Food Policy 104 (2021) 102125

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Impacts of agricultural incentive policies on land rental prices: New evidence from China

Wensheng Lin [1], Jikun Huang [*]

China Center for Agricultural Policy, School of Advanced Agricultural Sciences, Peking University, Beijing, China

ARTICLE INFO

Keywords:
Agricultural tax
Agricultural subsidy
Output price support
Land rental prices

ABSTRACT

Agricultural incentive policies affects not only agricultural production, but also land rental price. This paper extends the theoretical framework of the effect of agricultural incentive policies on land rental prices by simultaneously considering agricultural tax, agricultural subsidy and output price support policies and methods to implement these policies. The empirical analyses are based on a unique dataset from several rounds of representative rural household surveys that recorded the land rental prices of 7122 plots in 276 villages across 11 provinces during 1999–2018 in China. The survey results show that land rental price had increased significantly until the middle 2010s and then started to fall thereafter. Eliminating agricultural tax based on cultivated land and implementing price support policy through government procurement program have significantly raised land rental price, but the effect of agricultural subsidy to contract holder/owner on land rental price is insignificant. While the econometric results are consistent with the theoretical expectations, this study provides strong empirical evidence that the recipient of subsidy (owner or operator/tenant) matters, and finds the impacts of agricultural subsidy and output price support policies on land rental price in China differ significantly from the previous findings in developed countries due to different ways to implement subsidy and price support policies. The paper concludes with policy implications.

1. Introduction

In most countries, governments often intervene agricultural production through agricultural incentive policies. Agricultural tax based on output or land, agricultural subsidy (or payment) based on input or land or output, and output price support through market intervention (e.g., minimal price and government procurement) are three major incentive policies that have been widely used by many countries during different stages of economic development. Normally agricultural tax is an important source of government fiscal income in the early stage of development, which is still currently implemented in many developing countries. While agricultural subsidy (or payment) based to farmers is mainly implemented in the developed countries and agricultural subsidy for input use is often implemented in the developing countries, output price support policy is often implemented in both the developed and developing countries.

The effects of agricultural incentive policies, especially agricultural subsidy and output price support policies, on land rental prices have been extensively studied in the literature[2]. The theoretical models commonly showed that, owing to relatively price-inelastic supply of agricultural land, both agricultural subsidy based on land and output price support based on output and market price that increase the profitability of land could largely or even fully be capitalized into land rental prices (Floyd, 1965; Leathers, 1992; Choi and Johnson, 1993; Ciaian and Swinnen, 2006), and agricultural subsidy had higher capitalization effect than that of output price support policy. As the output price support has a production effect, the suppliers of various agricultural production factors can share a part of the policy dividend, which leads to a relatively smaller effect of output price support on promoting the increase in land rental price (Roberts et al., 2003; Guyomard et al., 2004).

* Corresponding author at: China Center for Agricultural Policy, School of Advanced Agricultural Sciences, Peking University, No. 5 Yiheyuan Road, Haidian District, Room 412, Wangkezhen Building, Beijing 100871, China.

E-mail addresses: linwensheng.ccap@pku.edu.cn (W. Lin), jkhuang.ccap@pku.edu.cn (J. Huang).

[1] China Center for Agricultural Policy, School of Advanced Agricultural Sciences, Peking University, No. 5 Yiheyuan Road, Haidian District, Room 415, Wangkezhen Building, Beijing 100871, China.

[2] To the best of our knowledge, only Dinterman and Katchova (2020) studied the impact of property tax on cropland cash rent in Ohio, which found that for each additional dollar of property tax levied on cropland, the cash rental rates from 2008 to 2017 increased between $0.31 to $0.61.

https://doi.org/10.1016/j.foodpol.2021.102125
Received 22 February 2021; Received in revised form 22 June 2021; Accepted 1 July 2021

However, the theoretical expectation is only partially supported by the empirical evidence. Several studies have shown that the magnitudes of actual effects of various agricultural subsidies have consistently been much lower than theoretical prediction, which also varied greatly among the different studies within a country or between countries. For example, it was found that the capitalization rates of an additional dollar per acre of subsidy (e.g., the production flexibility contract payments and direct payment based on land) in the United States ranged from 12 cents to 41 cents per acre (Lence and Mishra, 2003; Roberts et al., 2003; Kirwan, 2009; Hendricks et al., 2012; Kropp and Peckham, 2015; Kirwan and Roberts, 2016), while the marginal effect on land rental rates of an additional euro per hectare of subsidy (e.g., the coupled area payment, single farm payment, and single area payment scheme) changed from 6 euro cents to 53 euro cents per hectare in European Union (Breustedt and Habermann, 2011; Ciaian and Kancs, 2012; Kilian et al., 2012; Van Herck et al., 2013; Michalek et al., 2014; O'Neill and Hanrahan, 2016; Allen Klaiber et al., 2017; Guastella et al., 2018; Salhofer & Feichtinger, 2021). On agricultural price support policy, several studies have showed that price support policies such as Loan Deficiency Payment and Counter-Cyclical Payment did not significantly affect land rental prices in the United States (Kirwan, 2009; Kropp and Peckham, 2015; Kirwan and Roberts, 2016).[3]

Several reasons may explain the moderate impact of agricultural subsidy and insignificant impact of output price support on land rental price and the significant difference in capitalization rate of agricultural subsidies between across countries. While informal rural institutional arrangements and imperfect rural factor markets are often considered as the constraints for higher capitalization effect of agricultural subsidy policy on land rental price (Van Herck et al., 2013; O'Neill and Hanrahan, 2016), the empirical analyses based on the data with relatively short time period may also matter. For example, there could be expectation error between land transaction parties regarding the future of agricultural policies (Breustedt and Habermann, 2011; Hendricks et al., 2012). Graubner (2018) and Guastella et al. (2018) also pointed out that the land rental prices are not adjusted timely in long-term leases. Moreover, the empirical studies with short time period often failed to capture the long-term effects of agricultural policies on land rental prices (Ciaian and Kancs, 2012; Hendricks et al., 2012). In addition, actual methods of implementing agricultural subsidy policies that are often decoupled or partially decoupled from the current production may result in lower impacts of empirical results than the theoretical expectation (Breustedt and Habermann, 2011; Michalek et al., 2014; Ciaian et al., 2018).

While most studies have investigated the impacts of agricultural subsidy and output price support policies on land rental prices in developed countries, there is little knowledge on how agricultural incentive policies affect land rental prices in developing countries. While Wineman and Jayne (2018) examined the impacts of urbanization, tenure security and land characteristics on land sale value in Tanzania, it did not deal with agricultural incentive policies. To the best of our knowledge, only Zhang et al. (2020) analyzed the impact of land-based agricultural subsidy on land rental price using a cross-sectional household survey data in 2012, and Xin and Li (2019) empirically analyzed the impacts of grain support price on land rental price in 2014–2017 in China. The former found a 10% increase in agricultural subsidy per unit land resulted in 1% rise in land rental price, while the latter found that a moderate positive effect of grain price on land rental price (marginal impact is 0.15). In addition, the current studies in developed countries examined only the cases that land tillers or operators receive agricultural subsidies based on land (see Guyomard et al., 2004; Ciaian and Kancs, 2012, for example), ignoring the fact that landowners in some cases such as share-cropping contract are also eligible to receive partial agricultural subsidies (Kirwan and Roberts, 2016) and the fact that the households who rented out land still receive agricultural subsidy such as the case in China.

The overall goal of this paper is aimed to systematically analyze the effects of the agricultural incentive policies, including agricultural tax, agricultural subsidy and output price support policies, on land rental prices in the past two decades in China. An empirical study on this topic in China is interesting at least for three reasons. First, China is a good case to systematically study the impacts of agricultural tax, agricultural subsidy and output price support policies because China has shifted from taxing agriculture to subsidizing agriculture since the early 2000s and China had also implemented output price support policies in many years in the past two decades (Huang and Yang, 2017). On agricultural tax that had levied on rural households and lasted for centuries, it has been successively phased out in different provinces during 2004–2006, which provides a large policy variation not only among provinces but also overtime. Second, agricultural subsidies are mostly being given to the land contractor or "landowner"[4] instead of the tiller or operator in China (Huang et al., 2011). Under this situation, what is likely impact of agricultural subsidies on land rental price is an issue that has not been well examined in the literature. Third, understanding the impacts of agricultural incentive policies, particularly agricultural tax and agricultural subsidy on land rental prices in China is important not only on filling the research gaps in developing countries, but also on policy implications for other countries that may pursue the similar agricultural incentive policies now or in the future.

