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The effect of a fiscal squeeze on tax enforcement: Evidence from a natural experiment in China☆

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ABSTRACT

This paper investigates the impact of the abolition of the agricultural taxes in 2005 across China on county governments' incentives for tax enforcement. I show that the revenue loss of county governments was largely offset by tougher tax enforcement. The incentive for VAT enforcement can be weakened, however, if the county: (1) receives a lower share of total VAT revenues; (2) has a broader VAT tax base; or, (3) has more abundant sources of revenue from land sales. These findings suggest that incentives of local governments can be vital to tax enforcement and to the tax capacity of a country.

1. Introduction

In a fiscal sense, poor countries are characterized by low tax-to-GDP ratios, collecting less than 20% of GDP, while rich countries take up to half of their GDP in tax revenue (Gordon and Li, 2009; Kleven, 2014; Besley and Persson, 2014).

The reasons for the low tax-to-GDP ratio in poor countries continue to be debated. Recent theoretical studies argue that it can simply be a result of a lack of information. Underlying causes may include informality, cash transactions, the underground economy (Gordon and Li, 2009), or a lack of third-party reporting by large modern firms (Kleven et al., 2016). The role of information is also emphasized by a growing empirical literature based on field experiments or quasi-experiments, which highlight the importance of tax administration and the role of third parties, suppliers, and consumers in revealing information (Kleven et al., 2011; Naritomi, 2013; Pomeranz, 2015; Slemrod et al., 2001). These experiments mainly investigate tax payers' response to various exogenous interventions, such as randomized deterrent auditing letters.

Another strand of literature argues that real world tax administration is not only constrained by a society's economic structure, but also by incentives shaped by political institutions (Besley and Persson, 2014). Existing micro studies focus on the incentives of tax inspectors (Besley and McLaren, 1993; Khan et al., 2016).

In addition to tax payers and tax inspectors, local governments can play an important role in taxation. Theoretically, the tax capacity of a country can be undermined by weak incentives for local governments to enforce the tax law. This is a result of rampant horizontal tax competition between jurisdictions, or a conflict of interest between national and sub-national governments, due to the vertical tax-sharing system. Empirically, the role of local governments is not as well understood as that of tax payers and tax inspectors.

This paper focuses on the tax enforcement incentives of county governments in China. It exploits the nation-wide abolition of agricultural taxes in 2005 as a natural "fiscal squeeze" experiment in which county governments suffered a severe revenue loss. To meet their ongoing normal commitments to finance local services, county governments were forced to raise public revenue. However, the agricultural revenue loss and pressure from the fiscal squeeze vary substantially across counties, due to the longstanding rural-urban gap in China and the enormous geographical differences in the importance of the agricultural sector. The variation in agricultural revenue

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loss over time and across counties allows me to apply the standard Diff-in-Diff approach to identify the effect of local governments' incentives to enforce tax. The empirical study can be implemented with two widely used datasets: firm level data from the *Annual Survey of Industrial Production* conducted by the National Bureau of Statistics of China (2000–2007), and the *County Public Finance Statistics Yearbook* of China (2000–2007).

The results show that the agricultural taxes revenue loss can be largely offset by tougher tax enforcement on other existing taxes in the same year of abolition. On average, the total tax revenue net of agricultural taxes rose by 11.7%, and total tax revenue was virtually unchanged. This suggests that Chinese counties do not face binding fiscal capacity constraints.

To understand the role of local governments' incentives for tax enforcement, this research focuses on formal manufacturing firms and their effective VAT rate, which is defined as the ratio of a firm's payable VAT to their reported valued-added.[1] This is distinct from, and generally far below, the statutory VAT rate, which is the rate of tax that firms should legally pay.[2] I find that the effective VAT rate increased on average by 7% due to the abolition of agricultural taxes. I also show that this change is not driven by a change in reported value added; authorities are able to increase tax revenue by imposing higher effective tax rates on the reported tax base. This is a novel finding complementary to those focusing on the change in reported tax base (Kleven et al., 2011; Pomeranz, 2015; Slemrod et al., 2001).

Finally, this research examines several factors that may affect the incentives of local governments to enforce the VAT. The results show that the incentives could be reduced if the county: (1) receives a lower proportion of total VAT revenues after sharing with prefectural and provincial governments; (2) has a broader VAT tax base; or, (3) has more abundant sources of revenue from land sales. The first finding confirms that, in a fiscal system of multi-level government, tax-sharing does shape the tax incentives of lower level governments. The other two findings suggest that local governments are more liable to loose tax enforcement once they are more capable of mobilizing fiscal revenue.

All findings suggest that the incentives of county governments in China can play a vital role in tax collection. The paper is therefore complementary to the existing literature, which focus on either the incentives of tax inspectors (Besley and McLaren, 1993; Khan et al., 2016), or the behaviour of tax payers and the role of information. The latter include earlier works suggesting that audit threats deter tax misreporting behaviour (Slemrod et al., 2001), as well as subsequent studies highlighting the role of information, which find relevant parties, including product consumers in VAT (Pomeranz, 2015), third parties in income tax (Kleven, 2014; Kleven et al., 2011, 2016), final consumers (Naritomi, 2013), or workers (Kumler et al., 2013), remitting parties (Kopczuk et al., 2016), can play an important role in information disclosure.

In addition, the findings of this paper are consistent with a number of cross-country studies which claim that VAT administration is not effectively enforced either in developing countries (Keen and Lockwood, 2010) or OECD countries (Agha and Haughton, 1996). The paper is also linked to recent finding that a tax cut in VAT reform may not be efficient (Kosonen, 2015). The VAT enforcement problem in China was initially documented by Chen (2015a). Finally, this paper links to empirical evidence on tax evasion in China (Cai and Liu, 2009; Fisman and Wei, 2004).

It has long been acknowledged in the theoretical literature that governments may use tax enforcement as a tax instrument, in addition to statutory tax rates (Cremer and Gahvari, 1993, 2000; Kaplow, 1990). Similar to the mechanisms identified in this paper, empirical studies for Spain suggest that tax enforcement efforts can be weakened at the regional level due to an "income effect" resulting from unconditional grants provided by the central government (Esteller–Moré, 2005), or as a result of regional horizontal tax competition (Durán-Babré et al., 2015).

The rest of the paper is organized as follows. Section 2 introduces the institutional background. Section 3 interprets the conceptual framework. Section 4 describes the datasets and measurement of the main variables. Section 5 introduces the empirical strategy and reports the main results. Section 6 discusses alternative explanations and conducts a variety of robustness checks. Section 7 studies the heterogeneity in incentives for VAT enforcement and the effect on total tax revenue and other government revenues. Section 8 concludes.

2. Institutional background

2.1. VAT administration

2.1.1. Two separations in government and incentives for VAT enforcement

VAT enforcement in China is subject to two separations: a separation between governments and taxation administrators, and a separation between national and sub-national governments.

On the one hand, VAT administration is delegated to the *State Administration of Taxation* (*SAT*), which is under the direct leadership of the national government. On the other hand, the national government also delegates many executive tasks, such as GDP growth and employment, to sub-national governments. This leads to intense horizontal competition between sub-national governments across regions (Li and Zhou, 2005). In addition, VAT is a shared tax in China, with the national government obtaining 75% and sub-national governments (including provincial, prefectural, and county) taking 25%. This further weakens incentives of sub-national governments to enforce VAT. In an institutional setting like China, where sub-national governments have no legislative right to set tax rates, tax base, or to create a new tax, they have to lean on the tax administration to lower the local effective VAT rate.

2.1.2. Subnational government and VAT administration

Local governments in China can exert enormous influence, either directly or indirectly, on VAT inspectors, although the central government controls the personnel appointments for the *State Administration of Taxation* (*SAT*) and its fund is allotted via a vertical administrative system.

In the first place, the chief of a local office of the *SAT* is under the direct supervision of the secretary of the Communist Party in the same jurisdiction.[3] In addition, there are several indirect ways for subnational governments to intervene in VAT enforcement. *First*, the capability of the *SAT* in tax law enforcement is limited by local departments of Public Security, which are under tight control of local

[1] Normally, these formal manufacturing firms are known as "above-scale industrial firms". Before 2006, a manufacturing firm in China is defined by the Bureau of Statistics as "above scale" if it is a state-owned enterprise or its sales volume is greater than five million Yuan (approximately $810,000 USD). From 2007, a state-owned enterprise with a sales volume lower than five million Yuan is not known as an above-scale firm. From January 2011, the threshold increased from five million Yuan to twenty million Yuan. The value-added of all above-scale firms accounts for about 90% of the total GDP of the manufacturing sector.

[2] The standard VAT rate in China is 17%, while the average effective VAT was around 10% over 2000–2007. Strictly, the variation in the effective VAT rate is only a proxy for changing intensity of tax enforcement in the fiscal squeeze experiment. Direct measurements involve number and efforts of tax inspectors engaged in tax enforcement but data in this regard are rarely obtained.

[3] For example, the chief/party secretary of a county office of the *SAT* is led by the county secretary of the Communist Party. The latter can considerably affect the promotion and political career of the former. Chen (2015b) studies the role of the prefectural secretary of the Communist Party in selective enforcement of VAT.

governments. *Second*, the local government can help the *SAT* with issues such as obtaining land for office buildings, schooling for children, local hospitals for health care, and many others. *Third*, it is openly known that the *SAT* receives a subsidy from the local government in order to improve its working conditions, or for any other reasons. *Fourth*, tax administrators have their own dirty laundry. As a last resort, anti-corruption action can be proposed as a credible threat by local governments against a tax administrator once he/she refuses to cooperate.

2.1.3. Ways to manipulate the effective VAT rate

Although the *de jure* VAT rates are legislated at a national level, local governments can influence the *de facto* tax rate of a firm. There are many ways to manipulate the effective VAT rate. Here I introduce four possible cases, with the objective of tax reduction.

First, local governments can demand that the *SAT* turns a blind eye to firms using fake invoices, which are rampant across China.[4] *Second*, local governments can directly order the local office of the *SAT* to enforce a lower VAT rate on a firm, if the local politicians are powerful enough. *Third*, slack tax enforcement by local governments could be conducted through nominal delayed tax payment, so that the actual payment of a firm is smaller than its real tax liability. This delayed tax payment could be carried forward and not paid out unless demanded by governments. *Fourth*, although not quite popular, tax farming, usually called "Baoshui" in Chinese, can be used in VAT collection. This makes room for flexible tax enforcement.

2.2. Agricultural tax reform

Agricultural taxes in China before the 2005 reform were levied on various agricultural products. The tax-payer is an organisation or individual who receives revenue from the taxable agricultural products.[5] The agricultural taxes are a local tax and the revenue is mainly shared by county and prefectural governments.

The purpose of the central government in abolishing agricultural taxes was to relieve the burden of rural farmers and mitigate rural social unrest, which had been violent and rampant since the 1990s. To pave the way for the agricultural tax reform and to guarantee local government expenditure on education and government regular operation, the central government decided to subsidize local governments through an inter-governmental transfer/subsidy. The amount of subsidy is based on a formula in order to prevent any bargain between local and central governments.[6] Subsidy payments began in 2001.

All agricultural taxes were abolished by the Standing Committee of the 10th National People's Congress from January 1st, 2006. Nevertheless, under the pressure and order of the central government, local governments nearly stopped collecting all these taxes in 2005, even before the law was formally passed by the national congress.[7] Therefore, the exact timing of the revenue loss was somewhat of a surprise for local governments, even though they had known since the early 2000s that the tax would be abolished sooner or later.

It should be noted that the agricultural taxes are collected by the *Local Administration of Taxation* (*LAT*), and that VAT is administered by the *State Administration of Taxation* (*SAT*). They are two independent taxation bureaus. The former is under the direction of local governments, while the latter is led by the central government. The staff of the *LAT* would not be re-assigned to the *SAT* following the abolition of the agricultural taxes.

