Regional Economic Consequences of the Chinese Agricultural Support Policies

Can Wang*, Mahinda Siriwardana** and Xianming Meng***

Abstract

The Chinese government has implemented comprehensive domestic agricultural support policies to stimulate agricultural production for almost one decade. However, there is surprisingly little literature on its economic impact, particularly at the regional level. Using a multi-regional comparative static computable general equilibrium model, we estimate the spatial economic consequences of these policies for all 31 provinces/municipalities under the agricultural resource constraints in China. Our results show that, under the pressure of its scarce and progressively degrading natural resource base, the agricultural support policies ultimately push up production costs in all sectors and erode the international competitiveness of export-oriented industries.

Keywords: China; agricultural policies; SinoTERM model; regional economic consequences

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1. Introduction

Crops production costs in China have been driving up by scarcity of agricultural land and water, rising wages and intermediate inputs prices. In order to achieve the grain self-sufficiency, a major objective of Chinese agricultural policy, the Chinese government has implemented comprehensive domestic agricultural support policies to encourage domestic agricultural production since 2004. These broad agricultural support policies are to stimulate grain production, to insulate grain and oilseed producers from import competition, to increase rural income, to enhance exports of its most internationally competitive commodities such as fruits, vegetables, and aquatic products, to improve food safety, and to diversify the rural economy and to improve rural institutions and infrastructure.

Since 2004 to 2014, the subsidies to Chinese farmers have grown year by year via a series of the domestic agricultural support policies. While, because urbanisation and industrialisation have absorbed more rural labour and land from agriculture, land rental and rural wages rising rapidly in recent years. Increases in production costs have squeezed net returns to farmers, and the subsidies made a small contribution to rural income and weak incentives to produce grains and other crops. As production costs outpaced subsidies, from 2008 to 2014, in order to maintain rural income growth and stimulate grain production, Chinese officials began aggressively raising agricultural support prices annually and purchasing large volumes of commodities. However, because the subsidy strategy distorted the domestic market price and eroded China's international competitiveness in agriculture, China becomes a relative high-cost agricultural producer in the world. In addition, the subsidy policies not only increased

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government expenditures but also resulted in domestic crops output increase, soaring state-owned stockpiles of domestic crops and imported crops increase in each year from 2008.

Moreover, the economic development of China led to structural dietary changes in the country. The demand for meat, fruits and other non-staple foods have increased sharply and this trend of food consumption has boosted enormous changes in the structure of agriculture. As a result, it will be extremely difficult for domestic agriculture to provide food, employment and income for such a large population and also activate overall development due to the scarce and shrinking agricultural resources. China is now facing challenges around how best to deal with the contradiction between economic development and environmental protection, and the management of the dwindling cultivated land and the paucity of agricultural resources for the sustainable development of agriculture with continuous pursuit of grain self-sufficiency.

A country as large as China inevitably demonstrates enormous spatial or geographical differences in the sectoral distribution of economic activities, living standards, resource base, and other determinants of income levels and income growth. Although the agricultural domestic support policies have been implemented for almost one decade, there is surprisingly little literature on its economic impact, particularly at the regional level. The existing studies of agricultural domestic support policies usually investigate its impact at the country level, not the regional level. Yu and Jensen (2010) analysed the effects of these policies using a GTAP model and showed that grain production increases, the trade balance of grain improves, and overall farm income rises in national domestic market. Using a dynamic partial equilibrium simulation model, Hansen, Tuan, and Somwaru (2011) estimated the effects of China's agricultural domestic support policies and trade policies on domestic and world commodity markets. They stated that these polices increased returns to Chinese farmers and lowered domestic prices to consumers. But, these studies have been unable to investigate regional effects of the policies. In addition, and more importantly, very little was found in the literature on the question of the impacts of China's agricultural support policies under the natural resource constraints on national and regional economies. As far as we know, our research is the first one to examine the effects of agricultural subsidy strategy in this area.

In this study, we are interested in, under the environmental and resources constraints, how the Chinese domestic agricultural support policies influence the national and regional economies of China. What are the impacts of grain imports on the national and regional economies of China, on the well-being of rural and urban household, on the agricultural and non-agricultural sectors? What are the impacts of the agricultural labour productivity growth with the limitations from the agricultural resources?

This study employs a single-country multi-regional comparative static computable general equilibrium (CGE) model — SinoTERM model (Horridge & Wittwer, 2008) — to assess the spatial economic consequences of the recent agricultural support policies for all 31 provinces/municipalities in China. Findings from this research will not only contribute to the understanding of these policy trends and their consequences but also provide useful insights into designing agricultural policies in future.