This paper has made several major contributions to the literature. We extend the current theoretical model to include both negative (agricultural tax) and positive (agricultural subsidy and output price support) incentive policies and show the effect of each of these incentive policies on land rental prices. Three propositions generated from theoretical analysis are supported by the empirical studies. The empirical analyses are based on a unique dataset that covers a period from 1999 to 2018, which can better capture the long-term effects of agricultural incentive policies on land rental prices. Moreover, land rental prices are measured at plot level, which can control for the effect of quality or characteristics of rental land. We find that eliminating agricultural taxes significantly increased land rental prices, but the methods of implementing agricultural subsidy that is based on the contract land and the subsidy is provided to land contractor result in no any impact of the subsidy on land rental price in China. We also find that output price support significantly increased land rental prices. Interestingly, the results on the impacts of agricultural subsidy and output price support policies on land rental price in this study differ from the previous findings in developed countries. The reason behind these differences is due to the methods to implement the policies.

The rest of this paper is organized as follows. Section 2 briefly reviews the evolution of agricultural incentive policies in the recent

[3] In the United States, Loan Deficiency Payment is linked to both current production and current market prices, which paid producers the difference between the market price and the support price (loan rate). While Counter-Cyclical Payment (CCP) is based on a historical acreage, it is triggered by low market prices falling beneath a legislatively defined target price, to simply the presentation, we discuss CCP under output price support policy here.

[4] Although the farm land is collectively owned by village in China, the control and income rights have been belonged to individual households (land contractors) within the village after Household Responsibility Reform implemented in 1978–1984. The initial land contract was for 15 years. The contract was extended to the other 30 years (until the later 2020s) after the first term ended in the late 1990s. The government has also ensured that the third term of contract with the other 30 years will be offered in the late 2050s. Because the land contract is really a long-term contract and the next generation of family has right to inherit contracted land, the contract right is similar to ownership right except for not allowing to sell the contract land. To simply the discussion and avoid confusion in comparison with the literature, we use the term of "landowner" to replace "land contractor" in China from now on.

decades in China. Section 3 presents the theoretical model and illustrates the expected impacts of agricultural tax, agricultural subsidy and output price support policies on land rental price under different policy implementation methods. Section 4 explains the data and empirical strategy used in the econometric analysis. Section 5 discusses the major findings from estimation results. The final section concludes this study with policy implications.

2. Agricultural incentive policies in China

To raise farmer's income and ensure national grain security, China has implemented a series of agricultural incentive policies since the early 2000s. These include eliminating agricultural tax, providing agricultural subsidies to farmers, and implementing output price support policy in the past two decades (Huang and Yang, 2017).

2.1. Agricultural tax policy

There were several taxes levied on agriculture and land uses, but not all taxes were associated with the crop land. Officially, China uses a term of "agriculturally related taxes" (*nongyegeshui* in Chinese) that includes the taxes levied on agriculture and the taxes levied on land transferring from agricultural to non-agricultural uses. The former included agricultural tax, animal husbandry tax and special agricultural product tax (e.g., fishery, tea, tobacco, forestry products, etc.), which all had been phased out during 2004–2006. Total amount of agriculturally related taxes accounted for nearly 25% of annual government revenue in 1950s, but with the rising government fiscal revenues from industrial and service sectors, it fell to about 14% in 1960s, 8% in 1970s, and remained at about 4% in 1980s and 1990s (Ministry of Finance, 2006).

In this paper, we focus on agricultural tax that includes the tax and fees levied on crop production (Liu et al., 2012) but was collected based on crop land held by rural households. In 2000, the rising concerns on farmers' burdens and income led China's leaders to make decisions to reduce and finally eliminate the taxes and fees imposed on farmers in agricultural production. The reform was implemented in two steps. It started with the "tax-for-fee" reform, which converted all fees into a uniform agricultural tax and also reduced some unreasonable fees imposed on farmers. After a single agricultural tax was established in 2003, the central government planned to gradually reduce and completely eliminate agricultural tax within 5 years. In 2004, the pilot reform to fully eliminate agricultural tax was implemented in Heilongjiang and Jilin. While the Central Government planned 11 agriculturally important provinces[5] to cut their agricultural tax rates by 3 percent in 2004 and all the other provinces by at least 1% per year, to show their political commitment to the reforms, the provincial governments implemented the reform faster than the national plan. By 2005, 28 of 31 provinces had exempted farmers from agricultural tax, while the remaining three provinces (Hebei, Shandong and Yunnan) eliminated agricultural tax in 2006.

Fig. 1 shows agricultural tax and fees paid by farmers, measured in total amount and as percentage of crop output value in 1998–2006. We only present these tax and fees because they are the tax and fees levied on crops and have expected to have impacts on the land rental price. As Fig. 1 showed, agricultural fees accounted for more than 5% of annual crop output value in 1998, and fell moderately during 1999–2001. Agricultural tax increased during 2001–2003 when the fees were transferred into one simple tax, fell in 2004 and reduced to zero in 2006, which reflected the actual implementation of agricultural tax and fees reform in China as described above. To simplify the presentation, we use term of agricultural tax to replace the term of agricultural tax and fees in the following theoretical and empirical analyses.

[5] The 11 agriculture-based provinces including Anhui, Hebei, Henan, Hubei, Hunan, Inner Mongolia, Jiangsu, Jiangxi, Liaoning, Shandong and Sichuan.

2.2. Agricultural subsidy policy

Agricultural subsidy is direct subsidy to farmers, which is the other important incentive policy aimed to raise farmer's income in China since 2004 (Fig. 2). The direct subsidies to farmers started with grain and high-quality seed (*liangshi butie* and *liangzhong butie* in Chinese) in 2004. The initial policy design of these two subsidies was planned to link with grain production and high-quality seed purchased by each rural household. But due to extremely high implementation cost of monitoring grain production and seed purchase of more than 200 million small farms, the subsidy policy has been implemented by delivering the payment to each rural household simply based on the area of contracted land that was signed in the late 1990s (Huang et al., 2011; 2013) and regardless its land quality or cropping pattern. Implementing the subsidies in this way implies that the farmers who rent in land do not receive the subsidy associated with the rental land. With the rising fertilizer and other agricultural input prices during global food crisis in 2006–2008, China initiated subsidy for agricultural inputs (*nongzi zonghe butie* in Chinese) in 2006. The implementation of this input subsidy has followed the same way as grain and seed subsidies. That is, the subsidy is based on the contracted land area of each rural household. Such all agricultural subsidies examined in this study are decoupled with current production.

Except for grain direct subsidy that had kept nearly constant in nominal terms during 2004–2015, the subsidies for high-quality seeds and agricultural inputs had increased over time (Fig. 2), despite fertilizer price had decreased significantly during global financial crisis that started in the late 2008. Beside these three major subsidies that were provided to all farmers, the other important subsidy to farmers is the subsidy for agricultural machinery, which is based on whether farmers purchased the machinery. Details of subsidy policy implementation and delivery of payment can be found in Huang et al. (2011).

Facing a significant financial burden, a decision was made by the Chinese government in 2012 to cut down the total subsidy budget for 2013 (Huang and Yang, 2017). As shown in Fig. 2, the total amount of agricultural subsidies reached the peak value of 162.3 billion yuan in 2012 and began to decline thereafter. To further simplify government budget allocation and distribution to rural households, three direct subsidies that mentioned above have been merged into a single one since 2016, renamed it as "Agricultural support and protection subsidy" (*nongye zhichi baohu butie* in Chinese) or aggregated subsidy. The payment of this aggregate subsidy is also based on the contracted land area of each rural household.

2.3. Output price support policy

In addition to agricultural subsidies discussed above, China has also sought output price support measures. They include the minimum support prices for rice since 2004 and wheat since 2006, and the temporary procurement and storage policy (TPSP) for maize during 2008–2015 and for soybean, rapeseed and sugar during 2008–2013/14. Both minimal support prices for rice and wheat were announced before production season of each crop in each year, and the procurement prices of commodities under TPSP were announced before harvest of each crop. In the initial years, the support price for each crop was set at the level higher than market price and kept constant for a few years in nominal terms and adjusted periodically over time (Table 1). Government should procure whatever farmers are willing to sell to government under these support prices during the designated government procurement periods (e.g., the early season indica paddy in July-September, the middle and late season indica paddy in September-February, wheat in May-September, and the maize in November-April).