3. Conceptual framework

This section proposes a model that highlights the role of local governments in tax enforcement. The model helps to clarify the mechanisms underlying the effect of agricultural tax abolition on tax enforcement. It also discusses several factors affecting the incentives of local governments for tax enforcement. The model follows a standard framework of optimal commodity taxation theory, as summarized by Slemrod and Gillitzer (2014) and Slemrod and Yitzhaki (1996). It focuses on the trade-off between the benefits of public funds and the cost of taxation. For simplicity, I only sketch a reduced form model and its predictions relevant to my empirical work. As proved in online Appendix A, under some regular conditions, the reduced form model displayed here can be derived from a standard consumer-utility based optimal commodity taxation model.

Suppose the public funds T can bring benefits $B(T)$ to local governments, with $B'(T) > 0$, and $B''(T) < 0$. Without loss of generality, I assume there are only three types of taxes to finance the funds T such that $T_0 + T_1 + T_2 = T$. Each type of tax T_i bears a certain taxation cost denoted by $C_i(T_i)$, $i = 0, 1, 2$, with $C_i'(T_i) > 0$, and $C_i''(T_i) > 0$.[8] Suppose y_i is the tax base of tax-i, then its effective tax rate can be defined as $\tau_i = T_i/y_i$, where τ_i is determined by tax enforcement, and y_i is endogenous to τ_i due to the behavioural response of the tax base to the tax rate. Empirically, we can think of these three types of *taxes* respectively as agricultural taxes, VAT, and land sales revenue. Of course, they can be generalized to other taxes or types of public revenue depending on the scenario under study.

The optimal condition requires that the marginal cost of any tax should be equal to the marginal benefit of total public funds. That is,

$$B'(T) = C_i'(T_i) \qquad ,\forall i = 0, 1, 2 \tag{3.1}$$

Optimal condition (3.1) can be generalized to scenarios where tax-i is a shared tax between the central government and local governments. Suppose the sharing ratio for local government is denoted by $\alpha_i \in (0, 1)$, then Eq. (3.1) becomes $B'(T) = \frac{1}{\alpha_i} C_i'(T_i/\alpha_i)$, where T_i is the tax revenue *obtained* by local governments, and T_i/α_i is the total tax revenue *collected* for tax-i.

[4] For example, the *SAT* announced the eight biggest cases of tax law violation in 2013. All of these cases were related to fake VAT special invoices. In every case, the tax evaded is above one hundred million RMB Yuan (about $15 million USD). The highest effective tax rate a firm paid in one of these cases was only 0.11% (Xinhua Net, October 21, 2013. http://news.xinhuanet.com/2013-10/21/c_117804571.htm). Most of the VAT special invoices are not in fact fake. Actually, they are authentic invoices simply with a fake transaction or a fake recorded amount. There are many informal companies in China specialising in the sale of fake invoices. Fig. E.3 in online Appendix E shows records of my conversations with fake invoice dealers through text messages on the eligibility, price and sources of the VAT special invoices.

[5] The agricultural taxes included three types of taxes: *Agricultural Tax*, *Agricultural Specialty Tax* and *Livestock Tax*. These taxes. Refer to Note 2 of Fig. E.4 in online Appendix E for more details on the agricultural taxes.

[6] Because of the formula, the subsidy was pre-determined and exogenous to the post reform intervention or other efforts that local government could make. The factors used in the subsidy formula include previous local expenditure on education, health, road construction, militia training, as well as the number of villages and households under the poverty line, and the number of students in primary and high school. Of course, the subsidy in this way may be unfair – a county which suffered larger agricultural tax losses may not necessarily get more subsidies. But from the point of view of a natural experiment, it is good for economics researchers. Readers can refer to Note 3 of Fig. E.4 in online Appendix E for details on the subsidy formula.

[7] Although some local governments still collected agricultural taxes in 2005, it is very small and amounts only to 8.9% of collection in 2004. In a robustness check not reported in the paper, I alternatively chose year 2006 as the reform year in addition to the baseline regression with 2005 as reform year. The result is still robust.

[8] To simplify the analysis, the model makes an assumption that the marginal cost of a tax is independent of other taxes. Intuitively, a sufficient condition for this assumption is: the cross-price effects for different tax bases (or different commodities involved) are zero and each tax instrument only has behavioural effect on its own tax base (or taxed commodity). For more technical details on the assumption, please refer to online Appendix A (pp. 1–4).

Suppose tax-0 (the agricultural tax) is going to be abolished. What is its impact on the enforcement of other taxes and the mobilization of other sources of public revenue? How can this impact be affected by other relevant factors, such as the region-specific VAT sharing ratio between local governments and upper level governments, VAT tax base, and availability of other public funds? Specifically, the VAT in China is a shared tax among different levels of government. The VAT sharing ratio (α_i) between county and upper level governments varies across provinces. Does a county have weaker incentives for VAT enforcement if its VAT sharing ratio is lower? Additionally, revenue mobilization capacity also varies across counties in China. Would VAT enforcement become weaker if a county had greater revenue mobilization capacity, due to a broader VAT base or easier access to public funds?[9] These questions can be answered via the following four testable predictions based on the model. Technical proofs of the predictions can be found in online Appendix A.3 (pp. 6–11).

Prediction 1 (*Abolition of Tax*)**.** *Suppose that tax-0 is abolished and no new type of tax can be introduced, then the government would strengthen enforcement of existing tax-1 and tax-2 by increasing the effective tax rates τ_1 and τ_2 respectively.*

Prediction 2 (*Tax Sharing Ratio*)**.** *Suppose that tax-1's effective tax rate τ_1 increases following Prediction 1, then τ_1 would increase by less if the local government had a lower sharing ratio α_1 in tax-1.*

Prediction 3 (*Size of Tax Base*)**.** *Suppose that tax-1's effective tax rate τ_1 increases following Prediction 1, then τ_1 would increase by less if the tax base y_1 is greater in tax-1.*

Prediction 4 (*Marginal Cost of Other Public Funds*)**.** *Suppose that tax-1's effective tax rate τ_1 increases following Prediction 1, then τ_1 would increase by less if the marginal change of marginal cost of other funding sources (that is, $C_2''(T_2)$) is smaller.*

4. Data, main variables, and motivating facts

4.1. Data description

This paper employs two datasets: (1) the *Annual Survey of Industrial Production* conducted by the National Bureau of Statistics of China (2000–2007); and, (2) the *County Public Finance Statistics Yearbook* of China (2000–2007).

The *Annual Survey of Industrial Production* includes all state-owned firms and non-state owned firms with annual sales of more than 5 million RMB Yuan (approximately $800,000 USD). I use data from 2000 to 2007. The number of firms increases from about 66,000 to 168,000 during the sample period after dropping three types of bad observations: (1) the observation with empty cell, and (2) the observation with non-positive value for capital stock, labour input, value-added and wage compensation, and (3) the observation with value-added less than the wage. Information on each firm includes a 4-digit industry code, ownership, county-level region code, value-added, sales revenue and tax payments including VAT, corporate income tax, business tax and other minor local taxes.

The *County Public Finance Statistics Yearbook* of China (2000–2007) includes government revenue and government expenditure at county and prefecture levels. In this paper, we are interested in the following variables: (1) tax revenue; (2) total revenue (including off-budget revenue); (3) total expenditure (including off-budget expenditure); (4) agricultural taxes revenue; (5) subsidies for agricultural tax reform; (6) land sales revenue; and, (7) total GDP and GDP of secondary sector.

Summary statistics of the main variables used for regressions are reported in Table 1. Means and their differences of each variable are also reported for two sub-samples of "Treatment" and "Control" counties, which are divided according to their magnitude of agricultural revenue loss (That is, variable ΔAgr defined by Exp. (4.3). The prefectural median of ΔAgr is set as the threshold for the division of the two groups of counties.

4.2. Measurement of main variables

4.2.1. Effective VAT rate

I construct the effective VAT rate of a firm f in year t as:

$$\textit{Effective VAT Rate}_{f,t} = \frac{\textit{VAT Payment}_{f,t}}{\textit{Value Added}_{f,t}} \tag{4.1}$$

For notational convenience, I will ignore subscripts f and t hereafter for all relevant variables without causing confusion. In accounting, *VAT Payment* = *Payable VAT* + *Adjustment Items*. Because the invoice-based credit deduction method is adopted in VAT collection in China, *Payable VAT* of a firm is equal to the *Output VAT* it has paid to customers, less *Input VAT* it has collected from suppliers of intermediate inputs. The second term, *Adjustment Items*, include overdue VAT payable in previous years, and penalty fees for VAT evasion or overdue VAT payments.

There are five channels, which can lead to variation in the effective VAT rate: (1) change in *Adjustment Items* through audit or penalty, or by manipulating *de facto* tax rates, either output VAT rates or input VAT rates, not in accordance with statutory VAT rates; (2) manipulating the tax base by mis-reporting taxable input or taxable output; (3) change in statutory input VAT rate and output VAT rate; (4) change input-output ratio; (5) change in export-sales ratio due to export VAT refund. The main task of this paper is to show that the effect of abolition of agricultural taxes on the effective VAT rate is mainly through channel (1) by changing effective tax rates rather than through channels (2), (3), (4) and (5).[10]

[9] Regarding VAT sharing ratio, for 100 Yuan of VAT paid by a firm located in a county, 75 Yuan goes to the central government, the remaining 25 Yuan is divided between the provincial, prefectural and the county governments. Generally, the tax sharing ratio of a county government is determined at the subnational level. It therefore varies across provinces. Its regional variation provides an opportunity to study the effect of the tax sharing ratio of a county government and its incentive to enforce tax. After all, county governments are at the grassroots level; their incentives are critical for tax enforcement. Refer to online Appendix D for details on VAT sharing ratio.

[10] To understand sources of variation in the effective VAT rate defined in Exp. (4.1), it can be written as $\frac{\tilde{\tau}^s \bullet \tilde{S} - \tilde{\tau}^m \bullet \tilde{M}}{S-M}$ and further decompose it into two components:

$$\textit{Effective VAT Rate} = \frac{\tilde{\tau}^s \bullet \tilde{S} - \tilde{\tau}^m \bullet \tilde{M}}{S-M} = \frac{\tilde{\tau}^s \bullet \tilde{S} - \tilde{\tau}^m \bullet \tilde{M}}{\tau^s \bullet S - \tau^m \bullet M} \bullet \frac{\tau^s \bullet S - \tau^m \bullet M}{S-M} \tag{4.2}$$

where $\tilde{S}$ and $\tilde{M}$ are the sales and intermediate inputs used to calculate the payable VAT. Due to tax evasion, or other reasons, $\tilde{S}$ and $\tilde{M}$ may differ from S and M, which are used to calculate firms value-added. $\tilde{\tau}^s$ and $\tilde{\tau}^m$ are the tax rates actually applied for sales and intermediate inputs, respectively. They could differ from the statutory tax rates τ^s and τ^m. In the data, $\tilde{\tau}^s \bullet \tilde{S}$ and $\tilde{\tau}^m \bullet \tilde{M}$ are observable, while $\tilde{\tau}^s$ and $\tilde{\tau}^m$ are not. $\tau^s \bullet S - \tau^m \bullet M$ is the payable VAT calculated based strictly on the tax code.

The first component on the right-hand side of Exp. (4.2), $\frac{\tilde{\tau}^s \bullet \tilde{S} - \tilde{\tau}^m \bullet \tilde{M}}{\tau^s \bullet S - \tau^m \bullet M}$, reflects the ratio of actual VAT and statutory VAT payments. The second component, $\frac{\tau^s \bullet S - \tau^m \bullet M}{S-M}$, can be re-written as $\tau^s + (\tau^s - \tau^m)(S/M - 1)^{-1}$, which implies that the variation in the statutory rates τ^s and τ^m, as well as the input-output ratio M/S, could potentially be sources of variation in the effective VAT rate. If the firm exports goods worth E, then τ^s in Exp. (4.2) should be replaced with $\tau^s - \tau^e \bullet (E/S)$, where τ^e is the post-rebate statutory VAT rate for exports. In this case, the ratio of export to sales is an additional source of variation.

