

China's Abolition of the Agricultural Tax, Local Governments' Responses and Economic Growth*

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Abstract

When evaluating agricultural policy changes, much of the attention in the literature has been limited to agricultural productivity growth. This study demonstrates that, under a regionally decentralised authority system, the effect of China's abolition of the agricultural tax (AAT) in 2004–05 extended beyond the realm of agriculture. We find that, following the AAT reform, Chinese counties with higher reliance on agricultural taxation for budgetary revenue prior to the AAT reform experienced higher agricultural economic growth, as expected, but lower non-agricultural economic growth in the short run. This growth-inhibiting effect of the AAT reform on non-agricultural production in the short run can be explained, to some extent, by the increased non-agricultural taxation due to the insufficient funds that Chinese county governments received from the upper-level governments following the AAT reform; the magnitude of

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this tax increase was associated with the degree to which each county relied on agricultural taxation for budgetary revenue prior to the reform. In addition, our results show that the AAT reform resulted in a high level of regional inequality in terms of non-agricultural GDP per capita. In summary, our study shows that although the AAT reform succeeded in promoting agricultural production, such accomplishments were achieved at the cost of lower non-agricultural output growth and higher regional inequality of non-agricultural GDP per capita at the county level.

Policy points

- This study demonstrates that the effect of China's abolition of the agricultural tax (AAT) in 2004–05 extended beyond the realm of agriculture.
- Following the AAT reform, Chinese counties with higher reliance on agricultural taxation for budgetary revenue prior to the AAT reform experienced higher agricultural economic growth, as expected, but lower non-agricultural economic growth in the short run.
- Much of this growth-inhibiting effect of the AAT reform on non-agricultural production in the short run can be explained by the increased taxation on the non-agricultural sector, which is due to the insufficient funds that Chinese county governments received from the upper-level governments following the AAT reform.
- For a country with a regionally decentralised authority system, it is important to take into account the behaviours of local governments when evaluating a policy initiated by the central government.

I. Introduction

In the history of the People's Republic of China since 1949, Chinese agriculture has experienced several important policy changes, including the collective commune system during the period 1963–74, the household responsibility system (decollectivisation) during 1979–84, the market-oriented reform during 1985–89 and the abolition of the agricultural tax (AAT) in 2004–05. The decollectivisation and market-oriented reforms were shown to significantly increase total factor productivity in agricultural production,¹ and this agricultural productivity growth turned out to be the driving force of labour reallocation out of the agricultural sector into the non-agricultural sector and to be an important determinant of China's economic growth since 1978.² In fact, the rapid productivity growth in the agricultural sector and the sectoral

¹Lin, 1992.

²Cao and Birchenall, 2013.

reallocation out of agriculture have been common to and are able to characterise the modern growth experience of many nations.³

Given the important role of agriculture in economic development, increasing attention has been paid to the impact of various policy changes on agricultural productivity growth.⁴ This study intends to investigate the impact of China's AAT reform – the most recent agricultural policy change in China, which aimed to reduce the burden of Chinese peasants – under a regionally decentralised authority system, since Chinese local governments play a vital role in the allocation of resources.⁵ If Chinese local governments' behaviour can be shaped by their incentive to maximise their fiscal revenue net of the cost of public services,⁶ an agricultural policy change such as the AAT reform will alter local governments' fiscal stakes and hence affect their decisions. These decisions include taxation levied on the other sectors, budget allocation for investment in fixed assets, and publicly supported research and education extension programmes, etc. For that reason, unlike the majority of previous studies, which focused on the impact of policy changes on agriculture per se, we examine the AAT reform's impact on both agricultural and non-agricultural production as well as on Chinese county governments' behaviour within a more comprehensive framework.

Given that agricultural taxation has been entirely designated as the budgetary revenue of counties and towns in China since the tax sharing reform in 1994, this study focuses on the impact of the AAT reform at the county level. As Chinese counties exhibited great variation in their reliance on agricultural taxation for budgetary revenue prior to the AAT reform, it is natural to expect that the magnitude of the AAT reform's impact could significantly differ among counties in China's regionally decentralised authority system. Therefore, in this study, we take advantage of the variation in Chinese counties' reliance on agricultural taxation for budgetary revenue prior to the AAT reform and explore whether this variation could explain the regional differences in economic growth as well as in local governments' responses following the reform.

Our empirical results demonstrate that the AAT reform increased the growth rate of agricultural GDP per capita in the short run, and that the magnitude of this growth-enhancing effect was associated with the degree of each county's reliance on agricultural taxation for budgetary revenue prior to the AAT reform. Unlike the existing studies, which primarily focus on the existence of a growth-enhancing effect of China's AAT reform on agricultural production and rural

³Young, 1995; Caselli and Coleman, 2001; Gollin, Parente and Rogerson, 2002.

⁴Atwood (1990), Chavas (2001), Carter and Estrin (2001), De Gorter and Swinnen (2002), Brummer, Glauben and Lu (2006) and Wiemers (2015), among many others.

⁵Xu, 2011.

⁶Gordon and Li, 2012.

incomes,^{7,8} we investigate the heterogeneous impact of the AAT reform on agricultural GDP growth among Chinese counties by exploiting the variation of each county's reliance on agricultural taxation for budgetary revenue prior to the reform. Importantly, such heterogeneity allows us to investigate the AAT reform's impact on regional inequality.

Our empirical results also demonstrate that the AAT reform inhibited the growth of non-agricultural GDP per capita at the county level in the short run, and that the magnitude of this growth-inhibiting effect was also associated with the degree of each county's reliance on agricultural taxation for budgetary revenue. Additionally, the AAT reform's growth-inhibiting effect on non-agricultural production and its growth-enhancing effect on agricultural production are of similar magnitudes. As a result, with respect to overall economic production, we also find a negative impact of the AAT reform, since the non-agricultural sector is larger than the agricultural sector.

We also find that the AAT reform increased China's regional inequality of non-agricultural GDP per capita. Therefore, our study shows that although the AAT reform succeeded in increasing agricultural production, such accomplishments were achieved at the cost of lower non-agricultural output growth and higher regional inequality of non-agricultural GDP per capita. Furthermore, our results reveal that the increased fiscal transfer from the upper-level governments following the AAT reform could not sufficiently compensate for Chinese county governments' budgetary revenue reduction, and this insufficient compensation from the central government explains why the effect of China's AAT reform extended beyond the realm of agriculture.

To better understand the impact of the AAT reform on non-agricultural production, we investigate the changes in Chinese county governments' behaviour following the AAT reform and further explore how such changes influenced non-agricultural production. Under a regionally decentralised authority system, local governments have several options to balance their budgetary revenues and expenditures following the AAT reform, such as increasing their non-agricultural taxation,⁹ relying more on land financing, and changing the structure of their budgetary expenditure. Local governments need to choose the options that best suit their objectives given their budgetary constraints. Our empirical results demonstrate that, following the AAT

⁷Heerink, Kuiper and Shi, 2006; Yu and Jensen, 2010; Wang and Shen, 2014.

⁸Official documents also indicate that the primary purposes of the AAT reform were to stimulate agricultural production and increase peasants' incomes (The State Council, 2004).

⁹Although the tax base and most of the tax rates in China are determined and applied nationwide by the central government, local governments can still raise their taxation on the non-agricultural sector to some extent. First, local governments have officially been allowed to set the fees and rates on a number of local taxes within some ranges since the 1994 tax reform. Second, as the issues of tax evasion and fraud are evident in China, local governments can increase their tax revenues and hence real taxation rates by imposing more stringent tax auditing procedures or by increasing fines for tax evasion and fraud.

reform, Chinese county governments preferred the option of increasing their non-agricultural taxation and increasing the shares of government investment in fixed assets and human capital in their budgetary expenditures, and the magnitude of all of these changes depended on the degree to which each county relied on agricultural taxation for budgetary revenue prior to the AAT reform. Compared with the structural change in budgetary expenditure, however, we find that the increased non-agricultural taxation was a more important channel through which the AAT reform inhibited non-agricultural GDP growth.

