improvements in tax enforcement and administration are the main cause of increases in tax revenue.

\(^3\) After local government revenues decreased, education expenditures have decreased significantly.

\(^4\) For example, Guo (2019) proposed measures to address fiscal risks caused by tax and fee reductions by formulating fiscal consolidation strategies, strengthening fiscal governance and implementing tax expenditure budgets.
Moreover, weak tax enforcement leads to dispersion in effective tax rates across firms. Of course, we may expect this dispersion to gradually decrease with the simplification of tax rates and adoption of tax-collection technology; however, several recent studies show, surprisingly, that the dispersion in the effective tax rate across firms did not in fact decline between 2007 and 2017 (Bai et al. 2019; Lu 2019).

According to theories of misallocation (Restuccia and Rogerson 2008; Hsieh and Klenow 2009), dispersion in tax rates across firms can lead to the misallocation of resources among firms and reduce aggregate productivity. Chen (2017b) found that there is a big difference between the statutory VAT rate and the effective tax rate in China, and the total factor productivity (TFP) loss caused by dispersion in the VAT rate was as high as 7.9 per cent.

Existing studies of tax and fee reductions in China mainly aim to reduce the burden on firms. Few have analysed resource allocation at the macro-level or aggregate productivity. Our study makes the following contributions to the literature: first, we theoretically study the feasibility of revenue-neutral reform and its underlying mechanisms, which are based on a positive feedback loop of ‘lower tax rate → better tax enforcement and compliance → higher productivity → greater tax base → lower tax rate’. Second, using the estimates of key parameters, we calculate the lower bound of the statutory VAT rate that is able to sustain revenue-neutral reform.

The rest of the chapter is organised as follows: section two proposes a theoretical model; section three conducts the empirical work; section four quantifies the lower bound of the VAT rate deduction under the revenue-neutral reform; while section five concludes.

**Theoretical model**

This section proposes a model to explain the key mechanisms underlying the proposed revenue-neutral reform. The model includes firms’ tax-evasion behaviour and production and governments’ tax enforcement. The model features two mechanisms. On the one hand, strict tax enforcement and administration can reduce the dispersion in effective tax rates across firms, thereby improving the efficiency of resource allocation. On the other, a reduction in the statutory tax rate leads to better compliance, which consequently reduces effective tax rate disparities across firms and further improves aggregate productivity. In the end, ‘rate reduction’ and

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5 Bai et al. (2019) use data from the 2007–15 China Tax Survey on corporate taxation inequality to show that, for Chinese companies, the actual tax rate has actually increased since 2009. Lu (2019) showed the discretionary tax enforcement in total taxation, VAT and corporate income tax using Chinese listed-company data for 2008–17, and suggested there is no downward trend in the actual tax rate.
productivity enhancement' form a virtuous cycle. To verify whether the theoretical model is in line with China's current reality, we formulate testable propositions from the model to guide our empirical work.

Framework

Assume that all firms are facing the same statutory tax rate, $t$. Due to the lack of strict tax enforcement and administration, firms are evading tax to varying degrees; $\tau_i$ is the effective tax rate for company $i$.

**Definition 1:** Strict tax enforcement and administration refer to $\tau_i = t$ for $\forall i$. Lax tax enforcement and administration mean the following two conditions hold at the same time:

- The effective tax rate of some firms is lower than the statutory tax rate, $\tau_i \leq t$ for $\forall i$ and $\exists i$, such that $\tau_i < t$.
- There are dispersions in effective tax rates between firms—that is: $\text{var}(\tau_i) > 0$.

We introduce the parameter $\epsilon \in [0, +\infty)$, which represents the degree of tax enforcement and administration; $\text{var}(\tau_i)$ is a decreasing function in $\epsilon$. When enforcement is very strict, we have $\epsilon \to +\infty$, thus $\text{var}(\tau_i)$. When collection is abnormally lax, we have $\epsilon \to 0$ and $\text{var}(\tau_i) \to +\infty$.

Let $y_i$ be the output of firm $i$, $p_i$ is the corresponding price, $Y$ is total output and $P$ the price, which is normalised to 1.

Government tax revenue is shown as Equation 5.1.

**Equation 5.1**

$$T = \sum_{i} \tau_i p_i y_i = \bar{\tau}P Y$$

In Equation 5.1, $\bar{\tau} = \sum_i w_i \tau_i$ is the macro effective tax rate, which is the weighted average of the firm's effective tax rate, $\tau_i$; the weight is $w_i = \frac{p_i y_i}{PY}$ and content is $\sum_i p_i y_i = PY$.

To facilitate analysis, we assume that the production function satisfies the form of $AK$; $k_i$ is the capital stock of firm $i$ and the total capital is $k = \sum_i k_i$. The aggregate production function is $Y = TFP \cdot K$, where $TFP$ represents the aggregate total factor productivity. If there is dispersion in effective tax rates between firms, the misallocation will reduce the $TFP$ to a level lower than $TFP^e$ at which resources are efficiently allocated. With $P = 1$, Equation 5.1 can be written as Equation 5.2.

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6 We ignore the rare case of $\tau_i \leq t$ for $\forall i$, and $\text{var}(\tau_i) > 0$.

7 The conclusion of the Cobb–Douglas production function still holds. We use the $AK$ model for convenience of exposition.
In Equation 5.2, capital, $K$, is a function of the effective tax rate.

Under circumstances in which the effect of tax rate reduction on investment is small, tax revenue is at the rising part on the left side of the Laffer curve. There is a tension between tax rate reduction and maintaining tax revenue. To simplify the analysis, we make the following assumptions.

**Assumption 1:** $-d\ln K/d\ln \bar{\tau} < 1$. That is, the elasticity of net investment to the effective macro tax rate is less than 1, and the tax incentive for investment is small.

Generally, $\bar{\tau}$ is a function of the statutory tax rate, $t$. Additionally, the level of tax enforcement and administration, $\varepsilon$, also affects $\bar{\tau}$ and $TFP$. The relationships can be represented, respectively, by $\bar{\tau}(t;\varepsilon)$ and $TFP(\varepsilon)$, for which we formulate the following two assumptions.

**Assumption 2:** When tax collection is strict ($\varepsilon = +\infty$), we have $\bar{\tau}(t;\varepsilon) = t$. When tax collection is lax ($\varepsilon < +\infty$), we have $\bar{\tau}(0;\varepsilon) = 0$ if $t = 0$ and $\bar{\tau} = 0$; and, for a given tax enforcement intensity, $\varepsilon$, we have $\bar{\tau}(t;\varepsilon) < t$ and $0 < \partial\bar{\tau}(t;\varepsilon)/\partial t \leq 1$. That is, when the statutory tax rate is zero, the macro effective tax rate is also zero; the macro effective tax rate, $\bar{\tau}$, is lower than the statutory tax rate, $t$, and increases as the statutory tax rate rises.

**Assumption 3:** $\partial\bar{\tau}(t;\varepsilon)/\partial \varepsilon > 0$, $dTFP(\varepsilon)/d\varepsilon > 0$. Both the macro effective tax rate, $\bar{\tau}(t;\varepsilon)$, and $TFP(\varepsilon)$ increase as the tax enforcement intensity, $\varepsilon$, increases.