Table 1 shows the output price support for rice and wheat under the minimal support price policy and for maize under TPSP during the period of the policy implementations. In the nominal terms, the support prices for all types of rice between 2004 and 2007 and wheat between

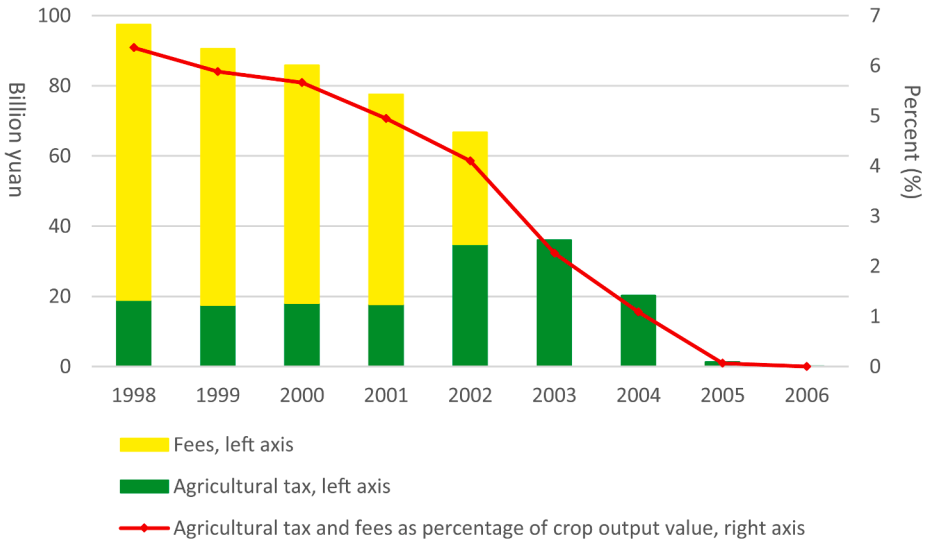

Fig. 1. Agricultural tax and fees in total values (billion yuan in 2005 price) and as percentage of crop output value in China, 1998–2006. Sources: Ministry of Agriculture (China Agriculture Yearbook, 1999–2003) for agricultural fees, and NBSC (China Statistical Yearbook, 1999–2007) for agricultural tax and crop output value[1]. [1]It was noted in Finance Yearbook of China (2009) that although agriculture tax was abolished in 2006, there was still a small amount of tax due to agriculture that year.

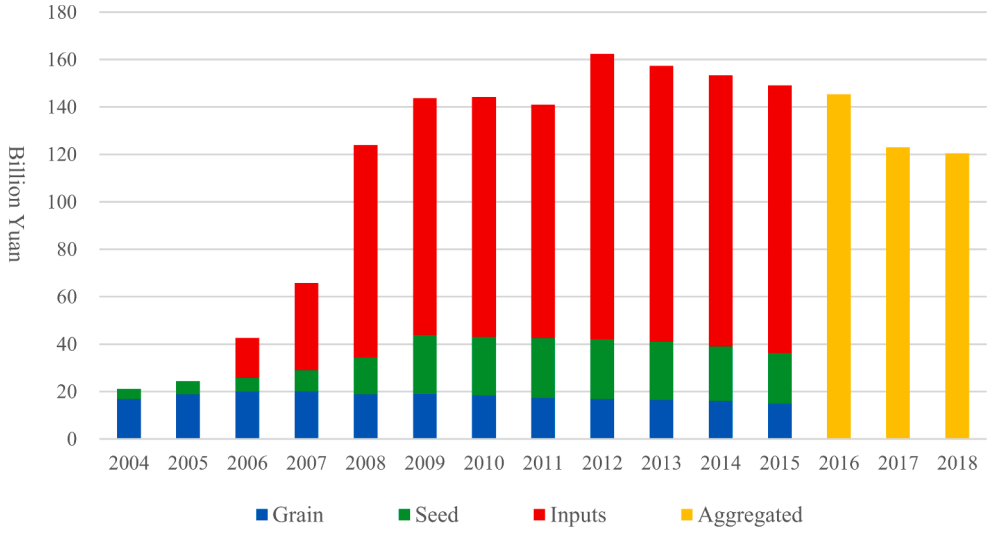

Fig. 2. Agricultural subsidies in China, 2004–2018 (billion yuan in 2018 price). Sources: China Agricultural Development Report (2005–2017), Ministry of Agriculture, China. China Agricultural and Rural Development Report (2018–2019). Ministry of Agriculture and Rural Affairs, China.

Table 1
Output price support policies in China, 2004–2018 (yuan/kg in current price). Sources: All price data are from the website of National Development and Reform Commission, China. Rural CPI (consumer price index) is from China Statistical Yearbook (2005–2019), NBSC.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Early indica paddy	1.40	1.40	1.40	1.40	1.54	1.80	1.86	2.04	2.40	2.64	2.70	2.70	2.66	2.60	2.40
Japonica paddy	1.50	1.50	1.50	1.50	1.64	1.90	2.10	2.56	2.80	3.00	3.10	3.10	3.10	3.00	2.60
Middle indica paddy	1.44	1.44	1.44	1.44	1.58	1.84	1.94	2.14	2.50	2.70	2.76	2.76	2.76	2.72	2.52
Late indica paddy	1.44	1.44	1.44	1.44	1.58	1.84	1.94	2.14	2.50	2.70	2.76	2.76	2.76	2.72	2.52
White wheat			1.44	1.44	1.54	1.74	1.80	1.90	2.04	2.24	2.36	2.36	2.36	2.36	2.30
Red and mixed wheat			1.38	1.38	1.44	1.66	1.72	1.86	2.04	2.24	2.36	2.36	2.36	2.36	2.30
Maize					1.50	1.50	1.70	1.98	2.12	2.24	2.24	2.00			
Rural CPI	68.6	70.1	71.2	75.0	79.9	79.7	82.5	87.3	89.5	92.0	93.7	94.9	96.7	97.9	100.0

2006 and 2007 had been kept the same. Considering the rising market food price inflation and further raising farmer's income, the support prices in nominal terms had been raised during 2008–2012/13 (Table 1). By 2013, however, the government had built up massive storage of the commodities under price support policies, particular maize, which enormously increased financial burden (Huang and Yang, 2017).

With rising grain stock and increasing financial burden, when the new government administration led by the president Xi started in 2013, a plan called for reform started in 2014. Then China has begun to adjust its output price support policies for rice, wheat, maize and other crops since 2014 (Table 1). These include gradually lowering the output price support for rice and wheat in the nominal terms in recent years, lowered maize price in 2014–2015, and phased out the output price support

policies for soybean and rapeseeds since 2014 and maize since 2016.

3. Theoretical analysis

Following Guyomard et al. (2004) and Latruffe and Le Mouël (2009), this paper extends their analytical framework to include simultaneously effects of three types of agricultural incentive policies on land rental prices, which including agricultural tax, agricultural subsidy and output price support policies. Let farm household (i) be endowed with fixed amounts of contract land (A_0). The aggregate agricultural output ($f(A,X,T^0)$) of farm household (i) depends on the amount of land area operated (A)[6] and other production factors (X), which including the aggregate of family labor, capital and intermediate inputs, according to a given production technology (T^0). The amount of land rented in or rented out (A-A_0) is the difference between the amount of area cultivated (A) and the own land endowment or the own contract land in the case of China (A_0). The profit function of this representative farm household is as follows:

$$\pi = (p_y + p_s) f(A, X, T^0) - (T - D)A_0 - (R + \alpha T - \beta D)(A - A_0) - p_x X \quad (1)$$

where π is the profit function of farm household (i), p_y is the market price of farm product, p_s is the gap between market price and support price of farm product, R is the observable land rental prices, T is agricultural tax based on land, D is agricultural subsidies that are decoupled and based on the contract land area, p_x is the prices of other production factors, and $A' = A - A_0$. α ($0 \le \alpha \le 1$) is the proportion of agricultural tax paid by farm household (i). All of the agricultural tax is paid by farm household (i) when $\alpha = 1$, while farm household (i) does not bear any agricultural tax when $\alpha = 0$. β is the proportion of agricultural subsidies received by farm household (i). As agricultural subsidies are only allocated for the landowner (or the land contractor) in China, which means that farmers who rent in land do not receive the subsidy associated with the rental land (i.e., $\beta = 0$), while land tillers or operators receive agricultural subsidies in the United States and the European Union (i.e., $0 \le \beta \le 1$).

The profit function $\pi(p_y + p_s, R + \alpha T - \beta D, p_x)$ is assumed to be non-increasing, linearly homogeneous and convex in land rental prices and the prices of other production factors. By differentiating the profit function $\pi(p_y + p_s, R + \alpha T - \beta D, p_x)$ with respect to the land rental prices and the prices of other production factors (ie., using Hotelling lemma), respectively, we can obtain the demand equations of land rental market and other factor markets.

$$\frac{\partial \pi}{\partial R} = -A'(p_y + p_s, R + \alpha T - \beta D, p_x) \quad (2)$$

$$\frac{\partial \pi}{\partial p_x} = -X(p_y + p_s, R + \alpha T - \beta D, p_x) \quad (3)$$

The equilibrium Equation (2) and (3) are the equilibrium conditions in the land (A') and other factor markets (X), which contain two endogenous variables (namely, the land rental price (R) and the prices of other production factors (p_x)).

In equilibrium, supply equals demand in the land and other factor markets. Then, we have

$$A'(p_y + p_s, R + \alpha T - \beta D, p_x) = S_{A'}(R) \quad (4)$$

$$X(p_y + p_s, R + \alpha T - \beta D, p_x) = S_X(p_x) \quad (5)$$

where $S_{A'}(R)$ is land supply, and $\partial S/\partial R \ge 0$. $S_X(p_x)$ is the supply of other production factors, and $\partial S_X/\partial p_x \ge 0$. Equations (4) and (5) are market clearing conditions for land and other production factors, respectively.