This paper is related to the one by Chen and Wang (2014), who examine the relationship between tax revenue reductions following the AAT reform and Chinese county governments' behaviour in land financing. We extend their study by examining county governments' responses to the AAT reform from the additional perspectives of non-agricultural taxation and the structural change in budgetary expenditure. This paper also contributes to the literature on second-generation federalism by focusing on how fiscal incentives affect the taxation and expenditure pattern and further economic growth.¹⁰ Specifically, we focus on how the changing fiscal incentives that result from the AAT reform influenced county governments' taxation and budgetary expenditure decisions and their effects on economic growth.

The remainder of this paper is organised as follows. Section II reviews the background and processes related to China's AAT reform. Data, measurements and estimation strategies are described in Section III. The main empirical results are presented in Section IV, followed by a discussion of several robustness checks in Section V. Section VI presents concluding remarks.

II. Background and process of China's AAT reform

In China, agricultural taxation has been entirely designated as the budgetary revenue of counties and towns since the implementation of a tax sharing reform between the local and central governments in 1994. The officially announced agricultural tax rate was 15.5 per cent of the total agricultural output. In addition to that, peasants in China were also required to pay other fees, such as public accumulation funds. The fees, unlike the agricultural tax, were regarded as extra-budgetary revenue. The fees, combined with the agricultural tax, imposed a heavy burden on peasants, in particular on the poorest peasants. Peasants with incomes of less than RMB 800 per year faced a real tax rate as high as 30 per cent in the mid 1990s.¹¹ That means that the relatively immobile peasants in China bore much heavier fiscal burdens than the capital

¹⁰Weingast, 2009.

¹¹Tao and Liu, 2005.

owners.¹² This is consistent with tax competition theory, which argues that local governments tend to levy more taxes on immobile factors.¹³ As Chinese peasants have lower income levels than non-agricultural workers, the high agricultural tax rates generated both feelings of unfairness and potential social instability.¹⁴

To relieve the fiscal burden on peasants, the Chinese central government decided to initiate its agricultural taxation reform gradually in 2000. During the first phase of this reform, local governments were gradually forbidden from collecting any agricultural fees because such fees could occur in various forms and were categorised as local governments' extra-budgetary revenue, which put them almost entirely outside the central government's control prior to the AAT reform. Simultaneously, the central government allowed the local governments to increase their agricultural taxation to compensate for their losses in extra-budgetary revenues due to the cancellation of agricultural fees. This tax-for-fee reform was piloted in Anhui province in 2000 and was applied nationwide in 2003. In 2004, the reform entered its second phase, which was referred to as the AAT reform. It was officially announced by Premier Wen Jiabao in his government work report stating that the central government aimed to terminate agricultural taxation in China within five years.

The AAT reform actually progressed much more quickly than expected. In 2004, the elimination of agricultural taxation was piloted in some but not all counties across eight provinces (Beijing, Fujian, Heilongjiang, Jilin, Shanghai, Tianjin, Tibet and Zhejiang).¹⁵ Simultaneously, the agricultural tax rate was reduced by 3 percentage points for the 11 major grain-producing provinces and 1 percentage point for the remaining provinces. In 2005, agricultural taxation had already been eliminated in 28 provinces, whereas the agricultural tax rate was reduced to less than 2 per cent for the other three provinces (Hebei, Shandong and Yunnan). On 29 December 2005, the National People's Congress of China officially abolished agricultural taxation through legislation. China's AAT reform terminated its history of agricultural taxation, which had endured for more than 2,600 years. Many economists consider this AAT reform the most important rural reform in China since the decollectivisation and market-oriented reforms in 1979–89.¹⁶ In addition to the termination of agricultural taxation, taxation on special farming products and

¹²The official tax rate for most manufacturing firms is 17 per cent of value added and the official tax rate is 3–5 per cent of sales for most firms in the service industry. However, the real tax rate for firms may be lower given that local governments often utilise tax reductions or exemptions as a strategic tool to attract investment.

¹³Bucovetsky, 1991; Wilson, 1991.

¹⁴Chen, 2003.

¹⁵To be exact, the province-level unit includes provinces, autonomous regions and municipalities in China. We call all types of province-level units provinces here for convenience.

¹⁶Luo et al., 2007; Kung, Cai and Sun, 2009; Huang et al., 2011.

animal husbandry was also eliminated in this reform. However, this reform is often called the AAT reform in the previous literature because the amount of tax on special farming products and animal husbandry was extremely small, at less than 2 per cent of the amount of agricultural tax.¹⁷

Realising the potential negative impact of the tax-for-fee reform and the AAT reform on county governments' budgetary revenue, the central government also implemented two other policy reforms at the same time. One was town merging, which aimed to reduce local governments' fiscal burden. This policy reform indeed significantly reduced the number of towns in China; however, most government employees at the town level were retained in the government sector.¹⁸ The other policy reform that accompanied the AAT reform was increasing the central government's fiscal transfer to county governments. This fiscal transfer increase, however, was less than the local governments' tax revenue reduction due to the tax-for-fee and AAT reforms, according to the estimate of Zhang (2005).¹⁹

III. Measurement, data and estimation strategy

Our empirical analysis exploits the great variation in Chinese counties' reliance on agricultural taxation for budgetary revenue prior to the AAT reform, which captures the reform's impact on a county's budgetary revenue. Given that the AAT reform refers to the abolition of agricultural taxation and of taxation on special farming products and animal husbandry, the ideal variable to capture its impact on a county's budgetary revenue is the ratio of the amount of these three taxes to the county's budgetary revenue prior to the AAT reform. However, the data for these three taxes are not publicly available. The data that are publicly available for each county are the sum of five agriculture-related taxes: the agricultural tax, special farming products tax, animal husbandry tax, cultivated land usage tax and deed tax. Therefore, we examine the ratio of the amount of these five taxes to budgetary revenue in 2003 (denoted as *AGTAX5* throughout the paper) as a substitute for the ideal variable. It is suitable since the amount of taxes on cultivated land usage and deeds collected by Chinese county governments was small relative to that of the other three taxes.

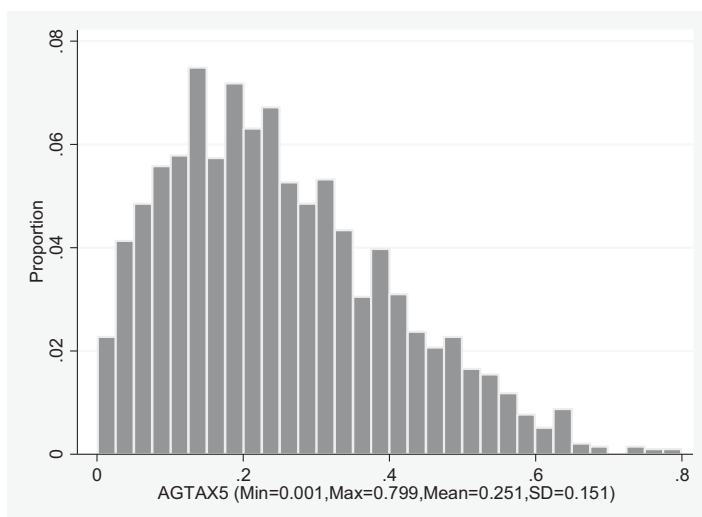
Additionally, although the data for cultivated land usage tax and deed tax are not publicly available for the year 2003, the data for these two taxes

¹⁷Wang and Shen, 2014.

¹⁸Tao and Qin, 2007.