Based on Assumptions 1–3, we will analyse the properties of the Laffer curve when the tax enforcement intensity, $\varepsilon$, varies.

The Laffer curve reflects the relationship between tax, $T$, and the statutory tax rate, $t$, for a given level of tax enforcement and administration. According to the analysis above, we know: $T(t;\varepsilon) = \bar{\tau}(t;\varepsilon) \cdot TFP(\varepsilon) \cdot K(\bar{\tau}(t;\varepsilon))$.

Given the tax enforcement intensity, $\varepsilon$, the relationship between tax, $T(t;\varepsilon)$, and the statutory tax rate, $t$, is the Laffer curve, and $\partial T(t;\varepsilon)/\partial t$ indicates the monotonicity of the Laffer curve. Given a statutory tax rate, $t$, the tax, $T(t;\varepsilon)$, changes with the tax enforcement intensity, $\varepsilon$, and different values of $\varepsilon$ correspond to different Laffer curves.
Let the Laffer curve under strict tax-collection conditions \((\varepsilon = +\infty)\) be \(T'(t)\), and under lax collection conditions the Laffer curve is \(T(t;\varepsilon)\). The following two propositions hold.

**Proposition 1:** Under Assumptions 1–3, the Laffer curve, \(T(t;\varepsilon)\), monotonically increases with the statutory tax rate, \(t\), and the Laffer curve with a low level of tax enforcement is located below that with a high level of enforcement.

Since the Laffer curve, \(T(t;\varepsilon)\), increases monotonically with the statutory tax rate, \(t\), lowering the tax rate will inevitably lead to lower taxes. However, Proposition 2 shows that, by strengthening tax enforcement and administration, the government can reduce tax rates and ensure that revenues remain unchanged, which means it is feasible to launch a revenue-neutral reform with tax rate reduction.

**Proposition 2:** Under the condition that the taxation income, \(T(t;\varepsilon) \equiv \bar{T}\), is unchanged, we have \(\Delta = -\frac{\partial T'}{\partial t} \cdot \Delta \varepsilon\), and the statutory tax rate, \(t\), and the tax enforcement intensity, \(\varepsilon\), are inversely changed.

Propositions 1–2 can be shown in Figure 5.1, where the horizontal axis represents the statutory tax rate and the vertical axis is total tax revenue. \(T(t)\) represents the Laffer curve under completely strict management conditions. \(T(t;\varepsilon_0)\) is the Laffer curve with statutory tax rate \(t\) and collection level \(\varepsilon_0\). When the statutory tax rate is \(t_0\), the total tax revenue is \(\bar{T}\). The equilibrium point is at A. When the statutory tax rate is unchanged and the tax enforcement and administration level is increased from \(\varepsilon_0\) to \(\varepsilon_1\), the Laffer curve rises from \(T(t;\varepsilon_0)\) to \(T(t;\varepsilon_1)\), the equilibrium point becomes point B and the total tax revenue corresponding to point B is higher than \(\bar{T}\). In a revenue-neutral reform, we can reduce the statutory tax rate to \(t_1\) and move the equilibrium from point B to point C. As the equilibrium point changes from point A to point C, total tax revenue remains unchanged, the level of tax enforcement and administration increases from \(\varepsilon_0\) to \(\varepsilon_1\) and the statutory tax rate decreases from \(t_0\) to \(t_1\). The variation in \(\bar{T}\) from point A to point B can be captured by \(\partial T' / \partial \varepsilon\), and that from point B to point C by \(\partial T' / \partial t\).
Figure 5.1 Tax enforcement and the Laffer curve

Source: Authors’ calculations.

Micro-foundation of the Laffer curve

This section provides the micro-foundation for the Laffer curve shown in Figure 5.1. It consists of two parts: firms’ tax evasion and firms’ production. For analytical convenience, the model assumes that firms’ tax evasion and production are handled by different departments. The financial department is responsible for taxation and the production department for hiring labour and producing goods.

Analysis of firms’ tax evasion

Drawing on the classic model of Allingham and Sandmo (1972), this section analyses how the effective tax rate of a firm in the presence of tax evasion is affected by the following three policies of the tax department: tax audit (probability $\eta$), tax evasion penalty (variable $F$) and the statutory tax rate, $t$. In the model, the statutory tax, $t$, applies to all firms, but due to the existence of tax discretion and tax cost differences, $\eta$ and $F$ differ from firm to firm, resulting in different equilibrium effective tax rates, $\tau$, across firms, further generating resource misallocation and loss of aggregate productivity.
Assuming the government levies taxes on total sales revenue, the sales revenue of firm $i$ is $s_i$, the statutory tax base is $t$, the revenue reported by the firm to the tax department is $x_i$, and the amount of tax evasion by the firm is $t(s_i - x_i)$. The probability that the government will conduct tax audits on firms is $\eta_i$. In the presence of an audit, firms’ tax evasion will be detected. Firms not only need to pay the tax in full, but also face a penalty of $F_i(s_i - x_i)$, where $F_i$ is a fixed constant. For the sake of calculation, we assume that the utility function of the firms’ financial department is Equation 5.3.

**Equation 5.3**
\[
\max_{x_i}(1-\eta_i)u(c_n) = \eta_i u(c_f)
\]

In Equation 5.3, $u(\cdot)$ is the state utility function; $c_n = s_i - tx_i$ is the after-tax income when tax evasion was not caught; otherwise, $c_f = (1-t)s_i - F_i(s_i - x_i)$ is the net income after tax payment and fines.

The firm’s optimal tax declaration decision, $x_i^*$, is determined by the following first-order conditions (Equation 5.4).

**Equation 5.4**
\[
\frac{(1-\eta_i)}{F_i} = \frac{u'((1-t)s_i - F_i(s_i - x_i))}{u'(s_i - tx_i)}
\]

With $x_i^*$, the company’s average effective tax rate is Equation 5.5.

**Equation 5.5**
\[
\bar{\tau}_i = \frac{\sum_{i=1}^{n} x_i^*}{n} + \eta_i \cdot t
\]

Propositions 5–6 explain how the tax enforcement intensity, $\varepsilon$, affects the mean, $\bar{\tau}$, and variance, $\text{var}(\tau)$.

**Assumption 4:** Assuming $-\frac{\partial \ln w_i}{\partial \ln \tau_i} < 1$, the elasticity of the tax base to the effective tax rate is less than 1, $(w_i \cdot \frac{\partial \ln \tau_i}{\partial \ln t_i}$ (please refer to Equation 5.1)).

Following the model above and Assumption 4, we can obtain Propositions 3–5. Combined with Assumption 5, we can get Propositions 6–7.

**Proposition 3:** As the statutory tax rate rises, the effective tax rate faced by firms increases, and the macro effective tax rate of the economy also rises. That means for any firm, $i$, there is $\partial \tau_i / \partial t > 0$. Combined with Assumption 4, we get $\partial \bar{\tau} / \partial t > 0$.

**Proposition 4:** Strengthening penalties and inspections can increase effective tax rates. That means for any firm, $i$, we have $\partial \tau_i / \partial F_i > 0$, $\partial \tau_i / \partial \eta_i > 0$. 
Proposition 5: Treating all taxpayers fairly can reduce the difference in effective tax rates between firms—that is, $\frac{\partial F_i}{\partial \epsilon} > 0$.