Table 1
Summary statistics.

	Panel A: Annual Survey of Industrial Production in China (2000–2007)[a]						
	Whole Sample[b]				Sub-Sample[b] "Treatment" vs. "Control"		
	Sample Size	Mean	St. Dev.	Median	Mean^C	Mean^T	Difference
Effective VAT Rate[c]	17,969	11.00	7.45	9.98	11.34	10.66	−0.68***
Profit Gap Rate[d]	17,969	32.98	34.14	37.06	30.99	34.97	3.98***
LOG(Value-added)[e]	17,969	8.89	0.88	8.88	9.02	8.76	−0.26***
LOG(Sales)[e]	17,968	9.85	0.96	9.89	9.99	9.72	−0.27***
Capital Intensity[f]	17,969	1.45	0.54	1.30	1.45	1.46	0.01
Profitability[g]	17,969	0.16	0.02	0.16	0.16	0.16	−0.00***
Ownership[h]	17,969	0.81	0.25	0.91	0.81	0.80	−0.01**
Mobility[i]	17,969	0.08	0.19	0.00	0.08	0.08	−0.01*
Export-Sales Ratio[j]	17,969	6.48	13.73	1.02	7.53	5.42	−2.10***
Input-Output Ratio[k]	17,969	68.87	10.82	70.34	68.75	68.99	0.23
	Panel B: County Public Finance Statistics Yearbook (2000–2007)[a]						
ΔAgr[l]	17,969	0.26	0.22	0.22	0.08	0.43	0.35***
Prefecture Share[m]	17,969	0.35	0.12	0.31	0.36	0.35	−0.01***
Province Share[m]	17,969	0.21	0.17	0.23	0.21	0.22	0.01**
VAT Base[n]	17,594	0.52	0.13	0.53	0.54	0.51	−0.02***
Total Tax[o]	17,896	9.18	1.19	9.16	9.42	8.95	−0.48***
Tax Net Agr.[o]	17,896	9.05	1.25	9.01	9.36	8.74	−0.61***
Business Tax[o]	17,896	7.59	1.31	7.49	7.92	7.25	−0.68***
All Rev.[o]	15,148	9.24	1.13	9.20	9.49	9.00	−0.49***
Bgt. Rev[o]	17,893	9.18	1.21	9.15	9.42	8.94	−0.48***
Land Rev.[o]	10,021	4.14	2.77	4.60	4.06	4.21	0.15**

Notes:
*** (**, *) Indicates statistical significance of the difference between "Mean^T" and "Mean^C" at the 1% (5%, 10%) level.
[a] Panel A is the variables from the *Annual Survey of Industrial Production* in China (2000–2007). Panel B is those from the *County Public Finance Statistics Yearbook* of China (2000–2007).
[b] The four columns under the "Whole Sample" report the "Sample Size", "Mean", "Standard Deviation", and "Median" of variables for the whole sample. The three columns under the "Sub-Sample" report the "Mean" and their "Difference" for two sub-samples called "Control" group and "Treatment" group. "Mean^C" ("Mean^T") is the mean of "Control" group ("Treatment" group). Although the treatment intensity "ΔAgr" (county agricultural revenue loss measured by Exp. (4.3)) is a continuous variable, in order to gain a sense of counties' heterogeneity along the dimension of treatment, I artificially label a county as a "Control" if its "ΔAgr" is below the prefectural median, or as a "Treatment" otherwise.
[c] "Effective VAT Rate" is defined as county-year average of firm level "Payable VAT / Value-added × 100".
[d] "Profit Gap Rate" is measured by county-year average of firm level "Profit Gap / Value-added × 100", where "Profit Gap" is the "Imputed Profit" minus the "Reported Profit". See Section 6.1 and on-line Appendix C for more details of the "Profit Gap Rate".
[e] "LOG(Value-added)" and "LOG(Sales)" respectively are the county-year median of logarithm of a firm's value-added and sales volume.
[f] "Capital Intensity" is measured by county-year median of firm level "Total Asset / Sales Volume".
[g] "Profitability" is measured by county-year median of firm level "Profit / Value-added".
[h] "Ownership" is the proportion of non-state-owned enterprise in each county-year cell.
[i] "Mobility" is the proportion of firms in the mining industry in each county-year cell.
[j] "Export-Sales Ratio" is defined as county-year median of firm level "Export / Sales Volume × 100".
[k] "Input-Output Ratio" is defined as county-year median of firm level "Intermediate Inputs / Total Value of Products and Services × 100".
[l] "ΔAgr" is the net tax revenue loss due to the abolition of agricultural tax. Refer to Exp. (4.3) for its definition.
[m] "Prefecture Share" and "Province Share" respectively are the VAT sharing ratio of prefectural governments and provincial government in the total VAT revenue of a province. "County Share" for county governments is not reported and it is equal to 1 − "Prefecture Share" − "Province Share".
[n] "VAT Base" is defined as the average "Manufacturing GDP / (Manufacturing GDP and Service GDP)" between 2000 and 2004 for each county.
[o] These variables are governments' revenue at county-year level, including: (1) "Total Tax" (that is, total tax revenue), (2) "Tax Net Agr." (total tax revenue net of agriculture tax revenue), (3) "Business Tax" (business tax revenue), (4) "All Rev." (the sum of Total Tax Revenue and fund revenue), (5) "Bgt. Rev." (county government budgetary revenue), (6) "Land Rev." (land sales revenue). All variables take logarithms of variable "X" as "LOG(1 + X)".

Several caveats should also be noted with the measurement of effective VAT rate in Exp. (4.1). *First*, because only $\tilde{\tau}^s \cdot \tilde{S}$ and $\tilde{\tau}^m \cdot \tilde{M}$ are observable, we cannot distinguish the exact manner of tax enforcement or tax evasion by manipulating tax rate ($\tilde{\tau}^s$ or $\tilde{\tau}^m$) or by tax base ($\tilde{S}$ or $\tilde{M}$). *Second*, the variation of the effective VAT rate may come from the manipulation of reported value-added, that is, the denominator in Exp. (4.1), rather than from tax evasion through the numerator. I will test this possibility in Section 6.1.2. *Third*, the effective VAT rate is not a direct measurement of tax enforcement, for which number of audits and number of fake invoices discovered may be better candidates. In this paper, given the good nature of fiscal squeeze natural experiment, I manage to provide circumstantial evidences to rule out other possibilities and to support that it was the tax enforcement by local governments that changed the effective VAT rate.

4.2.2. Revenue loss from agricultural taxes abolition

During 2000–2004, the agricultural taxes revenue on average accounted for around 12% of the county government tax revenue. Despite the subsidy for agricultural tax reform from the central government, the revenue loss incurred by the reform is still considerable to county governments.

In the main regressions of this paper, I propose the following measurement of a revenue loss to each county c due to the abolition of agricultural taxes:

$$\Delta Agr_c = \frac{(Agr\ Tax\ Revenue_{c,2000-2004} + Subsidy_{c,2000-2004})}{Total\ Tax\ Revenue_{c,2000-2004}} - \frac{Subsidy_{c,2005-2007}}{Total\ Tax\ Revenue_{c,2005-2007}} \tag{4.3}$$

On the right-hand side of Exp. (4.3), $X_{c,2000-2004}$ ($X_{c,2005-2007}$) is the average of variable X in county c in a year between 2000 and 2004 (2005 and 2007). *Agr Tax Revenue* is the agricultural taxes revenue. *Subsidy* is central government transfer associated with the agricultural tax reform and received at county level. To prevent bargain with local governments over the amount of transfer, the central government set it based on a pre-determined formula, mainly reliant on county governments' previous expenditure.[11] *Total Tax Revenue* is the county budgetary tax revenue, including VAT, corporate income tax, business tax and others, while off-budget revenue, such as fees and local funds, is not included.

Apparently, measurements of the agricultural taxes revenue loss are not unique. Measurement with Exp. (4.3) is potentially subject to endogeneity because the total tax revenue after 2005 may be affected by the altered tax enforcement post abolition of agricultural taxes. In Section 6.2.1, I will use alternative measurements to address the endogeneity.

4.3. Motivating facts

The nationwide abolition of agricultural taxes in 2005 generated a variation of tax revenue loss from two dimensions. Over time, most counties suffered a net revenue loss. Across counties, the intensity of the revenue loss varied. The variation over time and across counties allows for the standard Diff-in-Diff method to identify the impact of agricultural taxes abolition on tax enforcement. To make a plausible cross-county comparison, I exploit the variation within comparable localities in each prefecture rather than the variation across the whole country.

Figs. 4.1 and 4.2 present motivating facts on how the effective VAT rate over time and across counties varies with the intensity of agriculture revenue loss, ΔAgr, measured by Exp. (4.3).

In Fig. 4.1, all counties in a prefecture are divided into "control group" (That is, "Low Shock Counties" below the prefectural median of ΔAgr) and a "treatment group" (That is, "High Shock Counties" above the median). I then plot the time profile of the effective VAT rate for both groups. The figure suggests that parallel trends seem to be in place before the abolition of agricultural taxes. After 2005, something has caused the parallel pattern to break down, and there is a relative increase in the effective VAT rate for the "treatment group".[12]

Fig. 4.2 shows with supplementary evidence that the change of the effective VAT rate of a county after 2005 varies positively with the county's agricultural revenue loss relative to its prefectural average. It suggests that a county would increase the effective VAT rate more when suffering a greater loss of revenue.

5. Empirical strategy and results

5.1. Empirical strategy

5.1.1. Baseline

Both Figs. 4.1 and 4.2 suggest that the variation of the effective VAT rate is correlated with agricultural revenue loss, not only over time but across counties as well. In this section, I employ a standard Diff-in-Diff regression to identify the impact of tax revenue loss on the effective VAT rate. The regression of Diff-in-Diff can be specified as below:

$$\tau_{c,p,t} = \beta_c + \eta_{p,t} + \lambda \times \Delta Agr_c \times Post_t + \rho \times X_{c,t} + \epsilon_{c,p,t} \tag{5.1}$$

where the dependent variable $\tau_{c,p,t}$ is the effective VAT rate. The subscript c, p, t are county, prefecture, and year, respectively.

$Post_t$ is the dummy variable indicating the year pre and post the reform, taking a value of one in 2005 and after. ΔAgr_c, measured by Exp. (4.3), is the revenue loss to county c.

The parameter of interest is λ, capturing the response of the effective VAT rate to the intensity of the tax revenue loss.[13] County fixed effects β_c are included to absorb the county-specific characteristics. To guarantee that counties are comparable, the identification only exploits the within-prefecture variation, by controlling for prefecture-year fixed effects $\eta_{p,t}$, so that λ only captures the effect of the county specific revenue loss over time within a prefecture.[14]

$X_{c,t}$ is a vector of firm characteristics in county c and in year t, including the median of firm size, capital-intensity, profitability, and input-output ratio, as well as the mean of ownership, mobility, and export-sales ratio.[15] They are included to avoid missing variables potentially correlated with $\Delta Agr_c \times Post_t$ and affecting $\tau_{c,p,t}$.

Identification requires the assumption that there is no other county-year specific shock correlated with the revenue loss due to agricultural taxes abolition, or alternatively, counties should follow the parallel trend if tax abolition had not happened. To my knowledge, there is no other big reform in the same period correlated with the revenue loss that potentially has an impact on VAT rate. Of course, robustness checks in Section 6.2.5 will take into account of two concurrent reforms. To test the parallel-trend assumption, placebo tests will be conducted in Section 5.2.2.