¹⁹The sum of the fiscal transfers from the Chinese central government to the 1,850 counties in our sample was increased by RMB 40.9 billion over the period 2003–07, from RMB 29.1 billion in 2003 to RMB 70.0 billion in 2007. The agricultural tax of these 1,850 counties in 2003 was RMB 42.4 billion. Taking into consideration the rapid growth of agricultural output over the period 2003–07, the increased fiscal transfer from the Chinese central government to county governments was not enough to compensate for their agricultural tax reduction due to the AAT reform.

FIGURE 1
The distribution of AGTAX5 in 2003



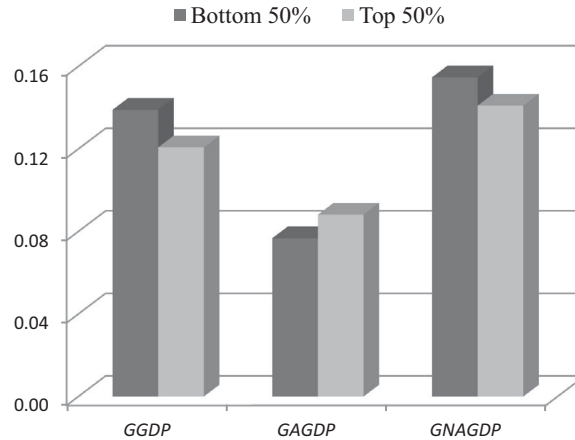
in 2005 and later years are publicly available. Using the available data for cultivated land usage tax and deed tax, we also define a variable *AGTAX3*, which represents the difference between a county's *AGTAX5* in 2003 and the ratio of that county's cultivated land usage tax and deed tax to its budgetary revenue in 2005. *AGTAX3*, of course, also allows us to measure the impact of the AAT reform on a county's budgetary revenue. However, *AGTAX3* is not necessarily a better measurement than *AGTAX5*, for two reasons. First, the ratio of a county's cultivated land usage tax and deed tax to its budgetary revenue would increase following the AAT reform simply because of its reduced budgetary revenue. This generates a downward bias for *AGTAX3*. Second, the cultivated land usage tax and deed tax might be endogenously raised by county governments to compensate for budgetary revenue reduction following the AAT reform.

Given the potential problem of *AGTAX3*, we employ *AGTAX5* as the primary variable and *AGTAX3* as an alternative measure for the purpose of a robustness check. Figure 1 presents the distribution of *AGTAX5* for all counties in 2003, which shows that *AGTAX5* is highly dispersed and varies between 0.003 and 0.799. *AGTAX5* has a mean of 0.252, indicating that Chinese county governments, on average, relied heavily on agricultural taxation for budgetary revenue prior to the AAT reform.

In Figure 2, we split the Chinese counties into two groups – the top 50 per cent and the bottom 50 per cent, based on their *AGTAX5* – and compare their growth rates of agricultural and non-agricultural GDP per capita over

FIGURE 2

Annual growth rates of agricultural and non-agricultural GDP per capita during 2004–07: the top 50% versus the bottom 50% based on AGTAX5



Note: The figures shown are the average annual growth rate of GDP per capita (GGDP), the average annual growth rate of agricultural GDP per capita (GAGDP) and the average annual growth rate of non-agricultural GDP per capita (GNAGDP) for each group over the period 2004–07.

the period 2004–07. This shows that, following the AAT reform, counties with higher reliance on agricultural taxation for budgetary revenue prior to the AAT reform experienced higher agricultural economic growth but lower non-agricultural and overall economic growth.

In order to better understand how China's AAT reform affected economic growth at the county level, we introduce *AGTAX5* into the model of the literature that studies the determinants of economic growth²⁰ and empirically examine the impact of *AGTAX5* on the growth rate of GDP per capita following the AAT reform. Specifically, the model is

$$(1) \quad Y = \alpha + \beta AGTAX5 + \gamma Z + \varepsilon,$$

where the dependent variable Y represents the growth rate of GDP per capita, the growth rate of agricultural GDP per capita or the growth rate of non-agricultural GDP per capita of Chinese counties following the AAT reform. Z represents control variables, which will be explained towards the end of this section, and ε is the error term.

When *AGTAX5* is exogenous, equation 1 can be estimated using the ordinary least squares (OLS) method. *AGTAX5* is endogenous when it is correlated

²⁰For example, Mankiw, Romer and Weil (1992), Davoodi and Zou (1998) and Xie, Zou and Davoodi (1999).

with the error term ε , which makes the OLS estimates inconsistent. One way to handle such potential endogeneity is to use the initial level of neighbouring regions' tax structure variables (*AGTAX5* in this study) as the instrumental variables (IVs), as suggested by the literature that examines the effect of tax structure on economic growth²¹ and corruption.²² In this strand of literature, the rationale for the validity of this instrumenting strategy is twofold. First, a region's tax structure variable is correlated with its neighbouring regions' tax structure variables because of tax competition. In other words, to compete for mobile tax bases, a region will mimic and respond to the fiscal policy of its neighbouring regions. As a result, any region tends to have a tax structure that is similar to its neighbouring regions' tax structures. Since tax structure evolves slowly, a region's tax structure variable tends to be correlated with the initial level of its neighbouring regions' tax structure variables. Second, current economic growth or corruption of any region should not affect the initial level of its neighbours' tax structure variables. Following this strand of literature, we instrument a county's tax structure variable by its neighbouring counties' tax structure variables. Specifically, we instrument *AGTAX5* of a county by the average of *AGTAX5* for the counties in the same prefecture (political neighbours). The defence for the validity of this instrumenting strategy is similar to that in the literature. First, a county's *AGTAX5* is correlated with its neighbouring counties' *AGTAX5*s due to tax competition. Second, economic growth of any county following the AAT reform should not affect its neighbouring counties' tax structures prior to the AAT reform.

Moreover, there is an increasing literature that emphasises economic interdependence of neighbouring regions.²³ This study also examines the potential economic interdependence of neighbouring regions. To incorporate this potential economic interdependence, we can add a spatial lag of the dependent variable into our regression:

$$(2) \quad Y = \alpha + \lambda WY + \beta AGTAX5 + \gamma Z + \varepsilon.$$

Equation 2 is referred to as the spatial autoregressive (SAR) model in the literature. The spatial weighting matrix W is constructed to reflect the spillover effect of economic growth from the other counties in the same prefecture, rather than that from the geographically neighbouring counties, because we find that the spatial interdependence among counties in the same prefecture is much stronger than that among geographically neighbouring counties in

²¹ Lee and Gordon, 2005; Liu and Feng, 2015.

²² Liu and Martinez-Vazquez, 2015.

²³ For example, Ades and Chua (1997), Conley and Ligon (2002) and Cohen and Paul (2004).

China.²⁴ The coefficient λ measures the spatial spillover effect of economic growth from neighbouring counties.

The spatial lag of the dependent variable, WY , is endogenous. When $AGTAX5$ is exogenous, the model in equation 2 can be estimated by the IV approach, with the IVs chosen as a subset of the linearly independent columns of $(Z, WZ, W^2Z, \dots, W^qZ, AGTAX5, WAGTAX5, W^2AGTAX5, \dots, W^qAGTAX5)$, where q is a pre-selected finite constant and is usually set to 2 in practice.²⁵ When $AGTAX5$ is endogenous, the model can be estimated by the IV approach, with the IVs chosen as a subset of the linearly independent columns of $(Z, WZ, W^2Z, \dots, W^qZ)$ ²⁶ since $WAGTAX5$ and $W^2AGTAX5$ may not be exogenous.²⁷

In the above, we list two models: one with economic interdependence (equation 2) and one without economic interdependence (equation 1). When economic interdependence is actually present in our data (λ differs from zero significantly), equation 2 is preferred to equation 1 for two reasons. First, the error term ε of equation 1 incorporates λWY , which is correlated with the independent variables Z . Thus, in equation 1, the omitted variable problem arises, which makes our estimates inconsistent. Second, when $AGTAX5$ is endogenous in equation 2, the variable $WAGTAX5$ that we select as an IV is also correlated with λWY in the error term. In other words, $WAGTAX5$ is no longer a valid IV in equation 1 if economic interdependence is actually present in our data. When no economic interdependence is present in our data (λ does not differ from zero significantly), however, the model without economic interdependence is preferred for its efficiency.