[6] The amount of land that rented in or rented out is the difference between the amount of area cultivated (A) and the own land endowment or the own contract land in the case of China (A_0).

Totally differentiating Equation (4) and (5) with respect to T, D and p_s yields:

$$\frac{\partial R}{\partial T} = -\alpha\left[\left(\frac{\partial X}{\partial p_x} - \frac{\partial S_X}{\partial p_x}\right)\frac{\partial A'}{\partial R} + \left(-\frac{\partial A'}{\partial p_x}\right)\frac{\partial X}{\partial R}\right](1/det[M]) \quad (6)$$

$$\frac{\partial R}{\partial D} = \beta\left[\left(\frac{\partial X}{\partial p_x} - \frac{\partial S_X}{\partial p_x}\right)\frac{\partial A'}{\partial R} + \left(-\frac{\partial A'}{\partial p_x}\right)\frac{\partial X}{\partial R}\right](1/det[M]) \quad (7)$$

$$\frac{\partial R}{\partial p_s} = \left[\left(\frac{\partial X}{\partial p_x} - \frac{\partial S_X}{\partial p_x}\right)\left(-\frac{\partial A'}{\partial p_y}\right) + \left(-\frac{\partial A'}{\partial p_x}\right)\left(-\frac{\partial X}{\partial p_y}\right)\right](1/det[M]) \quad (8)$$

with $det[M] = \left(\frac{\partial A'}{\partial R}\frac{\partial X}{\partial p_x} - \frac{\partial A'}{\partial p_x}\frac{\partial X}{\partial R}\right) + \frac{\partial S_{A'}}{\partial R}\left(-\frac{\partial X}{\partial p_x}\right) + \left(-\frac{\partial A}{\partial R}\right)\frac{\partial S_X}{\partial p_x} + \frac{\partial S_{A'}}{\partial R}\frac{\partial S_X}{\partial p_x} > 0$. As the profit function (π) is assumed to be convex in prices, then we have $\frac{\partial A'}{\partial R}\frac{\partial X}{\partial p_x} - \frac{\partial A'}{\partial p_x}\frac{\partial X}{\partial R} \ge 0$, and given $\frac{\partial S_{A'}}{\partial R}\left(-\frac{\partial X}{\partial p_x}\right) > 0$, $\left(-\frac{\partial A}{\partial R}\right)\frac{\partial S_X}{\partial p_x} > 0$, $\frac{\partial S_{A'}}{\partial R}\frac{\partial S_X}{\partial p_x} > 0$, then the sign of $\frac{\partial R}{\partial T}$ depends on -α, while the sign of $\frac{\partial R}{\partial D}$ depends on β, and $\frac{\partial R}{\partial p_s}$is unambiguously positive.

According to Equations (6)-(8), we can get three propositions as follows:

Proposition 1.. *If any agricultural tax is paid by land tiller or operator (i.e., $0 \le \alpha \le 1$), then $\partial R/\partial T < 0$, which implies that the agricultural tax policy has a negative impact on the land rental prices, while eliminating agricultural tax has a positive effect on the land rental prices.*

Proposition 2.. *If agricultural subsidies are only allocated to the landowner (or the land contractor in China), which means that farmers who rent in land do not receive the subsidy associated with the rental land (i.e., $\beta = 0$ and $\partial R/\partial D = 0$), agricultural subsidies do not affect land rental prices. If land tillers or operators receive agricultural subsidies (e.g., the cases in the United States and the European Union), $\beta = 1$ and $\partial R/\partial D > 0$, agricultural subsidies do have a positive effect on land rental prices. Moreover, if landowners are eligible to receive partial agricultural subsidies based on the share rates for share-cropping contract (e.g., the cases in the United States), then $0 \le \beta \le 1$ and $\partial R/\partial D > 0$, agricultural subsidies also have a positive effect on land rental prices.*

Proposition 3.. *The output price support policy has a positive impact on the land rental prices (i.e., $\partial R/\partial p_s > 0$).*

4. Data and empirical study

4.1. Data sources

This study uses two primary household survey datasets named as Dataset 1 and Dataset 2 and incentive policy data based on the county, provincial and national policies. Both Datasets 1 and 2 were collected by the Center for Chinese Agricultural Policy (CCAP) from 2000 to 2018, which helps to maintain the consistency of measuring key variables (e.g., land rental activities based on plot level by the household, agricultural tax, agricultural subsidies, output price support and land characteristics). Individual enumerator collects all of the survey information face to face at the farmer's home. The land characteristics (e.g., soil quality, whether irrigated, the terrain of plot, plot size, etc) were reported by the respondent. For details of the sampling approach of Datasets 1 and 2, see Wang et al. (2016) and Sheng et al. (2019), respectively. Combining two primary survey datasets enables us to have more regional and time period coverages and larger variation in incentive policies. This is important because agricultural tax and its elimination year normally differed by province, and the standard of agricultural subsidy (yuan/ha) varied mainly among counties. Even the output price support policy is nationwide uniformed for the same agricultural commodity, the supporting crops differ largely among the survey samples due to the large geographic coverage of this study.

Dataset 1 is from a randomly selected sample of 3263 households from 216 villages in 42 counties in 7 provinces. The surveys were conducted by CCAP in 2000, 2009, 2013, 2016, and 2018. The first three waves of panel household surveys in 2000, 2009 and 2013 included Hebei, Hubei, Liaoning, Shaanxi, Sichuan and Zhejiang. These provinces represent 6 of 8 major agricultural production regions in China. In the fourth and fifth waves of the surveys, Guangdong province was added to represent South China with the same sampling approach used in the previous surveys.

Dataset 2 is also from a randomly selected sample of 845 households from 84 villages in 21 counties in 6 provinces. A stratified random sampling approach was employed to choose farm households in Heilongjiang, Liaoning and Jilin in Northeast China, and Hebei, Henan and Shandong in North China in 2013. Except for Hebei and Liaoning that did not continue due to the research budget constraint, the follow up surveys of the same rural households were conducted in the other 4 provinces in 2016.

Datasets 1 and 2 have detailed information on characteristics of land and rental price by plot. These include soil quality, whether irrigated, the terrain of plot, plot size, etc. When the land use rights transfer occurred, the rental price in the first year by plot was collected. In some cases where the rent was paid in kind (e.g., grain), we converted it into cash using the farm gate procurement price[7]. For the cases where the land use rights transfer occurred among the relatives or friends without payment, these samples were excluded in this study[8].

On the incentive policy measurements, we generate each of the policy variables at the decision level that the corresponding policy was made. For example, agricultural tax and fees reform during 2000–2003 and actual decision to reduce agricultural tax and eventually eliminate it during 2004–2006 were made at provincial level, we collected agricultural tax reform policy data at provincial level. The data on the provincial agricultural tax and fees are from the Ministry of Finance (Finance Yearbook of China, 2000–2007) and the Ministry of Agriculture (China Agriculture Yearbook, 2000–2003), respectively. To measure agricultural tax policy (yuan/ha), we divide total agricultural tax and fees with total cultivated land by province, the latter is from the National Bureau of Statistics of China (China Statistical Yearbook, 2000–2019).

On agricultural subsidy policy, based on the nature of actual policy implementation discussed above, we measure it as amount of subsidy per hectare cultivated land (yuan/ha) at county level. The data were collected during each round of surveys. Subsidies include the grain, high-quality seed and agricultural input subsidies before 2016 and aggregated subsidy since 2016.

On output price support policy, the decision on either the minimal procurement prices for rice and wheat or the procurement price of other crops under temporary procurement and storage program have been always made at the national level, and the same price of each crop in each year had been applied to all provinces during the policy implementation period, the data presented in Table 1 are used in this study.

For the period when the output price support policy was not implemented, average farm gate price (or market price) by province is used, which is from National Compilation of Cost and Revenue in Agricultural Production (2000–2019), National Development and Reform Commission of China. Because the crops planted by farmers differed, we generated the prices for each household based on the largest crop planted by farmers in each village (based on Datasets 1 and 2). Finally, because the primary crop (the most important crop) differ among villages, all crop prices are standardized in the base year (1999) with 1 for the price in 1999.

4.2. Descriptive analyses

Based on the data discussed above, Table 2 presents a summary of all variables generated and used in the empirical analysis of this study. During 1999–2018, average rental price of 7122 plots was 7334.63 yuan/ha (at 2018 price, or about 1083 USD with official exchange rate of 6.62 yuan/USD in 2018). The large standard deviation indicates that the rental prices varied significantly over time and among plots (to be discussed later). About half of rental plot had the median soil quality and nearly one third had the high soil quality. There were 72% rental plots that could be irrigated. More than 80% land rental plots were recorded in the plain region (Table 2).