To adjust standard errors for serial correlation over time and cross-county correlation within a prefecture, I use the robust standard error clustered at the prefecture level (about 362 groups for the whole sample). In Section 6.2.2, a few additional robustness checks are conducted with cluster at county level and provincial level, as well as with cluster bootstrapped standard errors.

5.1.2. Placebo test

In addition to the baseline regression, I run another regression (5.2) as below:

$$\begin{aligned}\tau_{c,p,t} =& \beta_c + \eta_{p,t} + \lambda \times \Delta Agr_c \times Post_t \\ &+ \sum\nolimits_{t=Placebo\ Year}^{2003} \lambda_t \times \Delta Agr_c \times Yr\_D_t \\ &+ \rho \times X_{c,t} + \epsilon_{c,p,t}\end{aligned} \tag{5.2}$$

[11] Refer to Section 2.2 for details of the subsidy. The subsidy began in 2001. Alternatively, we can also use a broader measurement of subsidy by including additional subsidies due to abolition of agricultural specialty tax and reduction of agricultural tax rate, which started from 2004. Due to lack of data in 2007, this measurement is not used for main regressions but will be considered in a robustness check in Section 6.2.1

[12] In order to make a clearer comparison for both groups, the effective VAT rate can be normalized to zero in 2004 (that is, the effective VAT rate in all years are subtracted from that in 2004). I can also divide counties into four quartile groups. These graphs are provided in Figs. E.9 and E.10 of online Appendix E.

[13] Theoretically, λ depends on many underlying structural parameters (θ_i, ω) which are contained not only in all taxation costs $C_i(T_i, \theta_i)$ $(i = 0, 1, 2)$, but also in the benefit of public funds $B(T, \omega)$ (to see this, please refer to Eqs. (A.8)–(A.10) in online Appendix A). Empirically, however, I can neither identify each structural parameter (θ_i, ω) underlying λ, nor identify each cost $C_i(T_i, \theta_i)$. The estimate of λ captures the overall effects. Despite this empirical defect, several factors underlying λ are still observable. For example, guided by Predictions 2–4 made in Section 3, I study in Section 7 how λ can be affected by the VAT sharing ratio and capacity of public revenue mobilization.

[14] It should be noted that, even under the parallel-trend assumption, different counties may respond differently to the shock of the same magnitude. Therefore, what λ captures is the Average Treatment Effect on the Treated (ATET), instead of the Average Treatment Effect on the Untreated (ATEU).

[15] Firm size is measured by *LOG*(*Sales*), and *LOG*(*Value-added*); *Capital Intensity* by Total Assets/Sales; *Profitability* by Total Profit/Sales; *Input-Output Ratio* by Intermediate-input/output. To avoid bad control, all these variables take the median within a county. Additionally, by taking their mean, *Ownership* is the proportion of non-state-owned enterprises in a county; *Mobility* the proportion of firms in the mining industry of a county. I also take mean on *Export-Sales Ratio* because most firms do not export and its median is generally equal to zero.

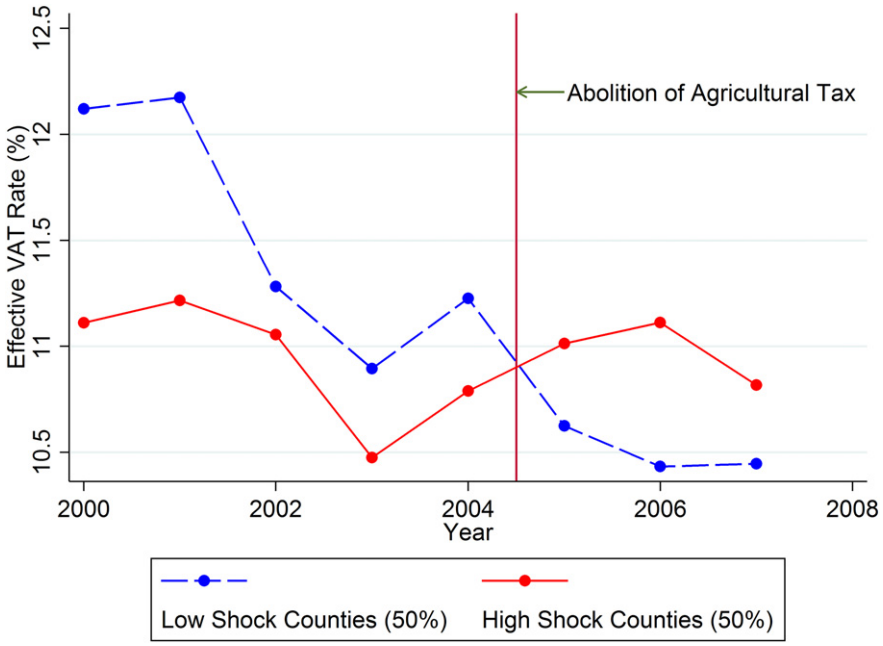

Fig. 4.1. Effective VAT rate over time (grouping by median). Note: The figure shows how the average effective VAT rate (defined by Exp. (4.1)) of two groups of counties change during 2000–2007. The two groups of counties in every prefecture are divided by prefectural median of county revenue loss ΔAgr (defined by Exp. (4.3)). "Low (High) Shock Counties" are counties below (above) the median. The vertical reference line between 2004 and 2005 indicates the timing of abolition of agricultural taxes. Prior to 2005, movement in the effective VAT rates over time of high shock counties, generally track those of low shock counties. The relative increase in effective VAT rates in 2001 for both groups is probably caused by an expected reform to corporate income tax in 2002. This will be discussed in Section 6.2.3. After 2005, the effective VAT rate of the high shock counties increases relative to that of the low shock counties. The figure suggests that the VAT enforcement might have been strengthened for the high shock counties after 2005. Of course, the parallel trend between the two groups before 2005 is not obvious in this motivating graph. I will conduct tests to demonstrate this in Sections 5.2.2 and 5.2.3.

The regression (5.2) specifies a year as placebo year, as well as assigns a dummy variable Yr_D_t for this year and each subsequent year before 2005. It can be used to test the parallel-trend assumption needed for regression (5.1). It can also test whether the treatment effect identified in regression (5.1) is potentially driven by other policy changes before 2005. 2004 is specified as the baseline year so its dummy is not included in Eq. (5.2). The parallel-trend assumption requires that $\lambda_t = 0$ for the placebo years prior to 2004.

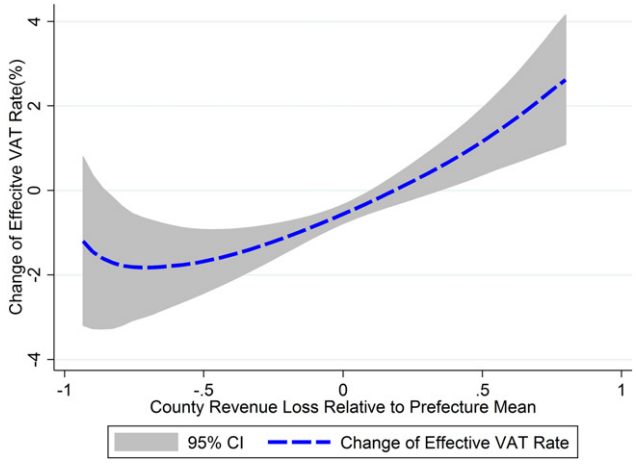

Fig. 4.2. Change of effective VAT rate across counties. Note: The figure shows that the change of the effective VAT rate (the vertical axis) of a county after 2005 varies positively with the county's agricultural revenue loss (the horizontal axis). The vertical axis "Change of Effective VAT Rate" is defined as the difference between the average effective VAT rate of a county after the abolition of agricultural taxes and its pre-abolition average. The effective VAT rate is defined by Exp. (4.1). The horizontal axis is the agricultural revenue loss ΔAgr of a county (defined by Exp. (4.3)) minus the prefectural average of ΔAgr so that the cross-county comparison is made within each prefecture. The dashed fitted curve is drawn with local polynomial regression (degree = 1, bandwidth = 0.5). The figure suggests that the change in VAT enforcement after 2005 is positively related to agricultural revenue loss.

5.1.3. Dynamic effects

Moreover, we may be interested in the entire dynamic effects on the effective VAT rate during 2000–2007. This can be done by running regression (5.3) as below:

$$\tau_{c,p,t} = \beta_c + \eta_{p,t} + \sum_{t=2000}^{2007} \lambda_t \times \Delta Agr_c \times Yr\_D_t + \rho \times X_{c,t} + \epsilon_{c,p,t} \quad (5.3)$$

In this setting, λ_t after 2005 is expected to be positive when $\tau_{c,p,t}$ is the effective VAT rate. Similar to Eq. (5.2), 2004 is specified as the baseline year so its dummy is not included. The parallel-trend assumption now requires that $\lambda_t = 0$ for any year prior to 2005.

5.2. Empirical results

5.2.1. Baseline

Panel A of Table 2 reports the baseline regression results of Eq. (5.1). The positive coefficient 2.29 of $\Delta Agr \times Post$ shows that counties which face bigger revenue loss from agricultural taxes abolition experienced a significant rise in the effective VAT rate, suggesting that the VAT enforcement was strengthened after the reform.

What does the magnitude of the coefficient 2.29 mean? Suppose a "treatment" county suffered 100 percentage points more revenue loss than a "control" county. Then the coefficient 2.29 implies that the effective VAT rate rose by 2.29 percentage points more in the "treatment" county compared to the "control" county. On average, the gap in revenue loss between an average treatment county and control county is 30 percentage points in the sample (because the standard deviation of revenue loss Δ *Agr* is 15 percentage points

Table 2
Agricultural tax reform and effective VAT rate.

	Dependent variable: Effective VAT Rate				
	Panel A: Baseline Panel B: Placebotest				
	(1)	(2)	(3)	(4)	(5)
ΔAgr × Post	2.29	2.18	1.82	1.85	1.52
	(0.74)***	(0.75)***	(0.76)**	(0.70)***	(0.62)**
ΔAgr × year 2003		−0.92	−1.24	−1.21	−1.73
		(0.97)	(1.00)	(0.97)	(1.07)
ΔAgr × year 2002			−1.15	-1.12	−1.31
			(0.78)	(0.82)	(0.86)
ΔAgr × year 2001				0.1	−0.77
				(1.56)	(1.78)
ΔAgr × year 2000					−1.19
					(1.77)
	Controls: firm characteristics at (2-digit) industry level				
LOG(Value-added)	0.11	0.11	0.10	0.10	0.10
	(0.52)	(0.52)	(0.52)	(0.52)	(0.52)
LOG(Sales)	0.94	0.94	0.94	0.94	0.93
	(0.59)	(0.59)	(0.59)	(0.59)	(0.59)
Capital Intensity	0.96	0.95	0.95	0.95	0.95
	(0.24)***	(0.24)***	(0.24)***	(0.24)***	(0.24)***
Profitability	1.86	1.96	1.83	1.75	1.47
	(9.70)	(9.72)	(9.73)	(9.74)	(9.75)
Ownership	−0.72	−0.72	−0.72	−0.72	−0.73
	(0.56)	(0.56)	(0.56)	(0.56)	(0.57)
Mobility	2.26	2.25	2.26	2.27	2.3
	(1.31)*	(1.31)*	(1.32)*	(1.32)*	(1.32)*
Export-Sales Ratio / 100	−0.01	−0.01	−0.01	−0.01	−0.01
	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***
Input-Output Ratio	0.23	0.23	0.22	0.22	0.23
	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***
	Fixed effects				
Prefecture-year FE	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes
Sample size	17,968	17,968	17,968	17,968	17,968
R^2	0.50	0.50	0.50	0.50	0.50
Clustering	Prefecture level (362 groups)				

Notes: OLS results in Panel A (column (1)) from baseline regression of Eq. (5.1), and OLS results in Panel B (columns (2)–(5)) from placebo test of Eq. (5.2). Refer to notes of Table 1 for variable definitions. In Panel B, 2003, 2002, 2001, 2000 are respectively set as the placebo year when the treatment is hypothetically thought to commence. Robust standard errors are clustered at the prefecture level (362 groups). The significance levels of 1%, 5% and 10% are noted by ***, ** and *. The results in Panel A suggest a significant positive effect of agricultural revenue loss on the effective VAT rate. The results in Panel B suggest that the parallel-trend assumption holds before 2005.

within prefecture). This means the effective VAT rate rose on average by 0.69 (=2.29 × 30 / 100) percentage points. Since the average effective VAT rate is 10 percentage points, this means it should have increased by around 7% on average. Additionally, suppose there was no response in tax base, then the 7% increase in the effective VAT rate would translate into a 7% rise in VAT revenue.