In terms of the control variables Z of both models, we follow Zhang (2006) to include: the initial level of GDP per capita (GDP_0), the initial level of agricultural GDP per capita ($AGDP_0$) or the initial level of non-agricultural GDP per capita ($NAGDP_0$) prior to the AAT reform; the initial ratio of agricultural GDP to total GDP ($AgShare_0$); the initial fiscal burden ($FisBurd_0$, defined as the number of government employees per RMB 10,000 of budgetary revenue); the initial urban–rural income difference ($IncomeDiff_0$, defined as the log difference of income between urban and rural residents); and the initial gap between the resident population and the hukou registered population ($LabourGap_0$, defined as the log difference between the resident

²⁴In the online appendix, W is constructed to reflect the spillover effect of economic growth from counties that are in the same prefecture or geographically connected, as a robustness check. All of the results remain unchanged.

²⁵Kelejian and Prucha, 1999.

²⁶Drukker, Egger and Prucha, 2013.

²⁷If there is little correlation between $AGTAX5$ and the excluded instruments out of (WZ, W^2Z, \dots, W^qZ) in the model, a weak instrument will increase asymptotic standard errors and therefore reduce the power of the hypothesis test even when IVs are perfectly exogenous. Moreover, a weak instrument will increase the inconsistency of IV estimates whenever IVs are not perfectly exogenous (Shea, 1997; Hahn and Hausman, 2002).

population and the hukou registered population). We also include the initial investment rate ($InvGDP_0$, defined as the ratio of investment in fixed assets to GDP) and the initial government size ($GovSize_0$, defined as the ratio of budgetary expenditure to GDP) as control variables based on the previous literature that investigates the impact of fiscal decentralisation on economic growth.^{28,29}

The fiscal and tax data used in this study are all extracted from the Fiscal Statistics for Prefectures, Municipalities and Counties, which are published annually by the Chinese Ministry of Finance. The data for GDP, agricultural GDP, non-agricultural GDP and population are extracted from the Socio-Economic Statistical Yearbooks for Chinese Counties and Cities.

IV. Empirical results

This section presents the study's main results regarding the impacts of the AAT reform on overall GDP growth, agricultural GDP growth, non-agricultural GDP growth, county governments' non-agricultural taxation and the structure of budgetary expenditure. As previously discussed, China's AAT reform was first piloted across eight provinces in 2004. Among these eight provinces, Tibet was excluded from our sample due to a lack of data. Beijing has only two counties, Tianjin has only three and Shanghai has only one. The four other provinces eliminated their agricultural taxes in some but not all of their counties. Therefore, the number of counties that were exempt from agricultural taxation in 2004 was limited. In 2005, agricultural taxation was eliminated in most counties in China. Therefore, the current study examines the impacts of the AAT from 2005 in all of the counties with data available as our primary results. Section V presents the results excluding all the counties that were exempt from agricultural taxation in 2004 and the results excluding all the counties in Hebei, Shandong and Yunnan. All of the main results are robust.

To capture the gradual impact of the AAT reform on economic growth, we define the dependent variable Y in equations 1 and 2 as the geometrically averaged growth rate of per-capita GDP, agricultural GDP and non-agricultural GDP (denoted by $GGDP$, $GAGDP$ and $GNAGDP$, respectively) over the periods 2004–07 and 2007–10.

1. The AAT reform's asymmetric impact on agricultural and non-agricultural growth

We first demonstrate the AAT reform's asymmetric impact on agricultural and non-agricultural growth over the period 2004–07. Columns 1–3 of Table 1

²⁸For example, Davoodi and Zou (1998) and Xie, Zou and Davoodi (1999).

²⁹The initial levels of the control variables are used to avoid potential endogeneity. By potential endogeneity, we mean that the current levels of the control variables may be affected by the AAT reform.

TABLE 1
The asymmetric impact of the AAT reform on agricultural and non-agricultural growth, 2004–07

	No spatial lag						With spatial lag					
	AGTAX5 is exogenous			AGTAX5 is endogenous			AGTAX5 is exogenous			AGTAX5 is endogenous		
	(1) GGDP	(2) GAGDP	(3) GNAGDP	(4) GGDP	(5) GAGDP	(6) GNAGDP	(7) GGDP	(8) GAGDP	(9) GNAGDP	(10) GGDP	(11) GAGDP	(12) GNAGDP
AGTAX5	-0.053*** (0.017)	0.113*** (0.019)	-0.114*** (0.024)	-0.054* (0.032)	0.143*** (0.033)	-0.125*** (0.040)	-0.059*** (0.019)	0.109*** (0.024)	-0.126*** (0.026)	0.007 (0.098)	0.184** (0.075)	-0.126 (0.139)
X ₀	-0.010** (0.005)	-0.005 (0.003)	-0.023*** (0.007)	-0.010** (0.005)	-0.005 (0.003)	-0.023*** (0.007)	-0.011** (0.005)	-0.005 (0.003)	-0.024*** (0.008)	-0.010* (0.005)	-0.005 (0.003)	-0.024*** (0.009)
AgShare ₀	-0.011 (0.021)	-0.109*** (0.023)	0.096*** (0.035)	-0.010 (0.026)	-0.127*** (0.028)	0.102** (0.040)	-0.013 (0.022)	-0.106*** (0.025)	0.103*** (0.036)	-0.048 (0.055)	-0.151*** (0.049)	0.103 (0.081)
FisBurd ₀	-0.009*** (0.002)	-0.006*** (0.001)	-0.011*** (0.002)	-0.009*** (0.002)	-0.007*** (0.002)	-0.011*** (0.002)	-0.009*** (0.002)	-0.006*** (0.001)	-0.012*** (0.003)	-0.011*** (0.003)	-0.008*** (0.003)	-0.012*** (0.005)
InvGDP ₀	0.018 (0.017)	-0.014** (0.006)	0.028 (0.023)	0.018 (0.017)	-0.014** (0.006)	0.028 (0.023)	0.020 (0.019)	-0.014** (0.007)	0.031 (0.026)	0.020 (0.019)	-0.013** (0.006)	0.031 (0.026)
GovSize ₀	0.096*** (0.030)	0.077*** (0.027)	0.095** (0.042)	0.095*** (0.032)	0.091*** (0.030)	0.090** (0.044)	0.102*** (0.031)	0.077*** (0.026)	0.103** (0.044)	0.131** (0.056)	0.113*** (0.041)	0.102 (0.079)
IncomeDiff ₀	0.011* (0.006)	0.012* (0.006)	0.004 (0.007)	0.011* (0.006)	0.012* (0.006)	0.004 (0.007)	0.012* (0.006)	0.011* (0.006)	0.005 (0.008)	0.011* (0.006)	0.009 (0.006)	0.005 (0.008)
LabourGap ₀	0.098*** (0.032)	-0.085*** (0.021)	0.148*** (0.039)	0.098*** (0.032)	-0.085*** (0.021)	0.147*** (0.039)	0.097*** (0.032)	-0.084*** (0.022)	0.146*** (0.039)	0.099*** (0.031)	-0.083*** (0.021)	0.146*** (0.039)
λ							-0.169 (0.190)	0.075 (0.188)	-0.193 (0.174)	-0.127 (0.213)	0.081 (0.193)	-0.185 (0.208)
Hausman test	1.0000	0.9868	1.0000	1.709	1.709	1.709	0.9999	0.9975	1.0000	1.709	1.709	1.709
N	1,709	1,709	1,709	1,709	1,709	1,709	1,709	1,709	1,709	1,709	1,709	1,709