Propositions 4–5 imply $\frac{\partial \text{var}(\tau_i)}{\partial \text{var}(F_i)} > 0$ and $\frac{\partial \text{var}(\tau_i)}{\partial \text{var}(\eta_i)} > 0$.

Assumption 5: For any firm, $i$, we have $\frac{\partial F_i}{\partial \epsilon} \geq 0$. For firm $i$, we have $\frac{\partial F_i}{\partial \epsilon} > 0$ and $\frac{\partial \text{var}(F_i)}{\partial \epsilon} < 0$. For any firm, $i$, there is $\frac{\partial \eta_i}{\partial \epsilon} \geq 0$, and there exists firm $i$, such that $\frac{\partial \eta_i}{\partial \epsilon} > 0$ and $\frac{\partial \text{var}(\eta_i)}{\partial \epsilon} < 0$. That means, when tax enforcement, $\epsilon$, is strengthened, the punishment for tax evasion, $F_i$, or the audit probability, $\eta_i$, would increase, and discretion over punishment or audit probabilities among firms is reduced.

Proposition 6: Under Assumptions 4–5, we have $\frac{\partial \bar{\tau}}{\partial \epsilon} > 0$.

Proposition 7: Under Assumptions 4–5, we have $\frac{d \text{var}(\tau_i)}{d \epsilon} < 0$.

Firms’ production decisions

This section analyses the relationship between the distribution of the effective tax rate, $\tau_i$, across firms and the aggregate TFP of the economy. Firms’ production function takes the form $AK$ in Equation 5.6.

Equation 5.6

$$y_i = A_i k_i$$

In Equation 5.6, $y_i$ is the total output of firm $i$ and $k_i$ is the capital stock. Assuming the firm is in a monopolistic competitive industry, the demand function of the firm is $p_i = Q - \theta$.

The problem of profit maximisation is $\max \ (1 - \tau_i) A_i^{\theta} k_i^{1-\theta} - r k_i$, in which $\tau_i$ is the effective tax rate of firm $i$. The solution to the problem above is $k_i = A_i^{\frac{\theta}{1-\theta}} (1 - \tau_i)^{\frac{1}{\theta}} (1 - \theta)^{\frac{1}{\theta}} r^{\frac{1}{\theta}}$.

Correspondingly, the optimal total output level of firm $i$ is Equation 5.7.

Equation 5.7

$$y_i = A_i^{\frac{\theta}{1-\theta}} (1 - \tau_i)^{\frac{1}{\theta}} (1 - \theta)^{\frac{1}{\theta}} r^{\frac{1}{\theta}}$$

And the total capital of all firms is Equation 5.8.

Equation 5.8

$$K = \sum_{i=1}^{N} k_i = (1 - \theta)^{\frac{1}{\theta}} r^{\frac{1}{\theta}} \sum_{i=1}^{N} A_i^{\frac{\theta}{1-\theta}} (1 - \tau_i)^{\frac{1}{\theta}}$$
According to Olley and Pakes’s definition of $TFP$, we have Equation 5.9.

**Equation 5.9**

\[
TFP = \frac{\sum_{i=1}^{N} \frac{y_i}{\sum_{i=1}^{N} y_i} \cdot A_i}{\sum_{i=1}^{N} A_i}
\]

By substituting Equation 5.7 into Equation 5.9, we can get Equation 5.10.

**Equation 5.10**

\[
TFP = \frac{\sum_{i=1}^{N} A_i^{1+\theta} (1-\tau_i)^{\frac{1}{2}}}{\sum_{i=1}^{N} A_i^{\frac{1}{2}} (1-\tau_i)^{\frac{1}{2}}}
\]

Assuming $\ln A_i$ and $\ln (1-\tau_i)$ follow a joint normal distribution, the correlation coefficient between the two variables is $-\rho (\rho > 0)$. From Equation 5.10, we can prove that $\log TFP$ can be expressed as Equation 5.11.

**Equation 5.11**

\[
\log TFP = \ln A_i + \frac{2+\theta}{\theta} \var[\ln(A_i)] - \frac{\rho}{\theta} \sqrt{\var[\ln(A_i)]} \cdot \sqrt{\var[\ln(1-\tau_i)]}
\]

Equation 5.11 shows that the larger the variance of the effective tax rate, the lower is the efficiency of resource allocation.

**Impact of tax enforcement intensity, $\varepsilon$, on aggregate $TFP$**

Based on the results of sections one and two, we have the following conclusions about the relationship between the level of tax enforcement and the aggregate $TFP$.

**Proposition 8**: $\partial \ln TFP/\partial \varepsilon > 0$.

So far, Propositions 3, 6 and 8 have provided microeconomic foundations for Assumptions 2–3 in section one.

Now we turn to the empirical test of three key hypotheses.
Empirical test

Hypotheses and empirical strategies

Based on the theoretical analyses in section two, we propose the following testable hypotheses.

**Hypothesis 1:** When the statutory tax rate remains unchanged, firms’ effective tax rate rises as regional fiscal pressure increases (that is, Assumption 3).

**Hypothesis 2:** When the statutory tax rate remains unchanged, as regional fiscal pressure increases, the decrease in the percentage of production factors (capital stock, labour) is lower than the increased percentage of the effective tax rate (that is, Assumption 1).

**Hypothesis 3:** When the statutory tax rate is unchanged, the variance of the effective tax rate among firms reduces as regional fiscal pressure increases. And, when $\ln A_i$ and $\ln (1 - \tau_i)$ are negatively correlated, the aggregate resource-allocation efficiency improves (that is, Assumption 3).

Chen (2016, 2017a) used the abolition of agricultural taxes as a quasi-natural experiment to verify Hypothesis 1. We use similar empirical strategies to test Hypotheses 2 and 3. We show the prerequisite of Hypothesis 3 ($\ln A_i$ and $\ln (1 - \tau_i)$ are negatively correlated) in section three (relationships among the main variables).

Data sources

The empirical study in this chapter examines whether fiscal pressure has affected the differences in the effective VAT rates for China’s manufacturing firms and ultimately improved the efficiency of manufacturing resource allocation. For this purpose, we use two datasets for our quantitative analysis: the *Annual Survey of Industrial Production* conducted by the National Bureau of Statistics of China (NBS 2000–07), which includes all state-owned and non-state-owned firms with annual sales of more than RMB5 million; and the *National Statistics on Prefecture, City, and County Finance* (Ministry of Finance 2000–07). The main reason for selecting these two datasets is that the former can relatively accurately calculate each firm’s effective VAT rate and the latter can calculate the fiscal pressure faced by the local government.
Measurement of main variables

Exogenous fiscal pressure shock

Following Chen (2017a), we measure the fiscal pressure generated by the abolition of agricultural taxes in China in 2005 by Equation 5.12.

Equation 5.12

\[
\text{Agr}_t = \frac{\text{Agr}_{\text{tax},2000-2004} + \text{Subsidy}_{\text{c},2000-2004}}{\text{Total}_{\text{tax},2000-2004}} - \frac{\text{Subsidy}_{\text{c},2005-2007}}{\text{Total}_{\text{tax},2005-2007}}
\]

In Equation 5.12, \(\text{Agr}_{\text{tax},2000-2004}\) is the sum of county-level agricultural taxes between 2000 and 2004; \(\text{Subsidy}_{\text{c},2000-2004}\) and \(\text{Subsidy}_{\text{c},2005-2007}\) represent the sums of transfer payments related to rural tax reform at the county level in 2000–04 and 2005–07, respectively; and \(\text{Total}_{\text{tax},2000-2004}\) and \(\text{Total}_{\text{tax},2005-2007}\) are the sums of tax revenue at the county level in 2000–04 and 2005–07, respectively.