More work can be done to account for the treatment effect identified in Table 2. In Exp. (4.1), *VAT Payment* = *Payable VAT* + *Adjustment Items*. Given firms' reported value-added, output, and intermediate input, the *Payable VAT* depends on the effective output VAT rate and effective input VAT rate actually imposed on sales and intermediate inputs (the two effective rates are respectively denoted as $\tilde{\tau}^s$ and $\tilde{\tau}^m$ in Exp. (4.2)). *Adjustment Items* mainly depend on the intensity of tax audit and penalties for tax evasion or overdue tax payments.

Accordingly, I run four regressions based on baseline regression Eq. (5.1), with the following four variables as dependent variables: (1) *VAT Gap Rate* (defined as [*Actual VAT Payment* − (*Payable Output VAT* − *Payable Input VAT*)]/*Value-added*); (2) *Payable VAT Rate* (defined as (*Payable Output VAT* − *Payable Input VAT*)/*Value-added*); (3) *Effective Input VAT Rate* (defined as *Payable Input VAT*/*Intermediate Input*); and (4) *Effective Output VAT Rate* (defined as *Payable Output VAT*/*Value of Output*).

The results are reported in Table C.4 in online Appendix C.3. Most results are not significant at the 10% confidence level. But quantitatively, they suggest that the change in "*VAT Gap Rate*" due to intensified tax audit and penalty (coefficient 1.25 in column (1)) accounts for about 55% (=1.25 / 2.29) of the overall treatment effect on the effective VAT rate (coefficient 2.29 identified in column (1) of Table 2). The remaining 44% is attributed to "*Payable VAT Rate*" in column (2), either due to falling "*Effective Input VAT Rate*" in column (3), or due to rising "*Effective Output VAT Rate*" in column (4).

5.2.2. Placebo test

Panel B of Table 2 reports the placebo test based on Eq. (5.2), with year 2004 as the baseline year. Columns (2)–(5) respectively set year 2003, 2002, 2001, 2000 as the placebo year. All coefficients of year 2003, 2002, 2001 and 2000 are not significantly different from zero, passing the placebo tests and confirming the parallel-trend assumption.

5.2.3. Dynamic effects

Fig. 5.1 displays the dynamic effect of revenue loss of county governments on the effective VAT rate based on regression (5.3). In the graph, $\tau_{c,p,t}$ can be thought to be normalized to zero for the county where $\Delta Agr_c = 0$ for all years and for the county where $\Delta Agr_c \neq 0$ but only for the baseline year 2004. The dots mark the $\tau_{c,p,t}$ for the county where $\Delta Agr_c = 1$, which means a 100 percentage point tax loss measured by Exp. (4.3). We can see that before 2005, the effective VAT rate is not significantly different from the baseline year 2004, confirming the parallel-trend. In 2005, the year agricultural taxes were abolished, the effective VAT rate increased in counties where $\Delta Agr_c = 1$ (significantly at the 90% confidence level but not at 95%). In 2006 and 2007, the effects continued to rise and they were significant at the 95% and 99% confidence levels respectively.

6. Alternative explanations and robustness checks

6.1. Testing for alternative explanations

6.1.1. Input-output ratio and export-sales ratio

As discussed in Section 4.2.1, in addition to tax enforcement or tax evasion, a firm's effective VAT rate could also be affected by three other factors: (1) statutory input VAT rate and output VAT rate; (2) input-output ratio (due to intermediate input deduction); and, (3) export-sales ratio (because of VAT export refunds).

By law, we know that there was no change in the statutory input and output VAT rate during the sample periods. However, it is still possible that the abolition of agricultural taxes affected the effective VAT rate through an input-output ratio or export-sales ratio. I explored these possibilities and report the results in Table 3, which show that there is no significant treatment effect either on the *Input-Output Ratio* (in column (1)) or on the *Export-Sales Ratio* (in column (2)). Therefore, both channels can be ruled out.

6.1.2. Decrease in the value-added

From definition (4.1) of the effective VAT rate, we may suspect that the increase in the effective VAT rate may come from a fall in value-added (the denominator) rather than from any increase of VAT payment (the numerator). However, the results in this section suggest that the decrease of value-added is rather unlikely.

I test the hypothesis of value-added decline in two ways. One is to directly look at the effect of the abolition of agricultural taxes on the value-added of firms. Another is to cross-validate the tax enforcement by studying the effect on the profit gap rate, which is thought

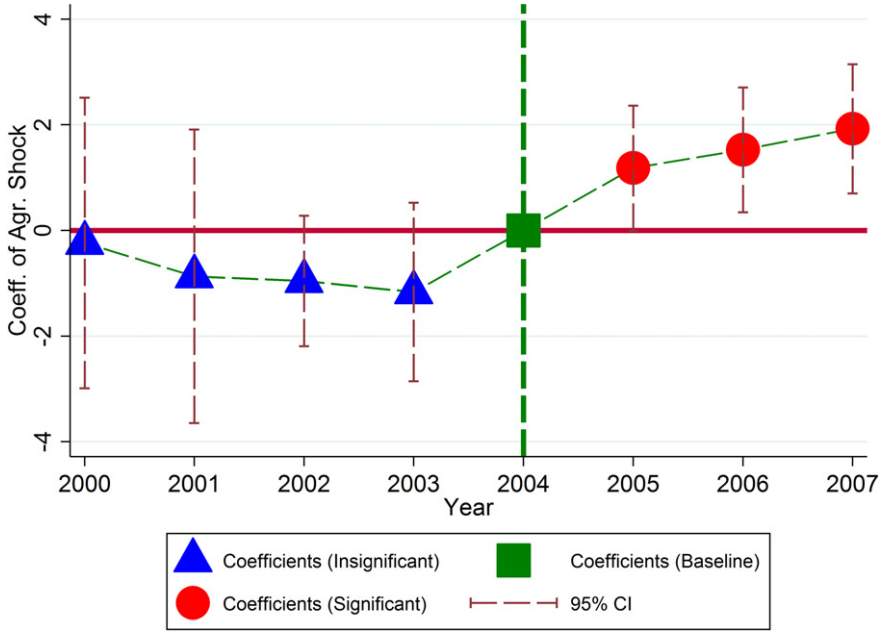

Fig. 5.1. Dynamic effect on effective VAT rate. Note: The graph shows the OLS regression coefficients from Eq. (5.3) and their 95% confidence intervals. Year 2004 is chosen as the baseline year. The coefficient and the prefecture level clustered standard error (in brackets) for each year [in squared brackets] is: −0.23 (1.40) [in 2000], −0.87 (1.41) [in 2001], −0.96 (0.63) [in 2002], −1.17 (0.86) [in 2003], 1.18 (0.60) [in 2005], 1.53 (0.60) [in 2006], 1.93 (0.62) [in 2007]. The coefficients suggest that the difference in the effective VAT rate between counties do not change significantly before 2005; and that the effective VAT rates increase more after 2005 in counties suffering greater agricultural revenue loss.

to be related to corporate income tax evasion in China (Cai and Liu, 2009).[16]

Table 4 reports the effect of the abolition of agricultural taxes on the value-added (in column (1)) and the profit gap rate (in column (2)) of firms. The regression is based on Eq. (5.1), with dependent variable replaced respectively with *LOG(Value-added)* and *Profit Gap Rate*. The result in column (1) shows that the effect on firms' value-added is not significant.

In column (2), the negative and significant coefficient of $\Delta Agr \times Post$ suggests that firms are less likely to evade corporate income tax through under-reporting profits thanks to the effect of abolition of agricultural taxes. This is in line with Prediction 1 in Section 3 that states the abolition of one type of tax would lead to the rise of tax enforcement on all available taxes. The result also confirms that both the positive effect on the effective VAT rate and the negative effect on the profit gap rate must be commonly driven by tougher tax enforcement rather than by a fall in value-added; both have value-added as the denominator, therefore they should have changed in the same direction if it had been the manipulation of value-added that mainly led to variation.[17]

6.1.3. Change in government expenditure

So far I have only focused on the revenue side of the government budget. However, one may suspect that the change in the incentives of tax enforcement can also be driven by positive shocks on government expenditure.

To explore this possibility, I studied the variation of county government expenditure associated with the abolition of agricultural taxes. The results are reported in Table 5. They show that the effects on ratios of government expenditure to GDP are negative

Table 3
Effect on input-output ratio and export-sales ratio.

	Dependent variable	
	(1)	(2)
	Input-Output Ratio	Export-Sales Ratio
ΔAgr × Post	−0.02	−0.99
	(0.84)	(1.26)
Controls	LOG(Value-added), LOG(Sales), Capital Intensity, Profitability, Ownership, Mobility, Export-Sales Ratio, Input-Output Ratio	
	Fixed effects	
Prefecture-year FE	Yes	Yes
County FE	Yes	Yes
Sample size	17,968	17,968
R^2	0.69	0.17
Clustering	Prefecture level (362 groups)	

Notes: OLS results from regression of Eq. (5.1), with dependent variable respectively being "Input-Output Ratio" in column (1), and "Export-Sales Ratio" in column (2). Control variables exclude "Input-Output Ratio" in regression of column (1), and exclude "Export-Sales Ratio" in column (2). Refer to the note of Table 1 for variable definitions. Robust standard errors are clustered at the prefecture level (362 groups). The significance levels of 1%, 5% and 10% are noted by ***, ** and *. The insignificant results suggest that the effect of the agricultural revenue loss on the effective VAT rate should not be produced through the "Input-Output Ratio" or the "Export-Sales Ratio".

[16] The profit gap rate is the profit gap normalized by the valued-added of a firm. The profit gap of a firm measures the difference between its imputed profit and reported profit. According to the *National Accounting Principle* and following Cai and Liu (2009), the imputed profit is calculated as: firm's gross output − intermediate input − financial charges − total wage bill − current depreciation − VAT payment. Cai and Liu (2009) suggest that the profit gap is potentially related to tax evasion of corporate income tax in Chinese manufacturing firms (a larger profit gap implies more possible tax evasion). Of course, the profit gap can also arise either from legitimate discrepancy between the *National Accounting Principle* and the *General Accepted Accounting Principle* or due to accounting errors. In this paper, I need to assume that the legitimate discrepancy and accounting error in the profit gap rate are uncorrelated with cross term $\Delta Agr \times Post$ in Eq. (5.1). Refer to Appendix B for more details on the profit gap rate, including its measurement, distribution (in Fig. B.1), joint distribution with the effective VAT rate (in Fig. B.2), and the dynamic effect of agricultural taxes abolition on it based on regression (5.3) (in Fig. B.3).

[17] Of course, I still cannot rule out the possibility that the value-added was manipulated and tax enforcement was strengthened simultaneously.

Table 4
Effect on firms' value-added and profit gap rate.