Note: GGDP denotes the average growth rate of GDP per capita during 2004–07. GAGDP and GNAGDP are the average growth rate of GDP per capita in the agricultural and non-agricultural sectors, respectively, during 2004–07. $X_0 = GDP_0$, $AGDP_0$ or $NAGDP_0$ when the dependent variable in the model is GGDP, GAGDP or GNAGDP, respectively. The other variables are defined in Section III. Standard errors are in parentheses. ***, ** and * indicate 1 per cent, 5 per cent and 10 per cent significance levels. The penultimate row lists the *p*-value of the Hausman test with the null hypothesis that AGTAX5 is exogenous. The IVs in columns 4–6 are (Z, WZ, W²Z, AGTAX5, WAGTAX5, W²AGTAX5), where Z = (X_0 , AgShare₀, FisBurd₀, InvGDP₀, GovSize₀, IncomeDiff₀, LabourGap₀). The IVs in columns 10–12 are (Z, WZ, W²Z).

report the OLS estimates of our model defined by equation 1 when *AGTAX5* is exogenous, while columns 4–6 present the IV estimates of our model defined by equation 1 when *AGTAX5* is endogenous. The F-statistics for weak IV of the first-stage regressions (reported in Table A1 in the online appendix) are much larger than 10, which suggests that our instrument *WAGTAX5* for *AGTAX5* is a strong IV in the model defined by equation 1. The Hausman tests reported in the penultimate row of Table 1 do not reject the null hypothesis that *AGTAX5* is exogenous.

Columns 7–9 of Table 1 report the IV estimates of our SAR model defined by equation 2 when *AGTAX5* is exogenous, while columns 10–12 present the IV estimates of our SAR model defined by equation 2 with *Z*, *WZ* and *W²Z* as the IVs when *AGTAX5* is endogenous. Columns 4–6 of Table A1 in the online appendix show that *Z*, *WZ* and *W²Z* are only weak IVs for *AGTAX5*, which explains why the standard errors of our estimated coefficients on *AGTAX5* in columns 10–12 of Table 1 are much larger than those in columns 7–9 of Table 1. Although the weak IVs make the estimated coefficients on *AGTAX5* in columns 10–12 less statistically significant, the Hausman tests still do not reject the null hypothesis that *AGTAX5* is exogenous in our SAR model defined by equation 2.

In Table 1, the coefficients on spatial lag (λ) are not statistically significant for any of the regressions. In fact, the inclusion of spatial lag in our regressions does not cause any significant change in the estimates of the coefficient on *AGTAX5*. Given that economic interdependence is irrelevant in our data, we choose equation 1 as our benchmark model for the period 2004–07 and, since the null hypothesis that *AGTAX5* is exogenous cannot be rejected, the estimates in columns 1–3 of Table 1 are taken as our baseline results. According to the baseline results, the coefficient on *AGTAX5* in the regression for *GAGDP* is statistically significant and positive, while the coefficient on *AGTAX5* in the regression for *GNAGDP* is statistically significant and negative. Such results suggest that the AAT reform promotes agricultural production but inhibits non-agricultural production following the AAT reform. Such results also indicate that counties with higher reliance on agricultural taxation for budgetary revenue prior to the AAT reform exhibited significantly higher growth rates in their agricultural GDP per capita but significantly lower growth rates in their non-agricultural GDP per capita following the AAT reform.³⁰ It is interesting to note that the growth-inhibiting effect of the AAT reform on non-agricultural production and its growth-enhancing effect on agricultural production are of

³⁰Note that *AGTAX5* in our regression equation is defined as the share of five agricultural taxes in a county's budgetary revenue in 2003. After the AAT reform in 2004, the taxes of land usage and deed remained, but the other three taxes were abolished. Since the share of land usage tax and deed tax in a county's budgetary revenue is extremely small and neglectable, *AGTAX5* can approximately be regarded as 0 after 2004. Therefore, the AAT reform's impact on economic growth is captured approximately by $\beta \times \text{AGTAX5}$ in our model.

similar magnitudes. Given that the non-agricultural sector is larger than the agricultural sector, we find a negative impact of the AAT reform on overall economic growth.

It should be pointed out here that the Chinese central government started to directly subsidise farmers and agricultural production in 2002. Some empirical studies have discussed how such agricultural subsidies may also boost agricultural production in China.³¹ The ideal way to disentangle the effect of direct agricultural subsidies on agricultural growth, of course, is to add a variable representing the increase in such subsidies to the model. Unfortunately, this is impossible because the data for direct agricultural subsidies across counties are not available. If the amount of direct agricultural subsidies that a county received following the AAT reform is positively correlated with its reliance on agricultural taxation for budgetary revenue prior to the reform, the coefficient on *AGTAX5* in our model captures both the effect of the AAT reform on agricultural growth and the effect of increasing agricultural subsidies on agricultural growth. In other words, the impact of the AAT reform on agricultural growth may be overestimated in the current study. However, the coefficient on *AGTAX5* mainly reflects the impact of the AAT reform over the period 2004–07, because the increase in direct agricultural subsidies over this period was much smaller than the level of agricultural taxation abolished.³²

The coefficient on *AgShare*₀ is significantly negative in the regression for *GAGDP* but significantly positive in the regression for *GNAGDP*, suggesting that the initial size of the agricultural sector in the entire economy has opposite effects on agricultural and non-agricultural economic growth. The significant and negative coefficients on *FisBurd*₀ in all of the regressions are consistent with the findings in the previous literature that examined the fiscal liberalisation and economic growth nexus. The insignificant and even negative coefficient for *InvGDP*₀ is a little bit surprising and may be explained by the great variation in *InvGDP*₀ (standard deviation 0.3626 with mean 0.3968) at the county level, which is probably the result of inefficient large-scale infrastructure investment in China's Western Development plan.³³ Government size has a significantly positive impact on economic growth, as a larger government size indicates county governments' greater ability to provide public goods (for example,

³¹Meng, 2012; Yu, Liu and You, 2012; Yi, Sun and Zhou, 2015.

³²We thank one anonymous referee for pointing out that our estimated impact of the AAT reform on agricultural production may be overestimated due to the increase in direct agricultural subsidies in China since 2002. According to Yu and Jensen (2014), the direct subsidy to farmers from the State Grain Risk Fund was RMB 11.6 billion in 2004, and it increased steadily to RMB 15.1 billion in 2007; the direct subsidy to agricultural production inputs, first given in 2006, was RMB 12 billion. The agricultural tax abolished, however, was RMB 51.7 billion in 2003. And note that the agricultural tax would also have grown if it had not been abolished in 2004.

³³Shi and Huang, 2014.

infrastructure) and hence to promote economic growth. The slightly significant and positive coefficient on $IncomeDiff_0$ may be explained by farmers' enhanced incentive to work, induced by larger urban–rural inequality. The coefficient on $LabourGap_0$ is significantly positive in the regressions for $GNAGDP$ and $GGDP$ but significantly negative in the regression for $GAGDP$, indicating that labour inflow promotes the growth of per-capita non-agricultural and overall GDP and inhibits the growth of per-capita agricultural GDP.

In addition to finding the opposite direction of the AAT reform's impact on growth in agricultural and non-agricultural GDP per capita over the period 2004–07, we also examine the persistency of the reform's impact on agricultural and non-agricultural growth by conducting regressions in which the dependent variable denotes the geometrically averaged growth rates of each county's GDP per capita over the period 2007–10. The independent variables in these regressions are the same as those in Table 1 in order to avoid any endogeneity in the control variables. The results are reported in Table A2 in the online appendix. The coefficients on spatial lag in the regressions for $GAGDP$, $GNAGDP$ and $GGDP$ are all statistically significant and positive, which indicates a positive spillover effect of economic growth among Chinese counties during 2007–10. And given that the null hypothesis that $AGTAX5$ is exogenous cannot be rejected, the models in columns 7–9 of Table A2 are taken as the baseline results. According to the baseline results, the coefficient on $AGTAX5$ is insignificant in the regressions for $GNAGDP$ and $GGDP$, indicating that the AAT's impact on non-agricultural and overall GDP growth was only temporary rather than persistent. The coefficient on $AGTAX5$ in the regression for $GAGDP$, although still significantly positive, is much smaller than that in Table 1. Moreover, direct agricultural subsidies increased fast during the period 2007–10, which may lead our estimated coefficient on $AGTAX5$ to overstate the effect of the AAT reform on agricultural growth in this period. This further suggests that the impact of the AAT reform on agricultural GDP growth was reduced significantly, if not completely eliminated, during 2007–10.