Data on the average agricultural tax presented in Fig. 3 are consistent with agricultural tax reform during 2000 and 2006. The average agricultural tax reached 1443 yuan/ha in 1999, had decreased gradually during agricultural tax and fees reform in 2000–2003 and fully eliminated since 2006. Heilongjiang and Jilin were the first provinces to eliminate agricultural tax in 2004, then followed by Guangdong, Henan, Hubei, Liaoning, Shaanxi, Sichuan and Zhejiang in 2005. Hebei and Shandong were the final provinces that phased out agricultural tax in 2006.

Fig. 3 also shows agricultural subsidy in our studied counties since 2004. On the average, agricultural subsidy increased from 552 yuan/ha in 2004 to a peak of 1252 yuan/ha in 2013, and then fell to 1114 yuan/ha in 2018, which follows well the trend of the national subsidy data presented in Fig. 2.

Fig. 4 shows several interesting observations on the land rental prices during 1999–2018. For the whole study period, the average land rental prices increased from 3008 yuan/ha in 1999 to 7376 yuan/ha in 2018

Table 2
Definitions and summary statistics of land rental prices, incentive policies and characteristics of rental plots, 1999–2018. Source: Authors' calculations.

Variable	Definition	Mean	Std. Dev.
Land rental prices [a]	Land rental prices at plot-level (yuan/ha)	7334.63	4630.11
Agricultural tax [a]	Agricultural tax rate at provincial level (yuan/ha)	132.29	511.08
Agricultural subsidy [a]	Agricultural subsidies at county level (yuan/ha)	1051.01	690.05
Output price support [a, b]	Output support price of the crop with the largest crop area in the village, in real term and standardized in 1999 (1999 = 1)	1.27	0.27
Low quality	=1 if soil quality of plot is poor; 0 otherwise	0.17	0.38
Median quality	=1 if soil quality of plot is median; 0 otherwise	0.51	0.50
High quality	=1 if soil quality of plot is high; 0 otherwise	0.32	0.47
With irrigation	=1 if plot with irrigation; 0 otherwise	0.72	0.45
Plain	=1 if located in plain; 0 otherwise (or in mountain)	0.83	0.38
Plot size	Plot size (ha)	0.98	2.67

Note 1: Total sample is 7122.
Note 2: 'a' indicates all values are measured in real 2018 price deflated by the rural consumer price index from the China Statistical Yearbook (2000–2019), NBSC.
Note 3: 'b' indicates the output price support are standardized in 1999 (i.e., set 1999 = 1).

[7] Among all rental agreements, 7.1% were in-kind, 67.6% were among relatives and friends. Higher percentages among relatives and friends are due to the facts that most rental activities are occurred within villages and that many people are relatives or friends in the same village in China.

[8] Among all transfers of land use rights, 18.1% were the transfer occurred among the relatives or friends without payment.

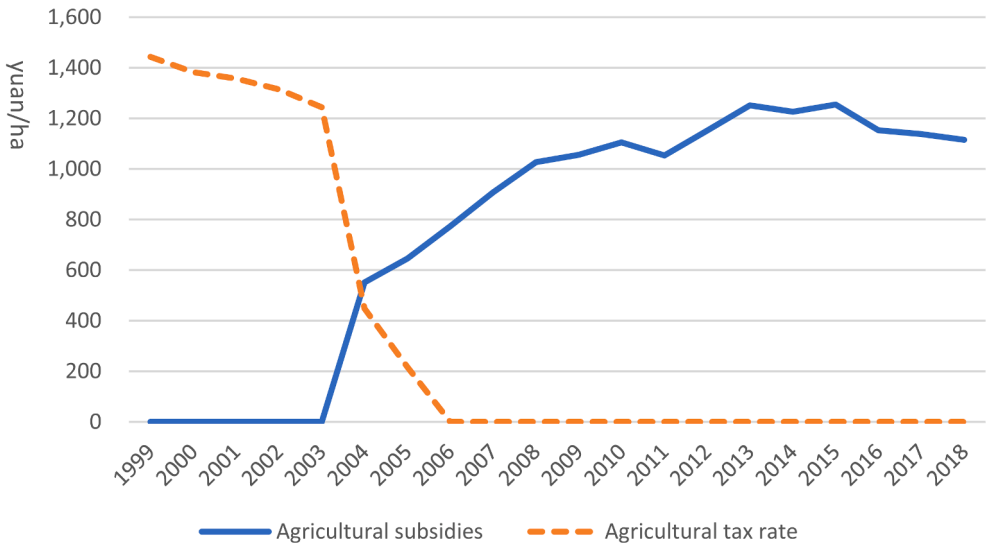

Fig. 3. Average agricultural tax and subsidy (yuan/ha in 2018 price) in 11 provinces studied, 1999–2018. Source: Authors' calculations.

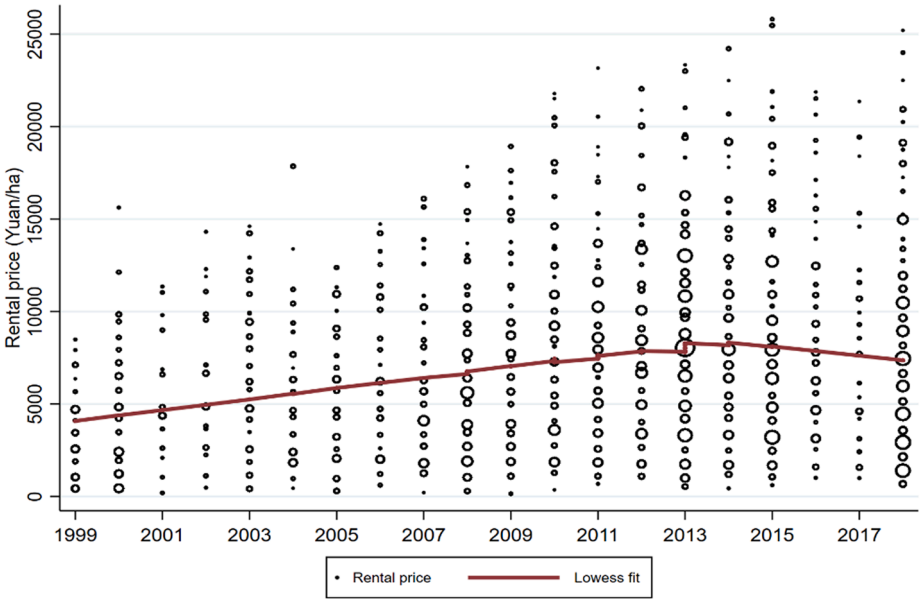

Fig. 4. Land rental prices (yuan/ha in 2018 price) based on the survey data, 1999–2018. Note: The size of circle represents the number of observations at the rental prices around the circle center. Sources: Authors' survey based on Datasets 1 and 2.

based on LOWESS fit line.[9] However, the rising trend of land rental prices had been reversed since 2014, which is consistent with the reduction in the supporting prices in real terms after 2013 (Table 1). The gradual increase of rental prices before 2014 had been accompanied with the reduction of agricultural tax before 2004 and elimination the tax as well as shifting from taxing agriculture to subsidizing agriculture after 2004. But based on our theoretical analysis presented in the previous section, agricultural subsidy provided to the land contractor in the case of China is not expected to have impact on the land rental price.

Fig. 4 also shows a wide variation of the land rental prices in each year. This large variation could be due to the facts that the sample has a large geographic coverage from North to South China and from East to West China and that the productivity of plots varies with the soil quality and other plot specific characteristics (Table 2). The actual effects of these on the land rental prices will be analyzed in the following econometric analysis.

4.3. Empirical model specification and identification strategy

According to the theoretical models in Equations (6)-(8), changes in land rental prices are affected by agricultural incentive policies. In addition, the plot characteristics may also affect land rental prices (Kirwan, 2009). Therefore, the empirical model used in this study is specified as:

$$R_{ijkt} = \alpha + \beta_1 T_{kt} + \beta_2 D_{jkt} + \beta_3 P_{t/t-1} + \sum_{l=1}^{4} \gamma_l Z_{ijkt} + \delta V_v + \varepsilon_{ijkt} \quad (9)$$

where dependent variable R_{ijkt} is the land rental prices (yuan/ha) of i^{th} plot in j^{th} county of k^{th} province in year t; T is agricultural tax (yuan/ha)

[9] We use the Locally Weighted Scatterplot Smoothing (LOWESS) method to draw the fit line.

in k^{th} province in year t; D is agricultural subsidy (yuan/ha) in j^{th} county of k^{th} province in year t; and $P_{t/t-1}$ is output price support at year t when the output price support policy was in effective, otherwise one-year lag market price of farm output is used. Z is a vector of plot-specific variables that may potentially affect plot-level land rental prices, including soil quality, whether irrigated, the terrain of the plot and plot size (see Table 2). V_v is village dummies used to control for spatial variations among sample villages (or village fixed effect estimation is used).[10] ε_{ijkt} is the error term.[11] Finally, because samples differ among provinces and over time after we merged Datasets 1 and 2, we estimate the above model with and without sample weights. To do this, each province has the same weight, but the samples from each province in each year have different weights based on the numbers of households surveyed in each province in each year.