2. The Current Situation of the Chinese Agricultural Production

China's unprecedented economic growth over the past few decades under its dramatic economic transformation has been accompanied by far-reaching changes not only in the industrial structure and employment but also in the pattern of consumption. China's economic transformation and labour mobility have stimulated the urbanisation and industrialisation. Whereas, the demand for food in China has changed dramatically and expanded due to rapid urbanization, dietary adjustments, and steady population growth. With about 21 percent of the world's population, 8 percent of world's cultivated land and only 7 percent of the world's potable water, China's ability to improve agricultural productivity will have a direct effect upon not only domestic market but also international food markets. However, the agricultural sector in China has had to struggle with the challenges of its scarce and progressively degrading natural resource base and rising input costs to maintain or improve productivity growth of most major agricultural goods production.

2.1. The Scarcity of Agricultural Resources and Deterioration of Natural Environment

Although China is the third largest country in the world, only about 14.8% of land is cultivated with field crops and horticultural products. The average cultivated land was only 0.106 hectares per capita; much less than the world average of 0.236 hectares. Thus the agricultural production in China is still primarily traditional household farming economy with little modernisation. Although the Chinese government set a "red line" on arable land at no less than 120 million hectares and conversion of farmland for non-agricultural use is strictly controlled, since food security is the top priority for the government, the arable land still shrank rapidly because of persistent increase in land demand for housing and industrial purposes. The arable land shrank from 130 million hectares in 1996 to 121.73 million hectares in 2007 (Chen, 2009). In recent years, China's food crops production can barely rely on the western and northern areas since all regions with rapid economic development are where arable land and grain output have decreased, i.e., the more developed areas are the more the arable land and grain production decrease.

Another serious problem in agricultural sector is the uneven distribution of water and land resources in China, namely, regions with adequate land are short of water and vice versa. The developed southeast coastal areas endow plentiful water, soil, and heat and light, which are the necessary growing conditions for field crops. However, because these areas are the fast economic growing regions in China, the farmland and grain output substantially declined in those areas. Data from China's second land survey released in December 2013 by the Ministry of Land and Resources of China (hereafter MLR) show that the proportions of arable land in the central, western, and northeast China are 22.7%, 37.3%, and 20.6% respectively. These areas have to play a key role for grain production, although they are all faced with the scarcity of water and the land quality in western regions is very low.

Moreover, with limited agricultural resources and satisfactory food consumption, the arable land was over exploited in China leading to the deterioration in natural environment. The agricultural resource potentials were destroyed by over-using chemical fertilisers and pesticides to make short-run productivity, stressing land resources by farming steep hillsides and areas, and by rarely leaving land out of

production to "rest". All of these measures are unsustainable and lead to serious environmental consequences, such as soil erosion problem, land degradation, salinity intrusion, and ecosystem deterioration. Recently, it is reported by Xinhua News Agency – an official press agency of China – that around 40 percent of cultivated land suffers from different types of degradation.

2.2. The Contradiction between Food Security and Food Safety

China is the most populous country in the world with over 1.35 billion people. The share of urban population surged from 17.92 percent in 1978 to 54.77 percent in 2014 due to a surprisingly high pace of urbanization (NBS, 2015). China's food security policy focuses on the domestic production of major crops such as wheat, corn and rice to ensure the grain self-sufficiency. However, it is the biggest challenge to meet the fundamental goal of the agricultural sector in China because of the following reasons.

First, according to the theory of comparative advantage, China is a land-scarce and labour-abundant country, and grain is a land-intensive product, therefore, China should export labour-intensive agricultural and industrial products and import agricultural crops. Although the grain self-sufficiency remains an important item on the agenda of policy makers, China changed from a net grain exporter in the 1950s to a large net importer of agro-food products, in particular of wheat, corn, rice and other feed grains.

Secondly, there are many stimuli to boost food imports, for instance increases in household income, rapid growth of urbanisation, the scarcity of land and agricultural resources, and food safety. China's arable land decreases each year to urban development, although the government put the "red line" on the farm land. Since scarce agricultural resources in China cannot align with the increasing domestic demand, China's import dependence of agricultural products is ineluctably rising to a large extent.

And last but not least, to achieve food security, China continually depends on further exploitation of agricultural resources. As a result, incompatibilities between the rapid demographic growth and the poor agricultural resources cause serious problems in food safety. Chemical fertiliser use per hectare has risen rapidly since 1978.