Due to the asymmetric impacts of the AAT reform on agricultural and non-agricultural sectors, it might be interesting to evaluate the reform's impact on regional inequality in the GDP level. For this purpose, we calculate the Gini coefficients³⁴ for both agricultural and non-agricultural GDP per capita utilising real data, and we calculate the counterfactual Gini coefficients by imposing the assumption that the AAT reform did not occur during the period 2004–07. Table 2 reports the Gini coefficients for the Chinese counties for the years 2004 and 2007. The Gini coefficient for agricultural GDP per capita decreased from 0.3116 in 2004 to 0.3071 in 2007. Without the AAT reform, however, this Gini coefficient would have increased slightly to 0.3127. The

³⁴ A Gini coefficient collapses a distribution into a single number between 0 and 1, where higher numbers mean greater inequality.

TABLE 2
Gini coefficients for agricultural and non-agricultural GDP per capita

	Entire economy		Agricultural sector		Non-agricultural sector	
	<i>Data</i>	<i>No AAT</i>	<i>Data</i>	<i>No AAT</i>	<i>Data</i>	<i>No AAT</i>
2004	0.3779	—	0.3116	—	0.4312	—
2007	0.3873	0.3870	0.3071	0.3127	0.4297	0.4173
<i>N</i>	1,709	1,709	1,709	1,709	1,709	1,709

Gini coefficient for non-agricultural GDP per capita decreased slightly from 0.4312 in 2004 to 0.4297 in 2007. Without the AAT reform, however, this Gini coefficient would have decreased significantly from 0.4312 to 0.4173 over the period 2004–07. Thus, the AAT reform increased the regional inequalities in non-agricultural GDP per capita over the period 2004–07. Interestingly, the AAT reform had little impact on the Gini coefficient for overall GDP per capita over the period 2004–07 due to its opposite impacts on the Gini coefficients for the agricultural and non-agricultural sectors.

2. Local governments' responses to the AAT reform

Following the AAT reform, two likely actions that the Chinese county governments may have taken, given their tightening budgetary constraints, were increasing their non-agricultural taxation and/or changing the structure of their budgetary expenditures. Table 3 reports the OLS regression results with regard to such responses to the AAT reform. $\Delta NAGTAX$ measures each county's response within taxation on its non-agricultural sector, defined as the difference between the ratios of taxes from the non-agricultural sector to non-agricultural GDP prior to and following the AAT reform. $\Delta INVEXP$ measures each county's response within budgetary expenditures on investment in fixed assets, defined as the difference between the ratios of budgetary expenditures on investment in fixed assets to total budgetary expenditures prior to and following the AAT reform. $\Delta ERHEXP$ measures each county's response within budgetary expenditures on investment in human capital, defined as the difference between the ratios of budgetary expenditures on education, research and healthcare to total budgetary expenditures prior to and following the AAT reform. $\Delta OTHEXP$ measures each county's response within budgetary expenditures other than on investment in fixed assets and human capital. Note that the sum of $\Delta OTHEXP$, $\Delta INVEXP$ and $\Delta ERHEXP$ is simply 0. $\Delta TRANS$ measures the increase in fiscal transfer from upper-level governments, defined as the difference between the ratios of the fiscal transfer from the upper-level governments to budgetary revenue prior to and following the AAT reform.

TABLE 3
County governments' responses to the AAT reform

	(1) $\Delta TRANS$	(2) $\Delta NAGTAX$	(3) $\Delta INVEXP$	(4) $\Delta ERHEXP$	(5) $\Delta OTHEXP$
$AGTAX5$	0.856*** (0.061)	0.066*** (0.007)	0.046** (0.021)	0.056*** (0.016)	-0.116*** (0.027)
$\Delta TRANS$		-0.036*** (0.003)	-0.007 (0.009)	-0.008 (0.007)	0.022* (0.012)
$NAGDP_0$	0.015 (0.013)	0.002 (0.001)	0.009** (0.004)	-0.021*** (0.003)	0.014*** (0.005)
$AgShare_0$	0.064 (0.074)	-0.018** (0.008)	-0.036 (0.024)	0.009 (0.018)	0.042 (0.031)
$FisBurd_0$	0.016*** (0.005)	-0.001 (0.001)	-0.003* (0.002)	0.008*** (0.001)	-0.004* (0.002)
$InvGDP_0$	-0.019 (0.015)	-0.001 (0.001)	-0.003 (0.004)	-0.010*** (0.003)	0.009* (0.005)
$GovSize_0$	-0.461*** (0.074)	-0.012 (0.009)	0.053** (0.024)	-0.161*** (0.020)	0.124*** (0.032)
$IncomeDiff_0$	0.021 (0.018)	0.003* (0.002)	-0.008 (0.006)	-0.001 (0.004)	0.008 (0.008)
$LabourGap_0$	-0.002 (0.031)	0.002 (0.004)	0.007 (0.009)	-0.021*** (0.007)	0.011 (0.011)
Dummy for prefecture	Yes	Yes	Yes	Yes	Yes
N	1,663	1,377	1,226	1,543	1,146

Note: The dependent variables $\Delta NAGTAX$, $\Delta INVEXP$, $\Delta ERHEXP$, $\Delta OTHEXP$ and $\Delta TRANS$ are defined in this section. The independent variables are all defined in Section III. Standard errors are in parentheses. ***, ** and * indicate 1 per cent, 5 per cent and 10 per cent significance levels.

We now perform a tentative analysis on the question of whether the increase in fiscal transfer was enough to compensate for the budgetary revenue reduction due to the AAT reform. Column 1 of Table 3 presents us with a significant and positive coefficient, 0.856, for $AGTAX5$ in the regression where $\Delta TRANS$ is the dependent variable. The coefficient is smaller than 1, implying that the increase in fiscal transfer from the upper-level governments may not be large enough to compensate for the budgetary revenue reduction of county governments due to the AAT reform.³⁵ This result is consistent with the finding of Zhang (2005).

Column 2 of Table 3 shows a significant and positive coefficient for $AGTAX5$ in the regression where $\Delta NAGTAX$ is the dependent variable. This indicates that the AAT reform forced the Chinese county governments to increase their

³⁵Please refer to the online appendix for a detailed explanation of why the coefficient on $AGTAX5$ in column 1 of Table 3 should be larger than 1 when the increase in fiscal transfer from the upper-level governments is just enough to compensate for the budgetary revenue reduction due to the AAT reform.

non-agricultural taxation and that the magnitude of this tax increase on the non-agricultural sector was greater in counties with higher reliance on agricultural taxation for budgetary revenue prior to the AAT reform. This evidence again suggests that the increase in fiscal transfer from the upper-level governments was not large enough to compensate for the counties' budgetary revenue reductions following the AAT reform. The significant and negative coefficient on $\Delta TRANS$ in column 2 demonstrates that a larger fiscal transfer from the upper-level governments helped to mitigate county governments' motivation to increase their non-agricultural taxation.

In columns 3 and 4 of Table 3, the coefficients on $AGTAX5$ are significant and positive, demonstrating that county governments increased their budgetary expenditure shares for investment in fixed assets and investment in human capital following the AAT reform. Thus, it is not surprising that they decreased the share for other budgetary expenditures, as shown by the significant and negative coefficient on $AGTAX5$ in column 5. All these results point to the fact that Chinese county governments changed the structure of their budgetary expenditures following the AAT reform.