We use \(\text{Agr}_t \times \text{Post}_t\) to capture the shock of fiscal pressure across counties and over time, where \(\text{Post}_t\) is the dummy variable indicating the year before and the year after the abolition of agricultural taxes, and \(\text{Post}_t\) takes a value of 1 if \(t > 2004\) and 0 otherwise.\(^8\)

Effective VAT rate and its variance

Using firm-level data, we can obtain the effective VAT rate of each firm and further calculate the variance of the effective VAT rate among firms at the year–county–(two-digit) industry levels, as shown in Equation 5.13.

Equation 5.13

\[
\text{Var}_{\text{tau}} = \text{Var}[\ln(-\tau_{ij})]
\]

The subscripts \(c, j, t\) and \(i\) are county, (two-digit) industry, year and firm, respectively; \(\tau_{ijt}\) is the effective VAT rate of each firm, which is defined as the firm-level ‘Payable VAT/Value-added’.

Aggregate TFP

Following Bartelsman et al. (2013), we use the Olley and Pakes (1996) productivity decomposition method to calculate the TFP, as in Equation 5.14 (for notational convenience, we ignore the county and industry subscripts, \(c\) and \(j\)).

\(^8\) Although the abolition of agricultural taxes officially began on 1 January 2006, from the perspective of taxes data, the nationwide large-scale complete taxes deduction and exemption actually took place in 2005.
Equation 5.14

\[
TFP_i = \bar{TFP}_i + \sum_{n=1}^{N} \left( s_{n} - \bar{s}_i \right) \left( TFP_{i, n} - \bar{TFP}_i \right)
\]

In Equation 5.14, \( TFP_i \) is average productivity using the firm size as weights; \( \bar{TFP}_i \) is the arithmetical average of the firm's productivity; and the last term, \( \sum_{n=1}^{N} \left( s_{n} - \bar{s}_i \right) \left( TFP_{i, n} - \bar{TFP}_i \right) \), represents the efficiency of resource allocation, which we call 'OP covariance'. Among them, \( s_{n} \) is the proportion of the output of a single firm in total output; \( TFP_{i, n} \) is the productivity of firm \( i \) at time \( t \); \( \bar{s}_i \) is the average of \( s_{n} \) for each firm, \( i \); and \( \bar{TFP}_i \) is the average of \( TFP_{i, n} \) for each firm, \( i \).

We use four methods to estimate the \( TFP_{i, n} \): LP (Levinsohn and Petrin 2003), ordinary least squares (OLS), ACF (Ackerberg et al. 2015) and OP (Olley and Pakes 1996).

The aggregate \( TFP \) in our empirical study is measured by 'OP covariance', which is calculated by the second component on the right-hand side of Equation 5.14. Specifically, \( s_{n} \) is the proportion of the total output value of a single firm in the total output value at the year-county-(two-digit) industry levels; \( TFP_{i, n} \) is the logarithmic productivity of firm \( i \) in year \( t \); and \( \bar{TFP}_i \) is the year-county-(two-digit) industry arithmetical average of the logarithmic productivity of the firm. For simplicity, we use \('\text{LOG}(TFP)\) (OP covariance)' to represent the aggregate \( TFP \) in regression tables.

Control variables

The key control variables are:

1. The average of \( \ln(1-\tau_{cij}) \). To be consistent with Equation 5.13, we first calculate \( \ln(1-\tau_{cij}) \) for each firm, and then calculate the average of \( \ln(1-\tau_{cij}) \) at the year-county-(two-digit) industry levels.
2. The Herfindal index, which is calculated based on the firm's sales income at the year-county-(two-digit) industry levels.
3. The logarithm of the year-county-(two-digit) industry average of firm-level output, which, for convenience, is simplified as 'LOG(Average output)' in the tables of regression results.
4. The average markup—first, we estimate the markup for each firm according to the method of De Loecker and Warzynski (2012), and then calculate the year-county-(two-digit) industry average of firm-level markup.
5. Export-sales ratio, which is defined as the 'total export/total sales income' at the year-county-(two-digit) industry level.
6. The logarithm of per capita capital stock within the same industry: we first calculate the total capital stock and labour force at the year-county-(two-digit) industry level, and then calculate the per capita capital stock and take the logarithm. For simplicity, we will use 'LOG(Per capita capital stock)' in the tables of regression results.
7. The proportion of capital of different ownership in total capital: first, we separately calculate the proportion of state-owned capital, collective capital and foreign capital in the total capital for each firm, and then calculate the average of the abovementioned proportions at the year–county–(two-digit) industry level. For simplicity, we will use ‘State-owned capital share’, ‘Collective capital share’ and ‘Foreign capital share’, respectively, in tables of regression results.

Descriptive statistics

Table 5.1 shows the descriptive statistics of all the measurements involved in the regressions at the year–county–(two-digit) industry level.

### Table 5.1 Descriptive statistics of variables

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Sample size</th>
<th>Mean</th>
<th>Std dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate TFP (LP estimation)</td>
<td>72,523</td>
<td>0.0270</td>
<td>0.089</td>
<td>−1.500</td>
<td>1.8880</td>
</tr>
<tr>
<td>Aggregate TFP (OLS estimation)</td>
<td>72,523</td>
<td>0.0030</td>
<td>0.077</td>
<td>−1.389</td>
<td>1.7550</td>
</tr>
<tr>
<td>Aggregate TFP (ACF estimation)</td>
<td>72,523</td>
<td>0.0110</td>
<td>0.080</td>
<td>−0.961</td>
<td>1.3740</td>
</tr>
<tr>
<td>Aggregate TFP (OP estimation)</td>
<td>72,523</td>
<td>0.0150</td>
<td>0.082</td>
<td>−1.300</td>
<td>1.6990</td>
</tr>
<tr>
<td>VarTau</td>
<td>71,648</td>
<td>0.0156</td>
<td>0.027</td>
<td>0.000</td>
<td>0.1960</td>
</tr>
<tr>
<td>Agr×Post</td>
<td>68,980</td>
<td>0.0840</td>
<td>0.112</td>
<td>−0.646</td>
<td>1.2000</td>
</tr>
<tr>
<td>Agr</td>
<td>68,980</td>
<td>0.1580</td>
<td>0.158</td>
<td>−0.646</td>
<td>1.2000</td>
</tr>
<tr>
<td>FP</td>
<td>46,743</td>
<td>−0.0150</td>
<td>0.072</td>
<td>−0.277</td>
<td>0.2247</td>
</tr>
<tr>
<td>The average of ln(1−τcijt)</td>
<td>72,523</td>
<td>−0.1370</td>
<td>0.085</td>
<td>−0.874</td>
<td>0.0000</td>
</tr>
<tr>
<td>The average markup</td>
<td>72,523</td>
<td>1.3350</td>
<td>0.446</td>
<td>0.669</td>
<td>42.0240</td>
</tr>
<tr>
<td>LOG(Average output)</td>
<td>72,523</td>
<td>10.3800</td>
<td>0.784</td>
<td>7.425</td>
<td>13.5520</td>
</tr>
<tr>
<td>LOG(Per capita capital stock)</td>
<td>72,523</td>
<td>3.8260</td>
<td>0.795</td>
<td>−1.350</td>
<td>8.2390</td>
</tr>
<tr>
<td>Herfindal index</td>
<td>72,523</td>
<td>0.3180</td>
<td>0.174</td>
<td>0.006</td>
<td>0.9840</td>
</tr>
<tr>
<td>Export–sales ratio</td>
<td>72,523</td>
<td>0.1110</td>
<td>0.198</td>
<td>0.000</td>
<td>0.9990</td>
</tr>
<tr>
<td>State-owned capital share</td>
<td>72,503</td>
<td>0.0590</td>
<td>0.136</td>
<td>0.000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Collective capital share</td>
<td>72,503</td>
<td>0.1170</td>
<td>0.188</td>
<td>0.000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Foreign capital share</td>
<td>72,503</td>
<td>0.1060</td>
<td>0.184</td>
<td>0.000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
**Variation in key variables**