Currently, the data from the Statistics Division of Food and Agriculture Organisation (FAO) of the United Nations and the report of the Greenpeace Organisation show that China has the highest intensive fertiliser and pesticide use per hectare in the world. The persistent increase in chemical fertiliser and pesticide application has led to environmental problems including water pollution, land degradation and declining soil fertility. According to the statistics on China's land in crop production, nearly all of this area is currently sowed—indeed overexploited, and subsequently risk of degradation went up. However, in order to meet the grain self-sufficiency goal, more fertiliser has to be applied to achieve higher yield. As a result, pollution of water, soil, and climate directly influence food quality. Figures from the United States Department of Agriculture (USDA) show that there were only 6 percent of China's agricultural products were considered pollution free in 2005. According to a book—*Soil Pollution and Physical Health (China, 2013)* published in 2013 by the Ministry of Environmental Protection in China, nearly 20.24 million hectares which account for one-sixth of cultivated land in China suffer from soil pollution. It seriously destroys the food safety and becomes an imminent public health hazard. The book states that more than 13 million tons of crops harvested each year were contaminated with heavy metals, and that 8.91 million hectares of farmland were affected by pesticides. Now food safety and consistent quality characteristics are increasingly demanded by the growing food processing industries, modern retailers, and middle class consumers in China.

3. The Recent Development of China's Domestic Agricultural Support Policies

During the past more than 30 years, Chinese agricultural policies experienced dramatic changes. Chinese authorities have been intervening in agriculture started from the 1980s to deal with key concerns, such as food security, rural-urban income inequality, and agricultural modernisation, but expenditure on agriculture was limited in earlier decades by lack of financial resources. Since 2004, a variety of agricultural domestic support policies have expanded rapidly in size and scope to stimulate farmers to produce and stabilise the production of grain. The main support policies include direct subsidies in grain, seed varieties, farm machinery and agricultural inputs

purchase; minimum purchase price for grain policy; temporary purchase and storage policies to boosting agricultural output and modernising production facilities.

In 2004, the central government began to introduce **direct subsidies to grain producers** based on acreages to motivate farmers to produce and stabilize the production of grain through making up for increasing costs of grain farming and ensuring reasonable benefits for grain producing farmers. The intended impact of this policy is to boost grain production and rural incomes. Meanwhile, China applied the minimum purchase price for grain policy to protect farmer's benefits, ensure grain supply and food security.

The minimum protection prices for rice and wheat are set by the Chinese government to ensure that prices are high enough to cover increasing production costs and earn a profit. The application of this policy is in effect only in major grain-production provinces that produce about 80 percent of China's commercial grains for a fixed period limited to several months after the harvest. The government purchase are made when the market price is lower than the minimum purchasing price, which is set by the Chinese authorities each year based on production cost surveys and market conditions. This policy was introduced in 2004 and the minimum prices had been quite stable until 2007. Since 2007 to 2014, the minimum prices for rice and wheat were increased annually because of the growing costs of agricultural production.

The officially named **'comprehensive direct subsidy to agriculture production materials'** was introduced in 2006 and had become the most important single budgetary transfer supporting agriculture by 2008. It aims to compensate grain producers for an increase in prices of agricultural inputs such as fertilisers, diesel fuel, pesticides and plastic films. However, it also caused a negative influence on nibbling the agricultural ecosystem.

In order to improve the quality of seeds and livestock, and to purchase large agricultural machinery and a wide variety of equipment, **the new variety extension payment scheme** has been introduced successively since 2002 and 2004. The program covers a variety of important crops and livestock including wheat, maize, rice, soybean, rapeseed, cotton, potatoes, peanuts, barley, pigs, dairy cows, beef cattle, and sheep.

The objectives of **temporary or provisional reserve support prices policy**, which was implemented in 2008, is to mitigate risks upon farmers' income, ensure domestic market stability and effective supply in case of a global price crisis. The Chinese government regarded this programme and the *"minimum price policy"* as measures to reduce risk from price volatility. Namely, if market prices dips below the established support level, the Government's reserve-management company — Sinograin — will purchase commodities, whereas purchased commodities storage will be sold by auctions during periods of rising prices. This policy has one obvious characteristics compared with *"the minimum purchase price for grain policy"*, i.e., it is applied for non-staple foods, such as corn, soybeans, rapeseed, cotton, and for wheat and rice outside the regions designated for minimum price procurement.