	Dependent variable	
	(1)	(2)
	LOG(Value-added)	Profit Gap Rate
ΔAgr × Post	0.05	−13.56
	(0.03)	(4.31)***
Controls	LOG(Sales), Capital Intensity, Profitability, Ownership, Mobility, Export-Sales Ratio, Input-Output Ratio, with LOG(Value-added) additionally included in Panel B	
	Fixed effects	
Prefecture-year FE	Yes	Yes
County FE	Yes	Yes
Sample size	17,968	17,968
R^2	0.88	0.46
Clustering	Prefecture level (362 groups)	

Notes: OLS results from regression of Eq. (5.1), with dependent variables respectively being "LOG(Value-added)" in column (1), and "Profit Gap Rate" in column (2). Refer to the note of Table 1 for variable definitions. Robust standard errors are clustered at the prefecture level (362 groups). The significance levels of 1%, 5% and 10% are noted by ***, ** and *. The results suggest that the treatment effect on the effective VAT rate should arise from the changing tax enforcement (that is, tougher tax enforcement reduces the "Profit Gap Rate"), rather than from the decrease in firms' reported value-added (that is, the decrease in the denominator of both the "Effective VAT Rate" and the "Profit Gap Rate").

but insignificant (columns (1)–(2)). In contrast, government revenue, including all tax revenue, budgetary revenue, and all revenue (columns (3)–(5)), fell with certain significance. This implies that the county government expenditure was quite rigid. The increase in the tax enforcement associated with the abolition of agricultural taxes should be driven by the adverse revenue shock instead of a positive expenditure shock.

Table 5
Changes in government expenditure.

	Dependent variable: LOG(1 + X / GDP)				
	(1)	(2)	(3)	(4)	(5)
	Bgt. Exp.	All. Exp.	Tax. Rev.	Bgt. Rev.	All Rev.
ΔAgr × Post	−2.21	−0.07	−5.47	−4.66	−4.46
	(2.88)	(3.02)	(2.61)**	(2.78)*	(2.52)*
	Fixed effects				
Prefecture-year FE	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes
Sample size	17,741	12,694	17,741	17,740	15,023
R^2	0.79	0.73	0.74	0.73	0.65
Clustering	Prefecture level (362 groups)				

Notes: OLS results from regression of Eq. (5.1), with dependent variable respectively being "LOG(1 + X / GDP)", where "X" is various county government expenditure or revenue item and "GDP" is county Gross Domestic Product. From column (1) to column (5), variable X is "Bgt. Exp." (defined as county government budgetary expenditure), "All. Exp." (defined as sum of county government budgetary expenditure and fund expenditure), "Tax. Rev." (defined as county government total tax revenue), "Bgt. Rev." (defined as county government budgetary revenue), "All Rev." (defined as sum of county government budgetary revenue and fund revenue). Refer to notes of Table 1 for other variable definitions. Robust standard errors are clustered at the prefecture level (362 groups). The significance levels of 1%, 5% and 10% are noted by ***, ** and *. The results suggest that the change in tax enforcement is a response to the agricultural revenue loss rather than to positive shocks on government expenditure.

6.2. Robustness checks

6.2.1. Endogeneity of agricultural revenue loss and alternative measurements

The measurement of agricultural revenue loss based on Exp. (4.3) is neither unique nor immune from endogeneity. Two components in Exp. (4.3) are very likely subject to the fiscal squeeze from the abolition of agricultural taxes. *First*, tax revenue between 2005 and 2007, $Total\ Tax\ Revenue_{c,2005-2007}$, is both directly affected by the abolition of agricultural taxes and indirectly by the strengthened tax enforcement. *Second*, although the subsidy associated with agricultural tax reform, $Subsidy_{c,2005-2007}$, is determined by a formula, it may still be affected by bargaining under the table between county governments and upper level governments.

To address these concerns, I propose simulated $Total\ Tax\ Revenue^{sim}_{c,2005-2007}$ and $Subsidy^{sim}_{c,2005-2007}$ to replace the original one in Exp. (4.3). The basic idea underlying the simulated variable is to construct a counter-factual counter-part in a scenario where the agricultural taxes had still been available and tax enforcement had not been affected. To this end, I use the exponential extrapolation of $Total\ Tax\ Revenue_{c,2000-2004}$ to obtain $Total\ Tax\ Revenue^{sim}_{c,2005-2007}$, and adopt the average of $Subsidy_{c,2002-2004}$ for $Subsidy^{sim_1}_{c,2005-2007}$. I use the average, instead of the exponential extrapolation, for the subsidy because it is, according to its formula, based on a county's expenditure in previous years and therefore pre-determined. As a robustness check, I use $Subsidy_{c,2004}$ in year 2004 for a second simulated subsidy $Subsidy^{sim_2}_{c,2005-2007}$. This is because $Subsidy_{c,2004}$ is in the year closest to the abolition of agricultural taxes but very unlikely to be affected by the possible bargain after the reform.

Columns (1)–(5) of Table 6 report the effect on the effective VAT rate based on regression Eq. (5.1), respectively using the following simulated values to replace their counter-parts in Exp. (4.3). In column (1), $Total\ Tax\ Revenue^{sim}_{c,2005-2007}$ is used instead; in column (2), $Subsidy^{sim_1}_{c,2005-2007}$ is used; in column (3), $Subsidy^{sim_2}_{c,2005-2007}$ is used; in column (4), both $Total\ Tax\ Revenue^{sim}_{c,2005-2007}$ and $Subsidy^{sim_1}_{c,2005-2007}$ are used instead; in column (5), both $Total\ Tax\ Revenue^{sim}_{c,2005-2007}$ and $Subsidy^{sim_2}_{c,2005-2007}$ are used. All results suggest that the effect on the effective VAT rate is still robust with alternative exogenous specification for Exp. (4.3). It should be noted that in columns (1), (4), and (5) where $Total\ Tax\ Revenue^{sim}_{c,2005-2007}$ is involved, the county revenue loss based on Exp. (4.3) is winsorized at 10th percentile and 90th percentile to deal with extreme values potentially created by exponential extrapolation based on the total tax revenue in 2000–2004.[18]

In addition to the endogeneity concern, another problem regarding Exp. (4.3) is whether we need to include other relevant subsidies. Indeed, an additional subsidy had been granted to county governments since 2004. This subsidy is called "Transfer Subsidy Associated with Abolition of Agricultural Specialty Tax and Reduction of Agricultural Tax Rate" in government documents. I do not include this subsidy in the main regression in Section 5 for two reasons. *First*, this subsidy is not strictly based on a written-down formula, therefore it is very likely to be subject to endogeneity. *Second*, the data of this subsidy is not available in 2007. As a robustness check, however, I include it in Exp. (4.3) and report the result in column (6) of Table 6. It is shown that the effect on the effective VAT rate is still very significant.

Some caveats should be noted about the simulated ΔAgr proposed in this section, despite their advantage of being exogenous.

[18] The extreme value such as negative simulated total tax revenue can be caused, for instance, by missing values of total tax revenue in some years and idiosyncratic yearly shocks during the period 2000–2004. Winsorizing at levels lower than 10%, say 5% or 1%, is not sufficient to remove the negative simulated total tax revenue.

Table 6
Alternative measurements of agricultural revenue loss.

	Dependent variable: Effective VAT Rate					
	ΔAgr = alternative measurement of county revenue loss					
	(1)	(2)	(3)	(4)	(5)	(6)
	Tax^{sim}	$Subsidy^{sim_1}$	$Subsidy^{sim_2}$	Tax^{sim} $Subsidy^{sim_1}$	Tax^{sim} $Subsidy^{sim_2}$	More Subsidy
ΔAgr × Post	2.41 (0.82)***	1.73 (0.64)***	1.71 (0.64)***	1.85 (0.72)**	1.86 (0.73)**	2.43 (0.91)***
Controls	LOG(Value-added), LOG(Sales), Capital Intensity, Profitability, Ownership, Mobility, Export-Sales Ratio, Input-Output Ratio					
	Fixed effects					
Prefecture-year FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	17,968	17,950	17,950	17,950	17,950	17,950
R^2	0.50	0.50	0.50	0.50	0.50	0.50
Clustering	Prefecture level (362 groups)					

Notes: OLS results from regression of Eq. (5.1), with various measurements of county government revenue loss "ΔAgr" to replace the original one based on Exp. (4.3). Columns (1)–(5) deal with the endogeneity problem of "ΔAgr". In column (1), simulated *Total Tax Revenue*$^{sim}_{c,2005-2007}$ is used to replace the *Total Tax Revenue*$_{c,2005-2007}$. In column (2), simulated *Subsidy*$^{sim_1}_{c,2005-2007}$ is used to replace *Subsidy*$_{c,2005-2007}$. In column (3), simulated *Subsidy*$^{sim_2}_{c,2005-2007}$ is used to replace *Subsidy*$_{c,2005-2007}$. Column (4) is the combination of columns (1) and (2), where both *Total Tax Revenue*$^{sim}_{c,2005-2007}$ and *Subsidy*$^{sim_1}_{c,2005-2007}$ are used. Column (5) is the combination of columns (1) and (3), where both *Total Tax Revenue*$^{sim}_{c,2005-2007}$ and *Subsidy*$^{sim_2}_{c,2005-2007}$ are used. In column (6), another subsidy is included in addition to the original one used in Exp. (4.3). Refer to Section 6.2.1 for details of these alternative definition of "ΔAgr" and refer to notes of Table 1 for other variable definitions. Robust standard errors are clustered at the prefecture level (362 groups). The significance levels of 1%, 5% and 10% are noted by ***, ** and *. The results in columns (1)–(5) suggest that baseline results in Table 2 are still robust to alternative exogenous specifications of the treatment variable "ΔAgr". The results in column (6) show that including an additional agricultural-related subsidy in "ΔAgr" does not considerably change the baseline results.

There are two reasons that they are not used in place of the measurement based on Exp. (4.3) in all main regressions in this paper. *First*, as pointed out in Footnote 18, the simulated Δ*Agr* is winsorized at the 10th percentile and 90th percentile in order to deal with extreme values between 2000 and 2004. The winsorized simulated Δ*Agr* loses some degree of variation, information, and statistical power. *Second*, the main endogeneity concern in this study is that the measurement of Δ*Agr* based on Exp. (4.3) may over-estimate the treatment effect on the effective VAT rate. The statement of over-estimation, however, faces two challenges both from theoretical argument and from empirical evidence. Theoretically, Exp. (4.3) might be positively correlated with tax enforcement because the strengthened tax enforcement increases the total tax revenue after 2005 (the denominator of second term). This implies that the intensified tax enforcement would not only increase the effective VAT rate on the left hand side of the regression but also increase the independent variable Δ*Agr* on the right hand side. In this case, the treatment effect of Δ*Agr* on the effective VAT rate would be under-estimated rather than over-estimated. Empirically, although some regression coefficients with simulated Δ*Agr* in Table 6 are greater than the coefficient in the benchmark regression in Table 2, it is not always the case if we slightly modify the regression specification. To see this, I use the same six alternative Δ*Agr* as in Table 6 but run the placebo test based on Eq. (5.2) instead of based on Eq. (5.1). The results show that the regression coefficient of Δ*Agr* defined as Exp. (4.3) is actually smaller than the coefficient of every alternative Δ*Agr* (refer to Table C.5 in online Appendix C.4 for the regression results). Additionally, I use Δ*Agr* measured with Tax^{sim} and $Subsidy^{sim_2}$ (the same as that used in column (5) of Table 6) and run the regressions with the dependent variable respectively being "Input-Output Ratio" and "Export-Sales Ratio", "LOG(Value-added)", and "Profit Gap Rate" (as I do in Tables 3 and 4). The results are consistent with those in Tables 3 and 4 where the measurement Δ*Agr* is based on Exp. (4.3) (refer to Table C.6 in online Appendix C.4 for the regression results). All of these results suggest that the simulated Δ*Agr* does not overwhelmingly dominate the one defined as Exp. (4.3). For this reason, the former is not used to replace the latter in main regressions in this paper.

6.2.2. Entry of new firms

China has experienced rapid economic growth with massive firm entry every year over the last two decades. To stimulate investment, local governments generally promise preferential tax treatment to new firms. This may affect the estimated effect on the effective VAT rate. To eliminate the channels through new firms, I drop the firms set up after 1999 so that newly born firms are not included in the sample period 2000–2007. The regression results are reported in column (1) of Table 7. They show that the effect on the effective VAT rate is still significant.