**Changes in fiscal pressure and effective VAT rate**

Figure 5.2 suggests that the regions with the greatest increase in fiscal pressure have the greatest growth in the effective VAT rate. This is consistent with Chen (2017a).

Figure 5.2 Changes in fiscal pressure and average effective VAT rate (comparison before and after reform)

Notes: Vertical axis variable: first, we calculate the average effective VAT rates at the county–(two-digit) industry level in 2005–07 and 2000–04, respectively, and then subtract the average for 2000–04 from that for 2005–07 for change over time of the average effective VAT rate. Horizontal axis variable: first, we calculate the averages of Agr*Post at the county–(two-digit) industry level in 2005–07 and 2000–04, respectively. We then subtract the average for 2000–04 from that for 2005–07 for the change over time in fiscal pressure. The shaded area in the graph is the 95 per cent confidence interval.

Source: Authors’ calculations.
5. REVENUE-NEUTRAL TAX REFORM IN CHINA

Changes in fiscal pressure and the variance of the effective VAT rate

Figure 5.3 shows that the regions with the greatest increase in fiscal pressure have the greatest reduction in the variance of the effective VAT rate.

![Figure 5.3: Changes in fiscal pressure and variance of the effective VAT rate (comparison before and after reform)](image)

Notes: Vertical axis variable: first, we calculate the averages of the variance of the effective VAT rate at the county–(two-digit) industry level in 2005–07 and 2000–04, respectively. We then subtract the average for 2000–04 from that for 2005–07 for the change over time of the variance of the effective VAT rate. Horizontal axis variable: first, we calculate the averages of Agr*Post at the county–(two-digit) industry level in 2005–07 and 2000–04, respectively. We then subtract the average for 2000–04 from that for 2005–07 for the change over time in fiscal pressure. The shaded area in the graph represents the 95 per cent confidence interval.

Source: Authors’ calculations.

Changes in fiscal pressure and aggregate TFP

Figure 5.4 shows the positive effects of fiscal pressure on the aggregate TFP, measured by four methods—LP, OLS, ACF and OP, respectively, in panels a, b, c and d.
CHINA’S CHALLENGES IN MOVING TOWARDS A HIGH-INCOME ECONOMY

Figure 5.4 Changes in fiscal pressure and aggregate TFP (comparison before and after reform)

Notes: Vertical axis variables: first, we calculate the averages of the aggregate TFP (TFP_LP, TFP_OLS, TFP_ACF and TFP_OP) at the county–(two-digit) industry level in 2005–07 and 2000–04, based on the second component (OP covariance) on the right-hand side of Equation 5.3, and then separately subtract the average for 2000–04 from that for 2005–07, constructing variables of TFP_LP change, TFP_OLS change, TFP_ACF change and TFP_OP change. Horizontal axis variable: first, we calculate the averages of Agr*Post at the county–(two-digit) industry level in 2005–07 and 2000–04, respectively, and then subtract the average for 2000–04 from that for 2005–07. Following Equation 5.12, we get the measurement of fiscal pressure. The shaded area in the graph represents the 95 per cent confidence interval.

Source: Authors’ calculations.

Correlation coefficient between \( \ln A_i \) and \( \ln(1-\tau_i) \)

Proposition 8 and Hypothesis 3 suggest that strengthening tax enforcement can improve the aggregate TFP if \( \ln A_i \) and \( \ln(1-\tau_i) \) are negatively correlated. The data show that the correlation coefficient between \( \ln A_i \) and \( \ln(1-\tau_i) \) is approximately 0.022 (for the LP method), –0.027 (OLS method), –0.028 (ACF method) or –0.025 (OP method).

Regression specification

The difference-in-difference model is specified as Equation 5.15.

**Equation 5.15**

\[
y_{ijt} = \alpha \times Agr_c \times Post_t + \beta \times Agr_c \times X_{ijt} \times \theta + \gamma \times \eta_{ij} + \epsilon_{ijt}
\]
In Equation 5.15, the subscripts \( c, j \) and \( t \) represent county, two-digit industry and year, respectively.\(^9\) The dependent variable, \( y_{ctj} \), is \( \text{VarTau} \) (variance of the effective VAT rate) and the aggregate \( TFP \) (OP covariance) (refer to Equations 5.13 and 5.14 for definition of the variables). The measurement for \( Agr \) on the right-hand side of Equation 5.15 is Equation 5.13. \( Post \) is the dummy variable indicating the years since the abolition of agricultural taxes; it takes a value of 1 if \( t > 2004 \) and 0 otherwise; \( X_{ctj} \) is a control variable vector of firm characteristics (‘county–industry–year’ level); \( \gamma_t \) is the year fixed effects; \( \eta_{cj} \) is the county–industry fixed effects; \( \varepsilon_{ctj} \) is the random error. The parameter of interest is \( \alpha \).

Regression results

Fiscal pressure shock and variance of the effective VAT rate

The regression results are reported in Table 5.2. In column (1), we control for the year fixed effects and the average \( \ln(1-\tau) \) at the industry level. The results show that the variance of the effective VAT rate decreases significantly (at the 5 per cent level) with the increase in fiscal pressure. Column (2) includes extra control variables. In column (3), we additionally control for the county–industry fixed effects. The estimates in columns (2)–(3) also show that the variance of the effective VAT rate among firms in the same industry decreases as the regional fiscal pressure increases. Columns (4) and (5) restrict the regression samples to those with the number of firms greater than three and greater than four, respectively, at the county–(two-digit) industry level, duplicating the regression in column (3).