4. Methodology and Database

4.1. Methodolody

CGE models with clear microeconomic structure significantly contribute the most to sound policy formulation (Clarete & Roumasset, 1986). SinoTERM (Horridge & Wittwer, 2008) represents multi-regional, sub-national economies in a 'bottom-up' manner linked by flows of goods and labour movements between provinces. In this model, each province has its own behavioural equations, input-output database and inter-regional trade matrices, therefore, prices and quantities are solved particularly for each region. The version of the model described in our research distinguishes 147 industries, 147 commodities, 2 occupational categories (i.e., unskilled and skilled worker) and 2 household groups (rural and urban household) in each of 31 domestic provinces/municipalities. In running the model, we aggregate sectors and regions automatically to reduce the database size, and we solve it using the GEMPACK software (Harrison, Pearson, & Powell, 1996).

The theoretical structure of SinoTERM follows the conventional neoclassical pattern common to many applied general equilibrium models. Each industry in each region minimises production costs a given level of output by optimising an input mix of primary factors (i.e. labour, capital and land) and specific intermediated inputs from different geographical sources. The model assumes that the levels of output should satisfy demands by users including other domestic industries, investors, households, governments and exports. For instance, a representative household in each region

purchases commodities in terms of the consumer utility maximisation in accordance with its preferences and disposable income. Export demand functions capture the responsiveness of foreigners to changes in export supply prices. National capital supply responds to rates of return. Labour is imperfectly mobile between regions and fully mobile between sectors within a region. Productive resource stocks in each region reflect changes of regional labour markets and relative rates of return on capital.

4.2. Database

We compiled the newest database for our TERM model. The base year chosen for this research is 2007[1]. The starting point for creating our database is the Input-Output (hereafter IO) Table of China 2007 published by the National Bureau of Statistics of China (NBS) in 2009. In this database, agricultural sectors were split from original 5 sectors into 15 sectors. The NBS published a 2007 national IO Table for the whole economy, but there are only 5 agricultural sectors (i.e., farming, forestry, animal husbandry, fishery, and the service industry in farming) out of 135 sectors. We expand some sectors, especially agricultural sectors, in the national database, according to the ratios from the GTAP 8 Data Base. The single farming sector is split into 8 sectors, i.e., rice; wheat; coarse grain; vegetables and fruits; oil seeds; sugar cane and sugar beet; cotton; and tobacco. The single livestock sector is disaggregated into four sectors that are cattle, sheep and goats; eggs, poultry, swine and other animal products; raw milk; and wool and silk-worm cocoons. The meat products industry is separated into meat of cattle, sheep and goats; and meat of swine. And, the single one industry — "Extraction of Petroleum and Natural Gas" — is disaggregated to oil and gas. These sectoral splits enlarged the published IO Table of China 2007 to 147 sectors.

In order to produce the regional database in SinoTERM for all 31 regions, we apply Horridge's method (Horridge, 2012) based on our 147-sector national database and certain regional data. These regional data are calculated and collected from miscellaneous official sources such as the National Bureau of Statistics of China (2008), the General Administration Customs of China (2008), the China Insurance Regulatory Commission (2008), the China National Tourism Administration (2008), The National

[1] When we finished our database compilation, the newest Chinese 2012 IO Table is published by NBS at the end of 2015. We will update our database as soon as possible based on the latest IO Table. But, until right now, our 2007 database is still the newest one for the Chinese CGE research.

Health and Family Planning Commission (2008), the Ministry of Human Resources and Social Security (2008).

Relying on this 31-province database, the SinoTERM model can capture inter-industry linkages between agricultural and non-agricultural sectors in each province and integrally present a multi-regional economy-wide perspective analysis. It also captures income disparities between provinces and between urban and rural households by province through detailed multi-regional information. Therefore, this study can provide a clear perception into winners and losers within a province and a whole country from particular policy scenarios.

4.3. Scenario Simulation

To answer the above questions mentioned in section 1, we develop two scenarios. Taken together, we are able to estimate the impacts of two important events: the decline of the international grain prices and the improvement of labour productivity in agricultural sectors.

To simulate the agricultural domestic support policies in all two scenarios, we shock a variety of agricultural subsidies for different agricultural sectors in different regions according to our calculation based on data from *China Rural Statistical Yearbook 2008 (National Bureau of Statistics of China, 2008)* and *2012 Chinese IO Table (National Bureau of Statistics of China, 2015)*. In scenario 1, because industrialisation and urbanisation attract more labour and land from agriculture to non-agricultural sectors, we assume that labour productivity in agricultural sectors declines by 10 percent. Meanwhile, a 5 percent decrease in land productivity and a 3 percent decrease in intermediate inputs productivity occur in all agricultural sectors in each region because of the land degradation and natural resources deterioration. The international grain prices (wheat, rice and corn) is fixed in the base year (2007) and is not allowed to decrease.