6.2.3. Other reforms

There are two major reforms during the sample period: (1) the corporate income tax reform in 2002[19]; and, (2) the transformation of VAT from production type to consumption type for eight industries in three north-east provinces in 2004.

In column (1) of Table 7, I have dropped the firms that were set up after 1999 so that the firms that remained in the sample would not be affected by the corporate income tax reform in 2002. In column (2), I drop all firms in the north-east provinces to ensure that the results would not be affected by the reform in 2004 of switching from production VAT to consumption. The results show that the effect on effective VAT is still significant.

6.2.4. Agriculture goods invoices

After the abolition of agricultural taxes, firms that purchased agriculture products as intermediate inputs could no longer get the invoices for VAT deduction.[20] This may increase the effective VAT rate of agriculture-related industries such as food processing, beverage, tobacco, textiles, leather and fur processing, among others. I drop all these industries from the sample. The regression results are reported in column (3) of Table 7 and show that the effect on effective VAT remains robust.[21]

6.2.5. Regression with median of the effective VAT rate

So far the effective VAT rate in all regressions is measured by the firm average within each county and year. But we know that the average is vulnerable to outliers. To deal with this concern, I re-run regression (5.1) with *median* of the effective VAT rate within each

[19] This reform requires the *State Administration of Taxation* to be in charge of the corporate income tax for all firms established after 2002. Before the reform, the *Local Administration of Taxation* also collected corporate income tax of some firms according to firms' ownership and affiliation. Lei (2016) shows that incentives of local governments for tax enforcement changed because of this reform.

[20] The availability of VAT invoice from agriculture goods had been a problem even before 2005. Some firms may get the invoice, others may not. After 2005, however, all firms cannot get it because the abolition of agricultural taxes. Therefore, this may still affect the effective VAT rate on average due to the agricultural tax reform.

[21] Without dropping the agriculture-related industries, the result is also robust in an alternative regression setting by introducing interaction term between agriculture-related industry dummy and Δ *Agr* × *Year* in Eq. (5.1). The estimated coefficient of Δ *Agr* × *Year* × (*Agriculture-related Dummy*) is −0.0024 and its standard error is 0.00028 (significant at 99% level), and the coefficient of Δ *Agr* × *Year* is 2.03 and its standard error is 0.63 (still significant at 99% level). The result suggests that, although the treatment effect on the effective VAT rate is significantly lower in agriculture-related industries than in other industries, the magnitude of their difference is rather trivial (the difference is just about 0.1% of the treatment effect in other industries (0.1% = 0.0024 / 2.03)).

Table 7
Other robustness checks.

	Dependent variable: Effective VAT Rate					
	(1)	(2)	(3)	(4)	(5)	(6)
	Drop	Drop	Drop	Median	Drop	Control
	1999+	NE Prov	Agr-Indu	Regress	Export	Indu-FE
ΔAgr × Post	1.76	2.69	2.46	2.09	2.08	1.31
	(0.83)**	(0.77)***	(0.77)***	(0.77)***	(0.78)***	(0.48)***
Controls	LOG(Value-added), LOG(Sales), Capital Intensity, Profitability, Ownership, Mobility, Export-Sales Ratio, Input-Output Ratio				Exclude Export-sales Ratio	No
	Fixed effects					
Prefecture-year	Yes	Yes	Yes	Yes	Yes	No
County	Yes	Yes	Yes	Yes	Yes	No
Pref-Indu-Year	No	No	No	No	No	Yes
County-Indu	No	No	No	No	No	Yes
Sample size	17,080	16,228	17,356	17,968	17,906	11,938
R^2	0.50	0.43	0.54	0.50	0.49	0.17
Clustering	Prefecture	Prefecture	Prefecture	Prefecture	Prefecture	Prov-Indu
Number of groups	362	362	362	362	362	155

Notes: Robustness checks are conducted in the following ways. OLS results from regression of Eq. (5.1) with sub-samples in columns (1)–(3), and (5). Column (1) drops firms established after 1999. Column (2) drops firms in north-east provinces. Column (3) drops industries heavily using agricultural goods as intermediate inputs (see Section 6.2.6 for details of these industries). Column (5) drops firms with positive exports. OLS results from regression of Eq. (5.1) with county-year median of the effective VAT rate as dependent variable in column (4). Column (6) is OLS results from regression of Eq. (5.1) with additional fixed effects controlled at (2-digit) industry level (in column (6), the Pref-Indu-Year FE refers to Prefecture-(1-digit) Industry-Year fixed effect; and the County-Indu FE is County-(2-digit) Industry fixed effect). In column (5), industrial characteristics control variables do not include "Export-Sales Ratio". In column (6), industrial characteristics control variables are not included because industry fixed effect has been controlled for. Refer to notes of Table 1 for variable definitions. Robust standard errors are clustered at the prefecture level (362 groups) in columns (1)–(5), and clustered at the province-(1-digit) industry level (155 groups) in column (6). The significance levels of 1%, 5% and 10% are noted by ***, ** and *.

county-year cell, instead of its *mean*, as the dependent variable. The result is reported in column (4) of Table 7. Although the magnitude of the effect drops a little to 2.08, it is still significant at 99% confidence level.

6.2.6. VAT export refund

Although I do not find significant effect on the effective VAT rate through export-sales ratio, VAT export refund can still be a potential channel that affects the effective VAT rate through statutory refund rate. Refer to Exp. (4.2) on the relationship between the VAT export refund rate and the effective VAT rate. As Liu (2013) pointed out, the VAT export refund rates indeed dropped in 2004 and 2006 onward for some products in China. To get rid of the potential impact from export refund rate, I drop all firms with positive exports and re-run the regression (5.1). The result is still significant in column (5) of Table 7.[22]

6.2.7. Change of industrial structure

The effective VAT rate varies across industries even if tax enforcement strictly follows the tax code. If the industrial structure changes across regions and over time, it may bias the regression results with Diff-in-Diff method. To control for this, I run an augmented regression based on Eq. (5.1) at the county-year-(2-digit) industry level, and control for the county-(2-digit) industry fixed effects. The results are reported in column (6) of Table 7. The effect on the effective VAT rate drops to 1.31 but is still significant.

6.2.8. Other robustness checks

Additionally, I conduct a couple of robustness checks and put the results in online Appendix C.

First, I use alternative robust standard errors at different levels of clustering (county, prefecture, province) and with bootstrapped estimation. The results are robust and reported in Table C.1 in online Appendix C.

Second, the identification may be confounded by expectations of local governments that could have led to an increase in tax enforcement, even before 2005, as preparation for possible adverse revenue loss in subsequent years. To deal with this concern, I use the two earliest pilot reform provinces as treatment groups, to test whether expectations change local government tax enforcement. The test in this way is valid because the pilot reform regions were allowed to, but did not have to, abolish the agriculture tax before 2005. All pilot reforms were not compulsory in the sense that local governments were at their own discretion as to the ways to reform and the magnitude to lower the agricultural taxes. Even within a province, different prefectures had their own views. Therefore, the real effect of the abolition of agricultural taxes might not have had taken place in pilot regions before 2005. However, the "expectation" must have kicked in at the time. The regression results suggest that the effect of the expectation is negligible, and the expectation would not considerably and significantly alter the baseline results in Table 7. For details, please refer to Tables C.2 and C.3 in online Appendix C.

7. Additional results

7.1. Heterogeneous effect on the effective VAT rate

In this section, I explore several factors that shape incentives of tax enforcement and study its heterogeneous effects on the VAT. In the conceptual framework in Section 3, I provided two predictions on the incentives of tax enforcement. *First*, counties with a lower VAT sharing ratio may be more weakly incentivized to enforce VAT (Prediction 2). *Second*, county governments may have a weaker

[22] The result is also robust in an alternative regression setting, in which I introduce interaction term between *Export-Sales Ratio* and Δ *Agr* × *Year* in Eq. (5.1) with whole sample instead of dropping the exporting firms. The estimated coefficient of Δ *Agr* × *Year* × (*Export-Sales Ratio*) is −0.02 and its standard error is 0.02 (insignificant at 90% level), while the coefficient of Δ *Agr* × *Year* increases from 2.29 (baseline regression in column (1) of Table 2) to 2.35 and its standard error is 0.75 (significant at 99% level). The result also suggests insignificant effect of the export refund.

incentive to raise the effective VAT rate if they have a stronger capacity to mobilize the revenue, or specifically, if they have either a greater VAT base or more capacity to obtain revenue from other sources, such as land sales (Predictions 3 and 4).

7.1.1. VAT sharing ratio and incentive of VAT enforcement

VAT is a shared tax between different levels of governments in China. Although the sharing ratio of the central government is uniformly 75% across the whole country, the sharing ratio of provincial governments, prefectural governments and county governments differ across provinces. Fig. D.1 in online Appendix D displays the cross-province variation of the VAT sharing ratio and its persistence over time. There is evidence that a lower sharing ratio for county governments may reduce their incentives to enforce VAT (refer to Table D.1 in online Appendix D that reports the regression coefficients of effective VAT rate on VAT sharing ratio). This is probably because the county government is at the grassroots level where tax enforcement is actually implemented.

The abolition of agricultural taxes provides us with an opportunity to study how the incentive of tax enforcement of local governments could be affected by VAT sharing ratio. In this regard, Table 8 reports the heterogeneous effect of the VAT sharing ratio on the effective VAT rate. Consistent with the baseline results in Table 2, Table 8 still shows that the abolition of agricultural taxes leads to a rise in the effective VAT rate. Additionally, it also suggests that the incentive of VAT enforcement could be weakened if county governments get a lower share of total VAT revenue. This can be seen from the negative coefficients on $\Delta\ Agr \times Post \times (1 - County\ Share)$ in column (1), on $\Delta\ Agr \times Post \times Prefecture\ Share$ in column (2), and on $\Delta\ Agr \times Post \times Province\ Share$ in column (3).

Table 8
VAT sharing ratio and incentive of VAT enforcement.

	Dependent variable: Effective VAT Rate			
	(1)	(2)	(3)	(4)
ΔAgr × Post	2.69	2.61	2.56	2.68
	(0.76)***	(0.76)***	(0.74)***	(0.76)***
ΔAgr × Post × (1 − County Share) / 100	−0.26			
	(0.06)***			
ΔAgr × Post × Prefecture Share / 100		−0.34		−0.20
		(0.08)***		(0.09)**
ΔAgr × Post × Province Share / 100			−0.47	−0.34
			(0.13)***	(0.15)**
Controls	LOG(Value-added), LOG(Sales), Capital Intensity, Profitability, Ownership, Mobility, Export-Sales Ratio, Input-Output Ratio			
	Fixed effects			
Prefecture-year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Sample size	17,968	17,968	17,968	17,968
R^2	0.50	0.50	0.50	0.50
Clustering	Prefecture level (362 groups)			

Notes: OLS results from regression of Eq. (5.1), with interaction term(s) between "ΔAgr × Post" and VAT share of different levels of government being included. "County Share", "Prefecture Share", and "Province Share" respectively are the VAT sharing ratio of county governments, prefectural governments, and provincial government in the total VAT revenue of a province. "County Share" + "Prefecture Share" + "Province Share" = 1. Refer to notes of Table 1 for variable definitions. Robust standard errors are clustered at the prefecture level (362 groups). The significance levels of 1%, 5% and 10% are noted by ***, ** and *. The results suggest that a lower VAT sharing ratio at the county level (or higher sharing ratios at the prefectural or provincial level) dis-incentivize the VAT enforcement effort.

In column (4) I include both $\Delta\ Agr \times Post \times Prefecture\ Share$ and $\Delta\ Agr \times Post \times Province\ Share$ in the regression. The coefficients of both terms are still negative, but only that of $\Delta\ Agr \times Post \times Province\ Share$ shows significance.