<table>
<thead>
<tr>
<th>Table 5.2 Fiscal pressure and variance of the effective VAT rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>( Agr \times Post )</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>( Agr )</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>( \text{Industry average } \ln(1-\tau) )</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

\(^9\) In this chapter, enterprises are divided into the year–county–(two-digit) industry level, which shows the possibility that the number of enterprises at this level is very small. To avoid the estimation bias caused by this issue, we drop the samples to those in which the number of enterprises is not more than two. The average number of enterprises participating in the regressions is nine, the maximum is 479 and the minimum is three. To further test the sensitivity of the regressions, we conduct sensitivity analyses by retaining the samples of those with the number of enterprises not less than four and not less than five.
### Table 5.3: Fiscal pressure shock and change in aggregate TFP

The productivity of firms in columns (1)–(4) is estimated by the methods of LP, OLS, ACF and OP, respectively. The regression in panel A of Table 5.3 restricts the samples to those with the number of firms greater than two in the same industry. It can be seen from the coefficients of the interaction term that aggregate productivity
in the manufacturing industry significantly increases as the fiscal pressure increases. To further investigate whether the number of firms at the year–(two-digit) industry level would affect the regression results, we use the samples with the number of firms greater than three and greater than four at the year–(two-digit) industry level for regression. The results are displayed in panels B and C of Table 5.3, which are basically the same as panel A.

### Table 5.3 Fiscal pressure and aggregate LOG(TFP) (OP covariance)

<table>
<thead>
<tr>
<th>TFP estimation method</th>
<th>Dependent variable: Aggregate LOG(TFP) (OP covariance)</th>
<th>(1)</th>
<th></th>
<th>(2)</th>
<th></th>
<th>(3)</th>
<th></th>
<th>(4)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: Number of firms in the same industry is greater than 2</td>
<td></td>
<td>(2)</td>
<td></td>
<td>(3)</td>
<td></td>
<td>(4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agr×Post</td>
<td></td>
<td>0.051**</td>
<td></td>
<td>0.039**</td>
<td></td>
<td>0.045**</td>
<td></td>
<td>0.048**</td>
<td></td>
</tr>
<tr>
<td>Industry average ln(1−t)</td>
<td></td>
<td>0.003</td>
<td></td>
<td>0.002</td>
<td></td>
<td>0.003</td>
<td></td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>Average markup</td>
<td></td>
<td>−0.017***</td>
<td></td>
<td>−0.015***</td>
<td></td>
<td>−0.016***</td>
<td></td>
<td>−0.017***</td>
<td></td>
</tr>
<tr>
<td>LOG(Average output)</td>
<td></td>
<td>−0.025***</td>
<td></td>
<td>−0.020***</td>
<td></td>
<td>−0.023***</td>
<td></td>
<td>−0.023***</td>
<td></td>
</tr>
<tr>
<td>LOG(Per capita capital stock)</td>
<td></td>
<td>−0.002**</td>
<td></td>
<td>−0.003**</td>
<td></td>
<td>−0.001</td>
<td></td>
<td>−0.002**</td>
<td></td>
</tr>
<tr>
<td>Herfindal index</td>
<td></td>
<td>0.034***</td>
<td></td>
<td>−0.003</td>
<td></td>
<td>0.006</td>
<td></td>
<td>0.013**</td>
<td></td>
</tr>
<tr>
<td>Export–sales ratio</td>
<td></td>
<td>0.009</td>
<td></td>
<td>−0.003</td>
<td></td>
<td>0.002</td>
<td></td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>State-owned capital share</td>
<td></td>
<td>0.016***</td>
<td></td>
<td>0.005</td>
<td></td>
<td>0.010**</td>
<td></td>
<td>0.011**</td>
<td></td>
</tr>
<tr>
<td>Collective capital share</td>
<td></td>
<td>−0.011***</td>
<td></td>
<td>−0.011***</td>
<td></td>
<td>−0.009***</td>
<td></td>
<td>−0.011***</td>
<td></td>
</tr>
<tr>
<td>Foreign capital share</td>
<td></td>
<td>−0.017***</td>
<td></td>
<td>−0.010</td>
<td></td>
<td>−0.012**</td>
<td></td>
<td>−0.014**</td>
<td></td>
</tr>
<tr>
<td>Constant term</td>
<td></td>
<td>0.306***</td>
<td></td>
<td>0.247**</td>
<td></td>
<td>0.247**</td>
<td></td>
<td>0.283**</td>
<td></td>
</tr>
<tr>
<td>Year fixed effects</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>County–industry fixed effects</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
### Dependent variable: Aggregate LOG(TFP) (OP covariance)

<table>
<thead>
<tr>
<th>TFP estimation method</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP</td>
<td>0.433</td>
<td>0.469</td>
<td>0.443</td>
<td>0.437</td>
</tr>
<tr>
<td>OLS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| R-squared             | 0.433 | 0.469 | 0.443 | 0.437 |
| Sample size           | 66382 | 66382 | 66382 | 66382 |

#### Panel B: Number of firms in the same industry is greater than 3

<table>
<thead>
<tr>
<th>Agr×Post</th>
<th>0.057***</th>
<th>0.045***</th>
<th>0.051***</th>
<th>0.054***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.009)</td>
<td>(0.010)</td>
<td>(0.011)</td>
</tr>
</tbody>
</table>

#### Panel C: Number of firms in the same industry is greater than 4

<table>
<thead>
<tr>
<th>Agr×Post</th>
<th>0.053***</th>
<th>0.042***</th>
<th>0.048***</th>
<th>0.051***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.010)</td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
</tbody>
</table>

* significant at the 10 per cent level
" significant at the 5 per cent level
*** significant at the 1 per cent level

Notes: Standard errors in parentheses, clustered at county level. The control variables of regression in panels B and C are the same as those in panel A.

### Dynamic effect

In this section, we show the dynamic effects of fiscal pressure on the variance of the effective tax rate (in Figure 5.5) and the aggregate TFP with annual change (in Figure 5.6). In Figures 5.5–5.6, Befor4, Befor3, Befor2 and Befor1 represent the interaction terms between Agr and year dummies for 2001, 2002, 2003 and 2004, respectively; After1 and After2 represent the interaction terms between Agr and year dummies for 2006 and 2007, respectively.

#### Dynamic effect of fiscal pressure and variance of the effective VAT rate

Figure 5.5 shows the dynamic effect of fiscal pressure on the variance of the effective VAT rate is not significant before the reform. But after a year of reform it has a significant, negative effect on the variance of the effective VAT rate.

#### Dynamic effects of fiscal pressure and aggregate TFP

Figure 5.6 depicts the dynamic effect of fiscal pressure on aggregate TFP measured by the covariance of OP based on firms’ TFP estimated by four methods: LP, OLS, ACF and OP. The figure shows that the effect is not significant before the reform, but there is a remarkable, positive impact of fiscal pressure on the aggregate TFP in the year of reform. Moreover, the effect gradually increases over time.
Figure 5.5 Dynamic effect of fiscal pressure and variance of the effective VAT rate

Notes: The longitudinal line represents the 95 per cent confidence interval; Befor4, Befor3, Befor2 and Befor1 represent the effect in the fourth, third, second and first year before the reform, respectively. ‘Reform’ represents the effect in the year of reform. After1 and After2 represent the effect in the first and second years after the reform, respectively.

Source: Data for the regression are from NBS (2000–07) and the County Public Finance Statistics Yearbook of China (2000–07).
Figure 5.6 Dynamic effect of fiscal pressure and aggregate LOG(TFP) (covariance of OP)

Notes: The vertical axis indicators of a, b, c and d are total TFP—namely, the LOG(TFP) (covariance of OP), which is calculated by using the four methods of LP, OLS, ACF and OP, respectively, according to the second term on the right-hand side of Equation 5.14; vertical line segments represent 95 per cent confidence intervals; Befor4, Befor3, Befor2 and Befor1 represent the effect in the fourth, third, second and first year before the reform, respectively; ‘Reform’ represents the effect in the year of reform; After1 and After2 represent the effect in the first and second years after reform, respectively. Source: Data for the regression are from NBS (2000–07) and the County Public Finance Statistics Yearbook of China (2000–07).