To identify the capitalization effect of agricultural incentive policies into land rental price, we must address several identification issues, which are simultaneity, omitted variable bias, measurement errors, and sample selection bias. The nature of three major agricultural incentive policies and the unique plot-level data used in this study help us overcoming these identification challenges.

The decision-making process and implementation of each of all three agricultural incentive policies in China have ensured that these policy variables are exogenous to local land rental prices. As discussed above, agricultural tax was almost uniform for all rural households within a province. Agricultural subsidies were allocated to rural households based on the area of the household contract land regardless its land quality and cropping pattern. The subsidy standard was set at the county level. The total amount of subsidies to each county was determined by the central and provincial government. Aggregate national subsidy depended on China's commitment to subsidize agriculture subject to budget availability. The output price support for all commodities were determined by the central government and were uniform for all rural households in China.

On the omitted variable issue, following Livanis et al. (2006), we have attempted to overcome this issue by including major land characteristics that have effect on land productivity. These include soil quality, whether irrigated, the terrain and size of the plot in Equation (9). In addition, in estimation Equation (9), as mentioned above, we use the village fixed effect estimation to control for unobservable and time invariant factors among villages.

Aggregate measurement errors have been largely controlled in this study. The benefit of using plot-level data is the ability to accurately measure the rental price and plot-level observable characteristics, which could avoid the aggregation error-induced bias and measurement error in the dependent variable (Kirwan and Roberts, 2016). Another important source of measurement error is the expectation errors of expected policies in the future (Lence and Mishra, 2003; Roberts et al., 2003). Agreed rental prices of land are based on farmers' unobservable expectations about changes in future policies (Allen Klaiber et al., 2017). On one hand, following Patton et al. (2008) and Kirwan and Roberts (2016), the amounts of agricultural tax and subsidies in China were known with certainty beforehand. On the other hand, the output price support for major commodities were released before crop production in China; moreover, the period of rental contract is normally short. In our sample, the lease term for most plots is one year, while average land rental period was only 4.6 years.

Last but not least, there could be sample selection bias because a significant share of the survey farm households did not participate in the land rental market (Kirwan, 2009; Ciaian and Kancs, 2012). To deal with this issue, we use a Heckman Selection Model to examine this potential sample selection bias. The first stage includes both characteristics of farm household (e.g., non-agri. employment which means the percentage of labors worked off-farm) and plot[12], which likely affect the propensity to rent land. The second stage excludes non-agri. employment as the land rental price is primarily determined by the characteristics of plot (Kirwan, 2009). The results of Heckman selection estimation are reported in Appendix A. Based on exclusion restrictions, the likelihood ratio test fails to reject the null hypothesis that the error terms from the selection (the propensity to rent land) and regression (the plot-level rental prices) equations are uncorrelated[13]. Indeed, selection bias has generally been implicitly assumed to be absent in much of the literature (O'Neill and Hanrahan, 2016), exceptions used Heckman two-stage estimation approach to correct selection bias and found that the unobservable factors influencing the probability of participation in the farmland rental market is not likely to be associated with the change of farmland rental prices in America, China, Germany, Italy, and New EU Member States (see Kirwan, 2009; Ciaian and Kancs, 2012; Allen Klaiber et al., 2017; Guastella et al., 2018; Zhang et al., 2020, for example). Furthermore, the statistical significance of agricultural tax, subsidy and output price support remains the same as the results reported below, demonstrating its robustness to this specification (see Appendix A).

5. Estimation results

5.1. Econometric estimation results

Table 3 presents the estimation results of the impact of agricultural incentive policies on land rental prices. The first two columns are based on whole data set of 7122 plots during 1999 and 2018. As robustness checks, we also estimated the model based on the data after elimination agricultural tax during 2004/2006–2018 (columns 3 and 4, Table 3). Overall, the models performed well in terms of both the values of F test (1% statistically significant) and R-squared (about 0.63). The estimated coefficients for all plot specific variables also have expected sigh and about half of them are statistically significant. The major findings on the impacts of agricultural incentive policies on the rental price are summarized as below.

First, eliminating agricultural taxes has a significant positive effect on the land rental prices. Whether adopting sample weights or not, we find that the estimated coefficient for agricultural tax policy is significantly negative (row 1, columns 1 and 2, Table 3), which confirms Proposition 1 presented in Section 3. The coefficients of agricultural tax variable (−0.60 and −0.61) indicate that, holding everything else constant, each yuan reduction in agricultural tax per hectare can raise the land rental price by 0.60 yuan/ha. This result suggests that the falling agricultural tax during 1999–2004 and eliminating agricultural tax during 2004 and 2006 had significantly contributed to the gradual rise of land rental price during 1999–2006 (Fig. 4). We will examine the extent of this impact in the decomposition analysis presented later.

[10] It would be more powerful if we could estimate the empirical model with household or plot fixed effect. However, our data do not allow us to run these fixed models at household or plot level. The village fixed effect is the lowest level that we can empirically estimate the model.

[11] Because the rental contract types may also be associated with rental prices, we also estimated the model with types of rental arrangements such as in-kind (vs in-cash) and among relatives/friends (vs otherwise). The estimated parameters of these rental arrangements are statistically significant, and all other estimated parameters of three key incentive policy variables are similar between with and without including rental types. However, we do not present the results of estimation with rental type variables because the rental contract types are likely endogenous and bad controls in this rental price model (see Angrist and Pischke, 2009).

[12] Following Kirwan (2009), we also estimated Heckman Selection Model with several additional farm household's characteristics such as average age, male share and the highest education level of agricultural labors, percentage of population over 60 years, and percentage of labors worked off-farm.

[13] Although we also estimated the model with the additional variables of farm household's characteristics, the Inverse Mills Ratio (IMR) in the Heckman Selection Model is still not significant.

Table 3
The estimation results of land rental prices with the village fixed effect models. Source: Authors' calculations.

Dependent variable: land rental price	1999–2018		2004/2006–2018	
	Without sample weights	With sample weights	Without sample weights	With sample weights
Agricultural tax	−0.60***	−0.61***	—	—
	(0.08)	(0.09)		
Agricultural subsidy	−0.06	−0.03	0.17	0.19
	(0.09)	(0.10)	(0.12)	(0.13)
Output price support	1023.88***	1013.56***	1241.68***	1345.34***
	(211.08)	(220.49)	(232.00)	(244.40)
Median quality	129.12	236.40**	44.34	126.18
	(105.38)	(116.73)	(115.86)	(129.78)
High quality	337.83***	413.33***	293.94**	328.88**
	(120.38)	(131.55)	(130.10)	(143.37)
With irrigation	198.48*	203.26*	71.03	88.06
	(111.96)	(111.64)	(124.92)	(122.23)
Plain	479.38***	413.23***	453.87***	374.86**
	(131.42)	(139.50)	(146.70)	(155.60)
Plot size	24.08*	39.13**	12.14	21.59
	(13.88)	(17.27)	(14.12)	(17.52)
Constant	−196.33	−261.39	−657.96*	−825.00**
	(319.37)	(331.30)	(352.54)	(372.39)
Observations	7122	7122	6239	6239
F test	41.12***	40.49***	38.41***	37.54***
R-squared	0.63	0.63	0.64	0.63

Note 1: The village effect estimation is used and the robust standard errors are in parentheses. Because the sample differed among provinces and over years due to combining Datasets 1 and 2, we also estimate the model with and without sample weights. The weights are based on the numbers of households surveyed in each province in each year.
Note 2: '*' indicates $p < 0.10$, '**' indicates $p < 0.05$, '***' indicates $p < 0.01$.

Second, agricultural subsidies have no effect on land rental prices in China. The estimated coefficients of agricultural subsidy variable are statistically insignificant (row 2, Table 3). This result confirmed with our theoretical expectation presented in Proposition 2. That is, if only landowner or land contractor receives agricultural subsidies, agricultural subsidy policy has no impact on the land rental prices. But the result differs from the empirical findings in other countries (e.g., the United States and European countries as we discussed above).

Third, output price support has a significant positive effect on the land rental prices. The estimated coefficient for the output price support variable for whole period suggests additional one unit rise in the support price (standardized with 1 in 1999) can increase the land rental price by 1014 yuan/ha during 1999–2018 and 1345 yuan/ha during 2004/2006–2018 (row 3, columns 2 and 4, Table 3). While the significant impact of output price support policy in China is what we should expected as Proposition 3 has showed, the magnitude of the impact is substantially large than the empirical studies conducted in other countries discussed early.