It should be noted that, although the coefficients of interaction terms with sharing ratios are significant, their magnitude is rather small. For example, in column (1), the coefficient is −0.26, implying that the rise of the effective VAT rate would be smaller only by 0.00026 percentage points if the county sharing ratio decreased by 10 percentage points.

7.1.2. Revenue mobilization capacity and incentive of VAT enforcement

Some studies suggest that governments' tax capacity could be weakened by abundance in other sources of revenue (Jensen, 2011; Besley and Persson, 2014). In this section, I exploit the exogenous variation of the abolition of agricultural taxes to study the similar mechanism for VAT enforcement by testing two predictions made in Section 3. According to Prediction 3, incentives should be weaker in regions where county governments have a relatively broader VAT tax base. Based on Prediction 4, incentives should be weaker in regions where county governments have more abundant sources of revenue from land sales (a type of revenue from natural resources). Both predictions are confirmed by the following empirical work.

VAT base and abundance in land revenue can be measured in the following ways. *First*, the relative size of the VAT tax base is measured by the average of "*manufacturing GDP* / (*manufacturing and service GDP*)" between 2000 and 2004 for each county because VAT is mainly imposed on manufacturing firms in China. The agriculture sector is not included in the denominator because it can lead to correlation with the revenue loss due to the agricultural taxes abolition. *Second*, local governments' capacity to mobilize land sales revenue is measured by two indices: "*Land sales revenue* / *local government revenue*", and "*land sales revenue* / *local GDP*". The indices also take the average between 2000 and 2004 for each county.

The results are reported in Table 9. Column (1) shows the heterogeneous effects associated with the relative size of VAT tax base. The significant negative coefficient of $\Delta\ Agr \times Post \times VAT\ Base$ suggests that a greater VAT tax base weakens the incentive to enforce VAT. However, the magnitude is quite small, coefficient −0.21 implies that the effective VAT rate falls only by 0.021 percentage point if the ratio *manufacturing GDP* / (*manufacturing and service GDP*) increases by 10 percentage points.

Columns (2) and (3) of Table 9 report the heterogeneous effects related to land sales revenue. The significant negative coefficients of $\Delta\ Agr \times Post \times Land\ Sales\ /\ Rev$ and $\Delta\ Agr \times Post \times Land\ Sales\ /\ GDP$ suggest that the incentive to enforce VAT could be weakened by greater capacity to mobilize revenue from other sources. However, the magnitude is also very small: coefficients −0.26 (or −1.77) suggest that the effective VAT rate falls by only 0.026 (or 0.00177) percentage points if the ratio *Land Sales* / Rev (or *Land Sales* / *GDP*) increases by 10 percentage points.

7.2. Effect on total tax revenue and other revenues

In the end, I shift focus from the effective VAT rate to various aggregate revenue in county fiscal budgets. The model in Section 3 also predicts that the tax revenue net of agricultural taxes should increase, while total tax revenue should drop, and local governments should also attempt to mobilize revenue from other sources such as land sales.

Table 10 reports the effect on total tax revenue, other sources of revenue, and other measurements of county government revenue. The logarithm is taken of each revenue. Panel A reports the effect on tax revenue. Columns (1), (2), and (3) are the total tax revenue, total tax revenue net of agricultural taxes, and business tax revenue,

Table 9
Revenue mobilization capacity and incentive of VAT enforcement.

	Dependent variable: Effective VAT Rate		
	(1)	(2)	(3)
ΔAgr × Post	2.55	2.39	2.49
	(0.76)***	(0.75)***	(0.76)***
ΔAgr × Post × VAT Base / 100	−0.29		
	(0.07)***		
ΔAgr × Post × Land Rev. / GDP / 100		−0.40	
		(0.16)**	
ΔAgr × Post × Land Rev. / Rev. / 10,000			−1.68
			(0.53)***
Controls	LOG(Value-added), LOG(Sales), Capital Intensity, Profitability, Ownership, Mobility, Export-Sales Ratio, Input-Output Ratio		
	Fixed effects		
Prefecture-year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Sample size	17,593	17,942	17,957
R^2	0.50	0.50	0.50
Clustering	Prefecture level (362 groups)		

Notes: OLS results from regression of Eq. (5.1), with interaction terms between "ΔAgr × Post" and different measurements of revenue mobilization capacity of county governments. Specifically, interaction terms with "VAT Base", "Land Rev. / GDP", "Land Rev. / Rev." are included respectively in columns (1), (2), and (3). "VAT Base" is defined as the average "manufacturing GDP / (manufacturing GDP and service GDP)" between 2000 and 2004 for each county. "Land Rev. / GDP" is defined as the average "Land Sales Revenue / Total GDP" between 2000 and 2004 for each county. "Land Rev. / Rev." is defined as the average "Land Sales Revenue / (Budgetary Revenue + Fund Revenue)" between 2000 and 2004 for each county. The interaction terms are divided by 100 or 10,000 to scale up the regression coefficients. Refer to notes of Table 1 for other variable definitions. Robust standard errors are clustered at the prefecture level (362 groups). The significance levels of 1%, 5% and 10% are noted by ***, ** and *. The results suggest that the incentive for VAT enforcement is weaker in counties with greater capacity for revenue mobilization, which is measured by the VAT tax base (in column (1)), and by lands sales revenue (in columns (2)–(3)).

respectively. The results show that, while the total tax revenue in column (1) insignificantly drops, the total tax revenue net of agricultural taxes in column (2) significantly increases. The coefficient of 0.39 implies that the total tax revenue net of agricultural taxes increased by 39% more in the "treatment" county compared to the "control" county. On average, the gap in revenue loss between an average treatment county and control county is 30 percentage points in the sample. This means the total tax revenue net of agricultural taxes rose on average by 11.7% (=39% × 30 / 100). Similarly, the business tax revenue in column (3) increased as well, by 7.5% (=25% × 30 / 100).

Panel B extends the definition of government revenue by including revenue other than taxes. Column (4) is all county government revenue including tax, transfer revenue and fund revenue. Column (5) is the budgetary revenue including taxes and transfer revenue. Column (6) is the land sales revenue, which has been a very important source of revenue for local governments after 2000. The results of all revenue and total budgetary revenue are insignificant. This is consistent with the effect on the total tax revenue in column (1). However, the land sales revenue significantly increased by 23.7% (=79% × 30 / 100).

Overall, the results in Table 10 show that county governments can raise revenue, both by strengthening existing taxes and from other sources, such as land sales. The tax revenue loss due to the abolition of agricultural taxes can be almost offset by the increase in other taxes. This suggests that the tax capacity of county governments is not strictly constrained, even in the short run.

8. Conclusion

Information and incentives are two pillars of a well-functioning tax collection system. Local governments can play an important role in this system, in addition to tax inspectors and tax payers. Abundant theoretical and empirical analysis has been conducted on the role of tax inspectors, tax payers, and information. In contrast, the number of empirical studies on local governments and their incentives remains relatively small. Using firm-level data from the *Annual Survey of Industrial Production* (2000–2007) and the *County Public Finance Statistics Yearbook* of China (2000–2007), this paper exploits the nation-wide abolition of agricultural taxes in China as a natural "fiscal squeeze" experiment in which county governments were forced to raise taxation from firms to cover their rigid public expenditure.

The paper makes several contributions to our understanding of the extent and mechanisms of local government incentives for low tax collection in developing countries through the lens of China. *First*, the paper shows that a loss of revenue for county governments in China can be largely and quickly offset by tougher tax enforcement. On average, the total tax revenue net of agricultural taxes increased by 11.7% in the subsequent years of agricultural taxes abolition. This implies that the tax capacity of a developing country like China may not be fixed, even in the short run.

Second, I focus on the VAT to understand whether local government incentives for tax enforcement could be a flexible mechanism to raise tax revenue. The paper has a novel finding in that tax enforcement can be made through raising the effective VAT rate. This implies that, given the reported tax base (firms' value-added), there is still room for tougher tax enforcement by imposing a greater effective tax rate. On average, the effective VAT rate increased by 7% subsequent to the agricultural tax abolition. This finding is complementary to the growing literature on the channels for raising tax, mainly through cracking down on under-reporting of the tax base.

Third, the incentives for VAT enforcement depend on several factors. The results show that it can be weakened if the county: (1) receives a lower proportion of total VAT revenue after sharing with prefectural and provincial governments; (2) has a broader VAT tax base; or, (3) has more abundant sources of revenue from land sales.

Due to limitations in data, the paper does not answer several important questions. For example, through which channel was the effective VAT rate raised after the abolition of agricultural taxes? Is it mainly through clamping down on fake invoice usage, or just by making deterrent calls to firms? In addition to increasing the effective VAT rate, in the long run, local governments may also attempt to increase their revenue by attracting more investment and new firms to expand their local tax bases. Did this result in more intense competition between local governments? It would also be very interesting to investigate the political process underlying the tax enforcement. Moreover, in addition to several factors studied in this paper, there should be many other factors that can constrain the incentives for tax enforcement. These questions are open for future research.

As Bird (2014) points out, "the best tax policy in the world is worth little if it cannot be implemented effectively". Despite the good nature of VAT in terms of information, its technological frontier cannot be fully achieved if tax enforcement is not well incentivized. Although the empirical study of this paper is based on the experience in China, it extends to other countries, especially where the task of collecting tax is not efficiently delegated or where local governments are dis-incentivized to enforce tax. The inefficiency in delegation

Table 10
Effect on total tax revenue and other revenues.

	Dependent variable: LOG(1 + X)					
	Panel A: Tax revenue			Panel B: Other revenue included		
	(1)	(2)	(3)	(4)	(5)	(6)
	Total Tax	Tax Net Agr.	Business Tax	All Rev.	Bgt Rev.	Land Rev.
ΔAgr × Post	−0.05	0.39	0.25	0.01	−0.04	0.79
	(0.07)	(0.05)***	(0.07)***	(0.07)	(0.07)	(0.36)**
Controls	LOG(Value-added), LOG(Sales), Capital Intensity, Profitability, Ownership, Mobility, Export-Sales Ratio, Input-Output Ratio					
	Fixed effects					
Prefecture-year FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	17,895	17,895	17,895	15,147	17,887	10,020
R^2	0.9	0.91	0.86	0.94	0.93	0.64
Clustering	Prefecture level (362 groups)					

Notes: OLS results from regression of Eq. (5.1), with dependent variable being replaced with "LOG(1 + X)", where "X" is various county government revenue items, including tax revenue in Panel A and other revenue in Panel B). From column (1) to column (6), variable X is respectively "Total Tax" (defined as county government total tax revenue), "Tax Net Agr." (sum of county government total tax revenue net of agricultural tax), "Business Tax" (county government business tax revenue), "All Rev." (sum of county government budgetary revenue and fund revenue), "Bgt. Rev." (county government budgetary revenue), "Land Rev." (county government land sales revenue). Refer to notes of Table 1 for other variable definitions. Robust standard errors are clustered at the prefecture level (362 groups). The significance levels of 1%, 5% and 10% are noted by ***, ** and *. The results suggest that, in response to the agricultural revenue loss, county governments mobilize more revenue from all available sources, such as all taxes net of agricultural taxes (column (2)), business tax (column (3), and land sales (column (6)). The total revenue changes slightly and insignificantly, either falling, such as total tax revenue (column (1)) and budgetary revenue (column (5)), or rising, such as all revenue including the extra-budgetary revenue (column (4)).

could be caused by the moral hazard of tax inspecting (Besley and McLaren, 1993), or the result of tax competition and tax sharing, which is prevalent in fiscal federalism regimes. All results suggest that weak incentives for tax enforcement can also be an important determinant of low tax-to-GDP ratios in developing countries, and local governments can play an essential role in this regard.

Online Appendix

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jpubeco.2017.01.001.

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