3. The channels through which the AAT reform influenced non-agricultural GDP growth

We have demonstrated how Chinese county governments responded to the AAT reform by increasing their non-agricultural taxation and changing the structure of their budgetary expenditures. It is natural for us to go on to investigate the relative importance of these responses for the determinants of the growth of non-agricultural GDP per capita. We thus include $\Delta NAGTAX$, $\Delta INVEXP$ and $\Delta ERHEXP$ step-by-step in a regression that examines the relationship between $AGTAX5$ and $GNAGDP$. All of the regressions are conducted with the same sample to ensure that the estimated results are comparable. For all of the regressions in Table 4, the OLS approach is used because the null hypothesis that $AGTAX5$ is exogenous cannot be rejected and economic interdependence was irrelevant during this period.

When $\Delta NAGTAX$ is added to the regression, the estimate for the coefficient on $AGTAX5$ increases from -0.087 in column 1 to -0.050 in column 2 of Table 4. We also see from column 2 that the estimated coefficient on $\Delta NAGTAX$ is significant and negative. Such evidence confirms that the increased non-agricultural taxation following the AAT reform was an important channel through which the AAT reform influenced the growth of non-agricultural GDP per capita.

Column 3 of Table 4 shows that including $\Delta INVEXP$ in the regression has no significant effect on the estimate for the coefficient on $AGTAX5$. One plausible explanation for the insignificance of this channel is that only a small portion of each county's investment in fixed assets comes from its budgetary

TABLE 4
Channels through which the AAT reform influenced non-agricultural GDP growth

	(1) GNAGDP	(2) GNAGDP	(3) GNAGDP	(4) GNAGDP
<i>AGTAX5</i>	−0.087*** (0.028)	−0.050* (0.028)	−0.052* (0.028)	−0.044 (0.028)
<i>ΔNAGTAX</i>		−1.068*** (0.158)	−1.071*** (0.158)	−1.123*** (0.156)
<i>ΔINVEXP</i>			0.073 (0.058)	0.067 (0.057)
<i>ΔERHEXP</i>				−0.274*** (0.050)
<i>NAGDP₀</i>	−0.017*** (0.005)	−0.015*** (0.005)	−0.016*** (0.005)	−0.018*** (0.005)
<i>AgShare₀</i>	0.152*** (0.038)	0.113*** (0.038)	0.112*** (0.038)	0.129*** (0.037)
<i>FisBurd₀</i>	−0.013*** (0.003)	−0.014*** (0.003)	−0.014*** (0.003)	−0.012*** (0.003)
<i>InvGDP₀</i>	0.008 (0.008)	0.007 (0.008)	0.008 (0.008)	0.004 (0.008)
<i>GovSize₀</i>	0.174*** (0.053)	0.209*** (0.053)	0.218*** (0.053)	0.171*** (0.053)
<i>IncomeDiff₀</i>	−0.004 (0.009)	−0.003 (0.009)	−0.004 (0.009)	0.002 (0.009)
<i>LabourGap₀</i>	0.204*** (0.019)	0.207*** (0.019)	0.207*** (0.019)	0.201*** (0.018)
<i>N</i>	1,017	1,017	1,017	1,017

Note: GNAGDP is the average growth rate of GDP per capita in the non-agricultural sector during 2004–07. The independent variables *ΔNAGTAX*, *ΔINVEXP* and *ΔERHEXP* are defined in Section IV.2. The other variables are defined in Section III. Standard errors are in parentheses. ***, ** and * indicate 1 per cent, 5 per cent and 10 per cent significance levels.

expenditure in China.³⁶ Additionally, column 4 of Table 4 demonstrates that the coefficient on *ΔERHEXP* is negative and significant, suggesting that greater expenditures on investment in human capital inhibited the growth of non-agricultural GDP per capita in the short run. One plausible explanation for this negative impact is as follows. More investment in human capital means less resources for other activities or programmes that stimulate economic growth. Although investments in human capital are conducive to economic

³⁶In 2004, budgetary expenditures from all of the governments funded 5.7 per cent of the total investment in fixed assets in China, whereas budgetary expenditures from the county-level governments funded only 0.36 per cent of it. In the same year, the GDP of all the counties accounted for 56.5 per cent of the national GDP.

growth in the long run, they tend to be less productive than other activities and programmes in the short run, implying a negative coefficient for $\Delta ERHEXP$.

We have examined the role of the three channels defined by $\Delta NAGTAX$, $\Delta INVEXP$ and $\Delta ERHEXP$ in explaining the influence of the AAT reform on non-agricultural GDP growth step-by-step. In sum, the three channels explain 49.5 per cent (i.e. $[(0.087 - 0.044)/0.087] \times 100\%$) of the entire influence of the AAT reform on non-agricultural GDP growth. How much do the three channels explain the influence of the AAT reform on non-agricultural GDP growth separately? To investigate the separate explanatory power of the three channels, a straightforward procedure is to define the change in the coefficient on $AGTAX5$ from column 1 to column 2 of Table 4 as the effect of the channel defined by $\Delta NAGTAX$, the change in the coefficient on $AGTAX5$ from column 2 to column 3 as the effect of the channel defined by $\Delta INVEXP$, and the change in the coefficient on $AGTAX5$ from column 3 to column 4 as the effect of the channel defined by $\Delta ERHEXP$. The results from this procedure, however, depend on the sequence in which we add the variables defining the channels. Gelbach (2016) proposes a method to handle this issue. Following his method, we find that the three channels defined by $\Delta NAGTAX$, $\Delta INVEXP$ and $\Delta ERHEXP$ explain 44.2 per cent, -1.3 per cent and 6.6 per cent of the influence of the AAT reform on non-agricultural GDP growth, respectively.³⁷

Given that the estimate for the coefficient on $AGTAX5$ in the last column of Table 4 stays negative and significant at the 15 per cent level, other channels may still exist through which the AAT reform influenced non-agricultural GDP growth. For example, the Chinese county governments could have increased their land transaction fees or their surtaxes on the non-agricultural sector, which are documented as fund budgetary revenue or extra-budgetary revenue. The importance of such extra channels, however, is not explored in the current study due to a lack of data.

V. Robustness checks

As noted in Section II, agricultural taxation was eliminated in 2005 in 28 Chinese provinces excluding Hebei, Shandong and Yunnan. For those three provinces, the agricultural tax rate was reduced to less than 2 per cent in 2005.

³⁷In our exercise, Gelbach's (2016) method works as follows. Set $\Delta NAGTAX$, $\Delta INVEXP$ and $\Delta ERHEXP$ as the dependent variable in sequence and run regressions on the covariates in column 1 of Table 5. The revealed coefficients on $AGTAX5$ are 0.03423, 0.01721 and 0.02110, respectively. 0.03423 multiplied by the coefficient on $\Delta NAGTAX$ in column 4 of Table 4 (-1.123) is -0.03845, and this measures the influence of the channel defined by $\Delta NAGTAX$. It accounts for 44.2 per cent of the influence of the AAT reform on non-agricultural GDP growth. The influence of the other two channels can be calculated similarly. Note that the results from this procedure do not depend on the sequence in which we add the variables defining the channels because we use the results of the regression with all three channels controlled for (i.e. column 4 of Table 4), instead of the step-by-step results. Also note that the influences of the three channels add up to the percentage change in the coefficient on $AGTAX5$ from column 1 to column 4 of Table 4.