By how much can China reduce the VAT rate?

In this section, we quantitatively estimate the extent to which the VAT rate can be reduced in revenue-neutral reform.

Theoretical analysis

The theoretical model in section two shows that the tax revenue $T(t;e) = \tau(t;e) \cdot TFP(e) \cdot K(\bar{t}(t;e))$. The relationship between $t$ and $e$ can be expressed as Equation 5.16.
Equation 5.16
\[
\Delta t = \frac{\partial T}{\partial \bar{\epsilon}} \cdot \Delta \bar{\epsilon}
\]

Equation 5.16 is the basis for calculating the range of feasible reduction in the statutory tax rate, \( t \), under the 'tax-neutral' reform. However, since the change in the tax enforcement level, \( \Delta \bar{\epsilon} \), is not observable, we need to transform Equation 5.16 into expressions of observable variables and estimable parameters in the following way.

First, when \( t \) is constant, \( \bar{\epsilon} \) and \( \epsilon \) correspond to each other one-to-one, so \( \partial T/\partial \epsilon \) in Equation 5.16, can be written as Equation 5.17.

Equation 5.17
\[
\partial T/\partial \epsilon = \frac{dT/d\bar{\epsilon}}{\partial \bar{\epsilon} / \partial \epsilon} = \left[ \left(1 - \eta^K_t \right) + \eta^{TFP}_t \right] \cdot \frac{T}{\bar{\epsilon}} \cdot \partial \bar{\epsilon} / \partial \epsilon
\]

Second, when \( \epsilon \) is constant, \( \bar{\epsilon} \) corresponds to \( t \) one-by-one, and \( \partial T/\partial t \) in Equation 5.16 can be written as Equation 5.18.

Equation 5.18
\[
\partial T/\partial t = \frac{dT/d\bar{\epsilon}}{\partial \bar{\epsilon} / \partial t} = \left(1 - \eta^K_t \right) \cdot \frac{T}{\bar{\epsilon}} \cdot \partial \bar{\epsilon} / \partial t
\]

In Equations 5.17 and 5.18, the two elasticities are defined as \( \eta^K_t \equiv -\frac{dlnK}{dln\bar{\epsilon}} \)
\( \eta^{TFP}_t \equiv -\frac{dlnTFP}{dln\epsilon} \), respectively.

Under the condition that \( t \) is constant, we know \( \Delta \bar{\epsilon} = (\partial \bar{\epsilon}(t, \epsilon)/\partial \epsilon)^{-1} \cdot \Delta \bar{\epsilon} \). Combining Equations 5.16–5.18, we get Equation 5.19.

Equation 5.19
\[
\Delta t = - \left[ \left(1 - \eta^K_t \right) + \eta^{TFP}_t \right] \cdot \Delta \bar{\epsilon}
\]

In Equation 5.19, \( \Delta \bar{\epsilon} \) is the change in the effective tax rate caused by the change in the tax enforcement level, \( \epsilon \), which can be observed. For convenience of description, we define the parameters as Equation 5.20.

Equation 5.20
\[
\lambda \equiv \left. \frac{\Delta t}{\Delta \bar{\epsilon}} \right|_{t, \bar{\epsilon}} = \left[ \left(1 - \eta^K_t \right) + \eta^{TFP}_t \right] \cdot \partial \bar{\epsilon} / \partial t
\]

\( \lambda \) is the elasticity of the effective tax rate with respect to the change in the tax enforcement level.
The economic meaning of \( \lambda \) is that, on the premise that the government’s tax revenue remains unchanged, the effective tax rate, \( \bar{\tau} \), can be increased 1 percentage point by strengthening tax enforcement, and the statutory tax rate, \( t \), can be reduced by \( \lambda \) percentage point.

**Estimation of parameters**

Equation 5.20 shows that the feasible range of reduction of the statutory tax rate, \( t \), in the ‘tax-neutral reform’ depends on \( \eta_{T}^{K} \) and \( \eta_{T}^{TFP} \). These two elasticities can be inferred from the previous regression results. Specifically, the fiscal pressure, \( \Delta Agr \), in the quasi-natural experiment of abolishing agricultural taxes can be used as an exogenous driver of the change in the tax enforcement level, \( \varepsilon \). \( \eta_{T}^{K} \) and \( \eta_{T}^{TFP} \) can be estimated by the following two expressions: 

\[
\eta_{T}^{TFP} = \frac{\Delta \ln TFP}{\Delta Agr} \quad \text{and} \quad \eta_{T}^{K} = \frac{\Delta \ln K}{\Delta Agr} 
\]

**Estimation of elasticity \( \eta_{T}^{TFP} \)**

First, according to the regression results in Table 5.3, we know that \( \Delta \ln TFP/\Delta Agr = 0.046 \). Second, we use Equation 5.15 with the effective VAT rate, \( \tau_{ijt} \), as the explained variable. The regression results are shown in columns (1) and (2) of Table 5.4. Column (1) controls the fixed time effect, the fixed effect of the firm and the logarithmic value-added per capita of the firm. Column (2) additionally controls the relative scale of firms in the same industry, \( Markup \), the proportion of firms’ exports in total sales revenue, the proportion of capital under different ownership in the total capital of firms and the interaction term of county–(two-digit) industry. The coefficient of \( Agr \times Post \) (that is \( \Delta \bar{\tau}/\Delta Agr \)) in column (2) is 0.048. Given the average value of the effective VAT rate for 2005–07 is about 12 per cent, we know \( \Delta \ln \bar{\tau}/\Delta Agr = \left( \frac{\Delta \bar{\tau}}{\Delta Agr} \right) / \bar{\tau} = 0.4 \). Therefore, \( \eta_{T}^{TFP} = 0.046/0.4 \approx 0.1 \).

**Estimation of elasticity \( \eta_{T}^{K} \)**

\( \eta_{T}^{K} \) is the elasticity of the input of a firm’s production factors to the effective tax rate of that firm. The input factors include both capital and labour.

We use Equation 5.15 to estimate the impact of fiscal pressure on capital stock and the labour force. Table 5.4 reports the results. The explained variables of columns (3) and (4) are the logarithmic number of employees in the firm. And the explained variables of columns (5) and (6) are the logarithmic capital stock of the firm. Columns (3) and (5) do not include control variables at the firm level, and the impact of fiscal pressure on factors of production is not statistically significant. Columns (4) and (6) include extra controls, including the relative size of firms in the same industry, the markup, the proportion of the firm’s exports in total sales revenue.
and the proportion of capital under different ownership in the firm's total capital. The regression results still show that the impact of fiscal pressure on production factors is not statistically significant.\(^{10}\)

Table 5.4 suggests that $\Delta \ln L / \Delta \text{Agr} \approx \Delta \ln K / \Delta \text{Agr} \approx 0$.

According to the definition of the elasticity, we know $\eta_i^L = \eta_i^K = 0$ and $\eta_i^K$ is not negative. From Equation 5.20, a greater $\eta_i^K$ implies a bigger $\lambda$, which consequently leaves more room to cut the statutory tax rate, $t$, in the 'tax-neutral reform'.