The large difference on the impacts of agricultural incentive policies on land rental prices between China and other countries is an interesting issue. In the empirical literature, it is often found that agricultural subsidies have significant positive effect on the land rental prices in the United States and European countries (see Kirwan, 2009; Ciaian and Kancs, 2012; Kirwan and Roberts, 2016; O'Neill and Hanrahan, 2016, for example), and the output price support does not significantly affect the land rental prices in the United States. Indeed, the method of implementing agricultural incentive policy matters in its impact on land rental price. Agricultural subsidy policy in China is implemented in a decoupled way. The subsidy is provided to the landlord or the land contractor in China, rather than the land operator in the cases of the United States and EU countries. China's agricultural subsidy is similar to income transfer policy and therefore it does not affect the land rental price. On output price support policy, the policy is mainly implemented for rice, wheat and maize in China. International trades of these commodities are subject to import quota. While the tariff for the import within the quota (5.3 million ton for rice, 9.3 million ton for wheat, and 7.2 million ton for maize) is only 1%, the import exceeding the quota is subject to above-quota tax (65%). Under this trade policy regime, the increased cereal production due to its output price support policy can significantly reduce cereal import. In the United States, loan deficiency payments (LDP) and marketing assistance loans (MAL) is linked to both current production and current market prices, which paid producers the difference between the market price and the output support price (loan rate). While market loss assistance (MLA) and counter-cyclical payments (CCP) are triggered by low market prices falling beneath a legislatively defined target price, which is paid only on a historical base acreage but not tied to current production. It is the fact that output price supports are tied to historical production patterns implied a lack of planting flexibility for producers.

5.2. Decomposition of the change of land rental price due to the incentive policies

In this sub-section, we use the estimated coefficients of agricultural incentive policy variables presented in Table 3 (column 2) and changes in the policies to calculate the extend of agricultural tax elimination and output price support policy on land rental price in China. To do this, we divide the whole study period into three sub-periods, 1999–2004/06 (the period with rising land rental price before complete elimination of agricultural tax), 1999–2014 (the period with the rising land rental price and shifting taxing to subsidizing agriculture), and 2014–2018 (the period with the falling land rental prices and weakening agricultural incentive policies). A summary of decomposition analysis for each period is presented in Table 4.

Table 4 shows that the reduction and the final elimination of agricultural tax contributed to about 50% of land rental price increase during 1999–2004/2006. During this period, the average land rental price increased by 2054 yuan/ha (or 67%), of which 1031 yuan/ha (or 50%) was the result of the reduction and elimination of agricultural tax (−1698 yuan/ha). The impact of output price support policy was very moderate (31 yuan/ha or 2%, Table 4) in this period because this policy was just initiated for rice in 2004–2006 (Table 4).

Table 4
Impacts of agricultural tax and output price support policies on the changes of land rental prices during 1999–2018. Source: Authors' calculations.

		Agri. tax	Price support	Total
1999–2004/06				
Estimated coefficient	(1)	−0.61	1013.6	
Change in policy variable	(2)	−1698.0	0.03	
Rental price changes (Percent %)	(3)=(1)*(2)	1031.0 (50)	30.73 (2)	2053.6 (100)
1999–2014				
Estimated coefficient	(1)	−0.61	1013.6	
Change in policy variable	(2)	−1698.0	0.54	
Rental price changes (Percent %)	(3)=(1)*(2)	1031.0 (19)	543.3 (10)	5436.6 (100)
2014–2018				
Estimated coefficient	(1)	−0.61	1013.6	
Change in policy variable	(2)	0	−0.34	
Rental price changes (Percent %)	(3)=(1)*(2)	0 (0)	−343.4 (30)	−1148.7 (100)

Note 1: Estimated coefficients are based on Table 3, column (2).
Note 2: Figures in the parentheses are the percentage changes of land rental prices.

Expanding the analysis to the entire land rental price rising period in 1999–2014, while the total contribution of agricultural incentive policies to land rental price fell, agricultural tax elimination and output price support policy still accounted for 29% of the total increase in land rental price rise (Table 4). During this period, land rental price increased by 5436.6 yuan/ha (or 181%). Of which, agricultural tax elimination and output price support policy contributed 19% and 10%, respectively. While not showed in this paper, a large resident (100–29%) in the decomposition analysis also suggest that demand for renting in land exceeded the supply of land in the rental market during 1999–2014. This is evidenced from several existing studies that showed the rising trend of new-type agricultural production entities (*nongye shengchang xinxing zhuti* in Chinese) entering agricultural production (Huang and Ding, 2016; Cheng et al., 2019), which often pushes up land rental price (Du and Han, 2020).

The fall in the output support price explained more than one third of the decrease in land rental prices during 2014–2018. During this period, land rental price declined by −1148.7 yuan/ha (or about 13%), of which the change in intervention price (−0.34) contributed 30% of the total rental price change (Table 4). We expect that the rental price could fall further if the output support price policy for rice and wheat would be phased out in the future. It is also interesting to note that some of the new-type agricultural production entities from the outside of villages have started to withdraw from crop production when they realized that crop production is not always profitable business for them (Cai and Du, 2020).

6. Conclusion remarks and policy implications

While the effects of agricultural subsidy and output price support policies on land rental prices have been extensively studied in the literature, there is little knowledge on how agricultural incentive policies (especially agricultural tax and subsidy policy) affect land rental prices in developing countries. In the literature, it is also often assumed that land tillers receive agricultural subsidies in the theoretical and empirical analyses. This paper systematically examines the expected impacts of agricultural incentive policies, including agricultural tax, subsidy and output price support policies on land rental prices, and then empirically analyzes their impacts using a unique dataset of rental plots in China between 1999 and 2018.

The paper generates several major conclusions. On one hand, the output price support policy in theory has a positive impact on land rental price, while the impact of agricultural tax and subsidy policies on land rental price depends on farmers who really pay the tax and receive the subsidy. For example, if the land tiller or land operator pays the agricultural tax and receives the agricultural subsidy, both agricultural tax elimination and subsidy implementation have a positive impact on the observable land rental price. Otherwise, if the land tiller or land operator does not pay any agricultural tax and receive any agricultural subsidy, both agricultural tax and subsidy policy have no effect on land rental price. On the other hand, the empirical results show that eliminating agricultural tax has a significant positive impact on land rental price, while agricultural subsidies in China do not affect land rental price, and the output price support policy also has a significant positive impact on land rental price. Overall, agricultural incentive policy changes have significantly contributed the land rental price change in the past two decades, either during the rising or falling rental price period in China. While the empirical findings on the impacts of agricultural subsidy and output price support policies on land rental price in this study differ largely from the previous findings in developed countries, we explain that these differences are due to the different approaches to implement agricultural subsidy and output price support policies between China and other countries (e.g., the United States and EU countries), and that the country's agricultural trade policy matters.

The results of this study have several policy implications. Firstly, in many developing countries, agricultural tax often is an important source of government fiscal income. However, agricultural tax not only has direct effects on farmers' income and agricultural production, but also have indirect effect on them through its impacts on land rental price. For the countries levied agricultural tax based on cultivated land, how this indirect effect on landlord and tillers depends on who actually pay for the tax. Secondly, although agricultural subsidy is mainly aimed to raise farmers' income, if the policy is implemented in a decoupled way even it is based on the land areas such as the case in China, the subsidy can still avoid its distortions to not only output market but also land rental price. This has an implication for many countries on how to subsidize agriculture when they will shift from taxing agriculture to subsidizing agriculture in the future. Finally, while output price support policy has little effect on land rental price as it found in many developed countries without tariff rate quota (TRQ) in agricultural imports in the literature, for the countries with TRQ in major agricultural imports, output price support policy affects not only output price, but also land rental price that has important implications for land rental market and land consolidation.

CRediT authorship contribution statement

Wensheng Lin: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing, Funding acquisition. **Jikun Huang:** Conceptualization, Methodology, Validation, Project administration, Writing – review & editing, Funding acquisition.

Acknowledgments

The authors acknowledge the financial supports from the National Natural Science Foundation of China (No. 71934003) and the China Postdoctoral Science Foundation (No. 2019 M650010).

Appendix A. . Heckman selection model

Results of Heckman Selection Estimation with the village fixed effect model.
Source: Authors' calculations.

	A. Selection		B. Land rental prices	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Agricultural tax	0.0001***	0.00001	−0.52***	0.08
Agricultural subsidy	0.0001***	0.00001	−0.22	0.14
Output price support	0.6779***	0.02970	909.82**	366.49
Non-agri. employment	0.0040***	0.00013	—	—
Median quality	−0.0272*	0.01515	176.46*	105.53

(*continued on next page*)

(*continued*)

	A. Selection		B. Land rental prices	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
High quality	0.0259	0.01650	337.75***	121.14
With irrigation	0.1356***	0.01535	114.92	129.63
Plain	0.0653***	0.01732	482.81***	134.53
Plot size	0.0370***	0.00215	−4.18	21.53
Constant	−2.8863***	0.2387***	2,184.99	1,710.51
ρ			−0.31	0.18
σ			2,937.39	160.10
λ			−911.33	573.54

Note: '*' indicates $p < 0.10$, '**' indicates $p < 0.05$, '***' indicates $p < 0.01$.