TABLE 5
Robustness check: with some counties excluded

	(1) <i>GGDP</i>	(2) <i>GAGDP</i>	(3) <i>GNAGDP</i>	(4) <i>GGDP</i>	(5) <i>GAGDP</i>	(6) <i>GNAGDP</i>
<i>AGTAX5</i>	−0.031* (0.019)	0.123*** (0.018)	−0.090*** (0.025)	−0.070*** (0.020)	0.132*** (0.019)	−0.149*** (0.026)
X_0	−0.012*** (0.004)	−0.005*** (0.001)	−0.024*** (0.005)	−0.010** (0.004)	−0.004*** (0.001)	−0.023*** (0.005)
<i>AgShare</i> ₀	−0.027 (0.023)	−0.109*** (0.020)	0.072** (0.032)	0.002 (0.024)	−0.108*** (0.021)	0.107*** (0.033)
<i>FisBurd</i> ₀	−0.008*** (0.002)	−0.006*** (0.002)	−0.010*** (0.002)	−0.009*** (0.002)	−0.007*** (0.002)	−0.012*** (0.002)
<i>InvGDP</i> ₀	0.021*** (0.006)	−0.014** (0.006)	0.032*** (0.008)	0.015** (0.006)	−0.016*** (0.006)	0.024*** (0.008)
<i>GovSize</i> ₀	0.091*** (0.026)	0.083*** (0.025)	0.086** (0.035)	0.088*** (0.027)	0.084*** (0.026)	0.081** (0.035)
<i>IncomeDiff</i> ₀	0.010* (0.006)	0.013** (0.005)	0.003 (0.008)	0.016*** (0.006)	0.015** (0.006)	0.010 (0.008)
<i>LabourGap</i> ₀	0.106*** (0.012)	−0.085*** (0.012)	0.157*** (0.016)	0.084*** (0.013)	−0.095*** (0.012)	0.135*** (0.017)
<i>N</i>	1,535	1,535	1,535	1,411	1,411	1,411

Note: *GGDP* denotes the average growth rate of GDP per capita during 2004–07. *GAGDP* and *GNAGDP* are the average growth rate of GDP per capita in the agricultural and non-agricultural sectors, respectively, during 2004–07. $X_0 = GDP_0$, $AGDP_0$ or $NAGDP_0$ when the dependent variable in the model is *GGDP*, *GAGDP* or *GNAGDP*, respectively. The other variables are defined in Section III. Standard errors are in parentheses. ***, ** and * indicate 1 per cent, 5 per cent and 10 per cent significance levels.

Columns 1–3 of Table 5 report the OLS estimates when all of the counties in Hebei, Shandong and Yunnan are excluded from the sample over the period 2004–07. They reveal that all of the primary results are maintained.

Section II also notes that some counties were exempt from agricultural taxation in 2004. However, the list of these counties has not been officially announced. We attempt to identify these counties by comparing the changes in each county's reliance on the agricultural tax for budgetary revenue before and after 2004. To be specific, if a county's change in *AGTAX5* between 2003 and 2004 was larger than that between 2004 and 2005, that county was identified as having been exempt from agricultural taxation in 2004. Columns 4–6 of Table 5 report the OLS estimates when all of those identified counties are excluded from the sample over the period 2004–07. They reveal that all of the primary results are maintained.

In Table 6, we report the estimates when *AGTAX5* is replaced by *AGTAX3*. Columns 1–3 show the OLS estimates. The OLS approach is valid if *AGTAX3* is exogenous, but the construction of *AGTAX3* uses information from a year after the AAT reform, which might be endogenously affected by the reform.

TABLE 6
Robustness check: with *AGTAX3* as an alternative measure

	<i>AGTAX3</i> is exogenous			<i>AGTAX3</i> is endogenous		
	(1) <i>GGDP</i>	(2) <i>GAGDP</i>	(3) <i>GNAGDP</i>	(4) <i>GGDP</i>	(5) <i>GAGDP</i>	(6) <i>GNAGDP</i>
<i>AGTAX3</i>	-0.018 (0.018)	0.099*** (0.017)	-0.068*** (0.023)	-0.023 (0.019)	0.125*** (0.019)	-0.077*** (0.025)
X_0	-0.013*** (0.004)	-0.022*** (0.004)	-0.025*** (0.005)	-0.013*** (0.004)	-0.021*** (0.004)	-0.025*** (0.005)
<i>AgShare</i> ₀	-0.046** (0.022)	-0.090*** (0.020)	0.051* (0.030)	-0.043* (0.022)	-0.105*** (0.021)	0.056* (0.031)
<i>FisBurd</i> ₀	-0.010*** (0.002)	-0.006*** (0.002)	-0.012*** (0.003)	-0.009*** (0.002)	-0.007*** (0.002)	-0.012*** (0.003)
<i>InvGDP</i> ₀	0.009 (0.006)	-0.009 (0.006)	0.014* (0.008)	0.009 (0.006)	-0.009 (0.006)	0.014* (0.008)
<i>GovSize</i> ₀	0.148*** (0.032)	0.060* (0.031)	0.155*** (0.042)	0.146*** (0.032)	0.072** (0.032)	0.151*** (0.042)
<i>IncomeDiff</i> ₀	0.008 (0.006)	0.002 (0.006)	0.001 (0.008)	0.008 (0.006)	0.002 (0.006)	0.001 (0.008)
<i>LabourGap</i> ₀	0.100*** (0.012)	-0.079*** (0.012)	0.151*** (0.016)	0.100*** (0.012)	-0.079*** (0.012)	0.150*** (0.016)
<i>N</i>	1,476	1,476	1,476	1,476	1,476	1,476

Note: When *AGTAX3* is treated as endogenous, *AGTAX5* is used as its IV. *GGDP* denotes the average growth rate of GDP per capita during 2004–07. *GAGDP* and *GNAGDP* are the average growth rate of GDP per capita in the agricultural and non-agricultural sectors, respectively, during 2004–07. $X_0 = GDP_0$, $AGDP_0$ or $NAGDP_0$ when the dependent variable in the model is *GGDP*, *GAGDP* or *GNAGDP*, respectively. The other variables are defined in Section III. Standard errors are in parentheses. ***, ** and * indicate 1 per cent, 5 per cent and 10 per cent significance levels.

This means that *AGTAX3* might be endogenous. Hence, we also take *AGTAX3* as endogenous and instrument it by *AGTAX5* to estimate the model. *AGTAX5* is used as the instrument because it cannot be rejected as exogenous. The results for endogenous *AGTAX3* are reported in columns 4–6 of Table 6. As demonstrated in the table, all of the primary results are maintained no matter whether *AGTAX3* is taken as exogenous or endogenous.

Section III describes the construction of the spatial matrix, W , to reflect the spillover effect of economic growth from the other counties in the same prefecture. This construction misses the spillover effect of economic growth from the counties that are geographically connected. To incorporate this spillover effect, we reconstruct W to reflect the spillover effect of economic growth from counties that are in the same prefecture or geographically connected. The results based on this spatial matrix are presented in Table A3 of the online appendix. All of the main results in Section IV remain the same.

Finally, we add the dummies for prefecture to the regressions in order to capture the influence of the characteristics of a prefecture on economic growth. The results with the dummies for prefecture included are presented in Table A4 of the appendix. It is again the case that all of the main results in Section IV survive.

VI. Conclusions

The AAT reform during the period 2004–05 is considered to be one of the most important rural reforms in China since 1978. With doubts that the effect of this reform could extend beyond the realm of agriculture, we evaluate the impact of China's AAT reform on Chinese county governments' behaviours and their economic growth. Employing county-level data for the period 2004–07, we find that the magnitude of the AAT reform's impact depended on each county's reliance on agricultural taxation for budgetary revenue prior to the reform. Specifically, following the AAT reform, counties with higher reliance on agricultural taxation for budgetary revenue prior to the reform tended to have higher growth rates in agricultural GDP per capita but lower growth rates in non-agricultural GDP per capita. Moreover, the AAT reform increased the regional inequalities in non-agricultural GDP per capita at the county level in China during 2004–07. The AAT reform influenced the non-agricultural sector through the channel of increased non-agricultural taxation by county governments following the reform. The reason for this may be that the increase in fiscal transfer from the upper-level governments was not enough to compensate for Chinese county governments' budgetary revenue reduction due to the AAT reform.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

- Appendix

References

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