**Table 5.4 The impact of fiscal pressure on the actual VAT rate and factors of production\(^{11}\)**

<table>
<thead>
<tr>
<th>Explained variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective rate of VAT</td>
<td>0.048** (0.009)</td>
<td>0.048** (0.009)</td>
<td>-0.017 (0.038)</td>
<td>-0.029 (0.038)</td>
<td>0.038 (0.072)</td>
<td>0.027 (0.068)</td>
</tr>
<tr>
<td>Logarithmic employment</td>
<td>0.048** (0.009)</td>
<td>-0.029 (0.038)</td>
<td>0.038 (0.072)</td>
<td>0.027 (0.068)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logarithmic value-added per capita of firms</td>
<td>-0.038** (0.001)</td>
<td>-0.043** (0.001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative scale of firms in the same industry</td>
<td>0.154** (0.007)</td>
<td>2.028** (0.054)</td>
<td>2.812** (0.051)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markup</td>
<td>-0.001* (0.000)</td>
<td>0.021** (0.003)</td>
<td>0.035** (0.005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of firm's exports in total sales revenue</td>
<td>0.019** (0.002)</td>
<td>-0.029** (0.011)</td>
<td>-0.046** (0.019)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average value of state-owned assets in the firm's total assets</td>
<td>-0.012** (0.001)</td>
<td>0.110** (0.006)</td>
<td>0.199** (0.013)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average proportion of collective assets in the firm's total assets</td>
<td>-0.000 (0.001)</td>
<td>0.009 (0.005)</td>
<td>0.012 (0.008)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The average proportion of foreign capital in a firm's total assets</td>
<td>-0.003 (0.002)</td>
<td>0.046** (0.007)</td>
<td>0.046** (0.013)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant term</td>
<td>0.273*** (0.004)</td>
<td>0.137*** (0.006)</td>
<td>4.705*** (0.003)</td>
<td>2.634*** (0.055)</td>
<td>8.191*** (0.006)</td>
<td>5.312*** (0.053)</td>
</tr>
<tr>
<td>Whether to control the fixed effect of the year</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Whether to control county-industry fixed effects</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

---

10 This may be because the samples we used did not cover a long period and the adjustment of production factors was relatively slow in the short term, and had not yet shown an effect.

11 The reason the regression does not control firms' logarithmic value-added per capita when the explained variables are a logarithm of the number of employees and a logarithm of the capital stock is that the logarithmic value-added per capita of firms is used as the outcome variable of the factor input and is placed in the control variables of the regression.
A simple calculation of tax reduction range

From the results in section five, we know that \( \eta^{\text{TPP}}_i = 0.1, \eta^L_i = \eta^K_i \approx 0 \). Substitute these into Equation 5.20 and we get Equation 5.21.

Equation 5.21

\[
\lambda = \frac{1.1}{\partial \bar{\tau}/\partial t}
\]

We cannot directly estimate \( \partial \bar{\tau}/\partial t \) for the VAT, but we know that, in our sample period, the statutory rate of the VAT is 17 per cent; and, given \( \partial \bar{\tau}/\partial t = 1 \), the minimum value of \( \lambda \) is 1.1, under the condition that tax revenue is kept constant, and the statutory tax rate for a single VAT, which is managed according to the law, is 14.38 per cent. We set the tax rate as the upper limit of the optimal VAT rate under tax-neutral conditions.

In addition, although there is no accurate estimate of VAT, \( \partial \bar{\tau}/\partial t \), at present, this chapter attempts to use the ‘Corporate Income Tax Unification’ of 2008 to make a rough estimate of \( \partial \bar{\tau}/\partial t \). In 2008, the corporate income tax unification was implemented to unify the statutory tax rate among domestic and foreign firms. In response to the decrease in the statutory tax rate for domestic firms, we found their effective tax rate decreased after the reform, which is consistent with the theoretical assumption. Specifically, the statutory rate of income tax for domestic firms decreased from 33 per cent in 2007 to 25 per cent (a drop of 8 percentage points). In 2008 and 2007, the average income tax rates of state-owned and domestic firms above designated size were 14.7 per cent and 16 per cent, respectively (down by 1.3
percentage points). Therefore, $\frac{\partial \bar{t}}{\partial t} \approx 1.3/8 = 0.163$. Substituting the above result into Equation 5.22, we get $\lambda = 6.75$, which implies that the lowest possible statutory VAT rate to sustain revenue-neutral reform is 12.65 per cent.\footnote{It is possible the effect of the income tax unification policy did not fully reflect the year of reform. We calculated the average corporate income tax rates of state-owned and domestic enterprises above designated size in 2010 at 11.7 per cent, then, $\frac{\partial \bar{t}}{\partial t} = 0.525, \lambda = 2.095$. At this time, under the condition of tax neutrality, the optimal VAT rate for the government to fully collect and administer in accordance with the law is about 13.6 per cent.}

To sum up, under tax-neutral reform, if the VAT is administered as a single statutory tax rate, the rate can be reduced to at least 14.38 per cent. Moreover, if we additionally take into account better tax compliance following the institution of lower tax rates, as suggested by the corporate income tax unification, the statutory rate of the VAT can be reduced to 12.65 per cent.

**Conclusion**

China's economic growth rate has been declining in recent years, leading Chinese local and provincial governments to attempt to stimulate the economy through cutting taxes. However, this leads to a decline in government revenue, raising concerns about fiscal risk and debt problems for local governments. To solve this tension, we propose a revenue-neutral reform through improving tax enforcement, cutting statutory tax rates and enhancing aggregate productivity.

Our theoretical model explains the mechanisms underlying the revenue-neutral reform. To test the theory, we made use of the abolition of agricultural taxes in 2005 as a 'quasi-natural experiment' to study how improvements in tax enforcement can lead to a smaller dispersion in the effective tax rate across firms and to greater aggregate productivity. Based on the estimates of several key elasticities, we estimated the extent of the VAT rate cut, with our results showing that the statutory VAT rate can be reduced to at least 14.38 per cent. Moreover, it can be reduced further, to 12.65 per cent, when the improvement of firms’ tax compliance in response to the statutory tax rate cut is taken into account. The results imply that the latest standard VAT rate of 13 per cent, adopted in April 2019, may be sustainable for maintaining government revenue as long as governments continue to improve tax enforcement. The proposed reform may encounter several problems in its implementation. First, strengthening tax enforcement will increase the tax burden on some firms, leading to opposition to the reform. Second, the efficiency of resource allocation is difficult to observe in the short term and at the local level. The central government must take a holistic and long-term perspective to harvest the final fruits of reform. Third, strengthening tax enforcement is consistent with the notion of ‘tax by law’, which is different from strengthening tax enforcement on firms to make up for the deficit due to the shortfall in revenue.
In summation, the revenue-neutral reform that we propose may help not only solve current public revenue distress, but also facilitate structural reform and the transformation of the Chinese economy towards high-quality development. It may also help to make China's fiscal and tax systems become the ‘foundation and important pillars of state governance’, as proposed in the report of the Nineteenth National Congress of the Chinese Communist Party.

References


5. REVENUE-NEUTRAL TAX REFORM IN CHINA