References

Allen Klaiber, H., Salhofer, K., Thompson, S.R., 2017. Capitalisation of the SPS into agricultural land rental prices under harmonisation of payments. J. Agric. Econ. 68 (3), 710–726.

Angrist, J.D., Pischke, J.S., 2009. Mostly Harmless Econometrics: An Empiricist's Companion. Princeton University Press.

Breustedt, G., Habermann, H., 2011. The incidence of EU per-hectare payments on farmland rental rates: a spatial econometric analysis of German farm-level data. J. Agric. Econ. 62 (1), 225–243.

Cai, Y., Du, Z., 2020. The influence of the adjustment of temporary corn collection and storage policy on the land rent of family farms. China Rural Surv (in Chinese). 3, 114–129.

Cheng, W., Xu, Y., Zhou, N., He, Z., Zhang, L., 2019. How did land titling affect China's rural land rental market? Size, composition and efficiency. Land Use Pol. 82, 609–619.

Choi, E.K., Johnson, S.R., 1993. Impacts and incidence of agricultural commodity programs. Econ. Dev. Cult. Change. 41 (3), 605–621.

Ciaian, P., Kancs, D., 2012. The capitalization of area payments into farmland rents: Micro evidence from the New EU Member States. Can. J. Agric. Econ. 60 (4), 517–540.

Ciaian, P., Kancs, D., Espinosa, M., 2018. The impact of the 2013 CAP reform on the decoupled payments' capitalisation into land values[J]. J. Agric. Econ. 69 (2), 306–337.

Ciaian, P., Swinnen, J.F.M., 2006. Land market imperfections and agricultural policy impacts in the New EU Member States: A partial equilibrium analysis. Am. J. Agr. Econ. 88 (4), 799–815.

Dinterman, R., Katchova, A.L., 2020. Property Tax Incidence on Cropland Cash Rent. Appl. Econ. Perspect. Policy. 42 (4), 739–758.

Du, Z., Han, L., 2020. The impact of production-side changes in grain supply on China' s food security. Chinese Rural Econ (in Chinese). 4, 2–14.

Floyd, J.E., 1965. The effects of farm price supports on the returns to land and labor in agriculture. J. Polit. Econ. 73 (2), 148–158.

Graubner, M., 2018. Lost in space? The effect of direct payments on land rental prices. Eur. Rev. Agric. Econ. 45 (2), 143–171.

Guastella, G., Moro, D., Sckokai, P., Veneziani, M., 2018. The capitalisation of CAP payments into land rental prices: A panel sample selection approach. J. Agric. Econ. 69 (3), 688–704.

Guyomard, H., Le Mouël, C., Gohin, A., 2004. Impacts of alternative agricultural income support schemes on multiple policy goals. Eur. Rev. Agric. Econ. 31 (2), 125–148.

Hendricks, N.P., Janzen, J.P., Dhuyvetter, K.C., 2012. Subsidy incidence and inertia in farmland rental markets: Estimates from a dynamic panel. J. Agric. Resour. Econ. 37 (3), 361–378.

Huang, J., Ding, J., 2016. Institutional innovation and policy support to facilitate small-scale farming transformation in China. Agric. Econ. 47 (S1), 227–237.

Huang, J., Yang, G., 2017. Understanding recent challenges and new food policy in China. Glob. Food Secur.-Agric.Policy. 12, 119–126.

Huang, J., Wang, X., Zhi, H., Huang, Z., Rozelle, S., 2011. Subsidies and distortions in China's agriculture: evidence from producer-level data. Aust. J. Agr. Resour. Econ. 55 (1), 53–71.

Huang, J., Wang, X., Rozelle, S., 2013. The subsidization of farming households in China's agriculture. Food Policy. 41, 124–132.

Kilian, S., Antón, J., Salhofer, K., Röder, N., 2012. Impacts of 2003 CAP reform on land rental prices and capitalization. Land Use Pol. 29 (4), 789–797.

Kirwan, B.E., 2009. The incidence of U.S. agricultural subsidies on farmland rental rates. J. Polit. Econ. 117 (1), 138–164.

Kirwan, B.E., Roberts, M.J., 2016. Who really benefits from agricultural subsidies? Evidence from field-level data. Am. J. Agr. Econ. 98 (4), 1095–1113.

Kropp, J., Peckham, J.G., 2015. US agricultural support programs and ethanol policies effects on farmland values and rental rates. Agric. Finance Rev. 75 (2), 169–193.

Latruffe, L., Le Mouël, C., 2009. Capitalization of government support in agricultural land prices: What do we know? J. Econ. Surv. 23 (4), 659–691.

Leathers, H.D., 1992. The market for land and the impact of farm programs on farm numbers. Am. J. Agr. Econ. 74 (2), 291–298.

Lence, S.H., Mishra, A.K., 2003. The impacts of different farm programs on cash rents. Am. J. Agr. Econ. 85 (3), 753–761.

Liu, M., Xu, Z., Su, F., Tao, R., 2012. Rural tax reform and the extractive capacity of local state in China. China Econ. Rev. 23 (3), 190–203.

Livanis, G., Moss, C.B., Breneman, V.E., Nehring, R.F., 2006. Urban sprawl and farmland prices. Am. J. Agr. Econ. 88 (4), 915–929.

Michalek, J., Ciaian, P., Kancs, D., 2014. Capitalization of the single payment scheme into land value: Generalized propensity score evidence from the European Union[J]. Land Econ. 90 (2), 260–289.

Ministry of Agriculture and Rural Affairs, 2018-2019. China Agricultural and Rural Development Report. China Agriculture Press, Beijing.

Ministry of Agriculture, 2005-2017. China Agricultural Development Report. China Agriculture Press, Beijing.

Ministry of Agriculture, 1999-2003. China Agriculture Yearbook. China Agriculture Press, Beijing.

Ministry of Agriculture, 2000-2003. China Agriculture Yearbook. China Agriculture Press, Beijing.

Ministry of Finance, 2000-2007. Finance Yearbook of China. China State Finance Magazine, Beijing.

Ministry of Finance, 2006. Finance Yearbook of China. China State Finance Magazine, Beijing.

Ministry of Finance, 2009. Finance Yearbook of China. China State Finance Magazine, Beijing.

National Bureau of Statistics of China, 1999-2007. China Statistical Yearbook. China Statistical Press, Beijing.

National Bureau of Statistics of China, 2000–2019. China Statistical Yearbook. China Statistical Press, Beiijing.

National Bureau of Statistics of China, 2005-2019. China Statistical Yearbook. China Statistical Press, Beijing.

National Development and Reform Commission, 2000-2019. National Compilation of Cost and Revenue in Agricultural Production. China Price Press, Beijing.

O'Neill, S., Hanrahan, K., 2016. The capitalization of coupled and decoupled CAP payments into land rental rates. Agric. Econ. 47 (3), 285–294.

Patton, M., Kostov, P., McErlean, S., Moss, J., 2008. Assessing the influence of direct payments on the rental value of agricultural land. Food Policy. 33 (5), 397–405.

Roberts, M.J., Kirwan, B., Hopkins, J., 2003. The incidence of government program payments on agricultural land rents: The challenges of identification. Am. J. Agr. Econ. 85 (3), 762–769.

Salhofer, K., Feichtinger, P., 2021. Regional differences in the capitalisation of first and second pillar payments of the CAP into land rental prices. Eur. Rev. Agric. Econ. 48 (1), 8–41.

Sheng, Y., Ding, J., Huang, J., 2019. The relationship between farm size and productivity in agriculture: evidence from maize production in Northern China. Am. J. Agr. Econ. 101 (3), 790–806.

Van Herck, K., Swinnen, J., Vranken, L., 2013. Capitalization of direct payments in land rents: evidence from New EU Member States. Eurasian Geogr. Econ. 54 (4), 423–443.

Wang, X., Yamauchi, F., Otsuka, K., Huang, J., 2016. Wage Growth, landholding, and mechanization in Chinese agriculture. World Dev. 86, 30–45.

Wineman, A., Jayne, T.S., 2018. Land prices heading skyward? An analysis of farmland values across Tanzania. Appl. Econ. Perspect. Policy. 40 (2), 187–214.

Xin, L., Li, X., 2019. Rental rates of grain land for consolidated plots and their determinants in present-day China. Land Use Pol. 86, 421–426.

Zhang, J., Mishra, A.K., Hirsch, S., Li, X., 2020. Factors affecting farmland rental in rural China: Evidence of capitalization of grain subsidy payments. Land Use Pol. 90, 1–10.