Because the key question of our policy analysis is the evaluation of the effects of increase in grain products import and growth of agricultural labour productivity under the current agricultural resources constraints with agricultural subsidies. We set up scenario 2. In this scenario, because a growing positive price gap between domestic and international prices is caused by domestic policy intervention. I.e., agricultural

production costs increase, and international products prices decrease. We assume that the international prices fall down by 40 percent in import price of rice, and decrease 20 percent in import prices of wheat, coarse grain, oilseed, sugarcane, cotton, cow and sheep, pig, poultry and egg; and raw milk. We also assume that the agricultural labour productivity is improved by 5 percent because the government invests more on the training of agricultural workers. Other assumptions are maintained as same as in scenario 1.

5. Results

In order to model the economic impacts of the Chinese domestic agricultural support policies, we simulate these two scenarios in a long-run setting. The total aggregate national employment is fixed. An increase in real wages relative to other provinces drives the imperfect labour mobility between provinces and sectors. In the long run, capital stocks can be adjusted to eliminate short-run variations in rates of return on capital in each industry. The national balance of trade is fixed as a share of GDP. Additionally, the real regional government consumption follows real household consumption. Therefore, real consumption is the main indicator of welfare on the GDP expenditure side in our model.

The results from our study reveal a more in-depth understanding of the Chinese agricultural domestic support policies under different situation over the past several years and the effects of these policies on agricultural and non-agricultural sectors, and on all 31 provinces and municipalities.

5.1. Effects of agricultural domestic support policies (Scenario 1)

5.1.1. Macroeconomic results

National macroeconomic results are shown in Table 1. Real gross domestic product (GDP) drops by 3.29 percent, because of the outpacing decline in exports to imports, decrease in household consumption, investment and government consumption. This is accompanied by a decrease in capital stock by 3.37 percent. Real wages rise by 1.13 percent as the agricultural support policies take effect. The declines in national real consumption are slightly lower than the decrease in real GDP. This is because a rise in real wage offsets the rise in CPI in some extent.

In scenario 1, CPI increases by 0.74 percent because of two reasons. At first, subsidies stimulate the rise of real wages. Secondly, as we mentioned in Section 1, the economic growth changed the pattern of consumption in China. China's demand for grains has shifted from staple grains – rice and wheat – to vegetables, fruits and livestock products. However, the agricultural support strategy changes the industrial structure of the economy. It reduces the non-agricultural output and the output of vegetables, fruits and some livestock products, such as pork, poultry and egg, and aquatic products. We will investigate the sectoral effects of the agricultural support policies further in Section 5.1.2.

Table 1. National macroeconomics effects of different policy experiments (long run, % change relative to base case)

National Macroeconomic Variables	**Scenario 1** *10% decrease in agricultural labour productivity, 5% decrease in farm land productivity, 3% decrease in intermediate inputs productivity*	**Scenario 2** *40% decrease in import price of rice, 20% decreaes in import prices of wheat, coarse grain, oilseed, sugarcane, cotton, CowSheep,PigPoultryEgg, and raw milk, 5% increase in agricultural labour productivity, others are as same as Scenario 1*
Real Consumption	-3.25	-0.54
Real Investment	-3.64	0.77
Real Government	-3.09	-0.40
Exports	-2.82	-0.05
Imports	-2.15	0.43
Real GDP	-3.29	0.33
Real Wage	1.13	4.38
Capital Stocks	-3.37	0.58
GDP deflator	0.16	-0.64
CPI	0.74	-1.27
ExportPI	0.42	-0.01

Column 2 in Table 1 shows that the higher shrink of exports than imports induce a real depreciation of the Chinese currency, given that the nominal exchange rate is exogenous and unchanged. At the same time, the terms of trade increases by 0.42 percent because of the increase in export prices.

Table 2. Real wage changes by region and occupation in different policy experiments (long run, % change relative to base case)

Real wage	Scenario 1		Scenario 2	
	Unskilled workers	Skilled workers	Unskilled workers	Skilled workers
Beijing	1.00	-6.88	3.93	1.19
Tianjin	1.34	-6.80	3.78	0.85
Hebei	6.42	-6.83	7.32	1.01
Shanxi	3.70	-6.95	5.26	0.64
Inner Mongolia	5.71	-6.60	6.87	1.10
Liaoning	4.52	-7.03	6.21	1.15
Jilin	5.82	-6.80	6.84	0.91
Heilongjiang	6.00	-6.72	6.94	1.05
Shanghai	1.16	-6.69	3.59	0.72
Jiangsu	2.42	-7.12	4.91	1.11
Zhejiang	1.69	-7.14	4.83	1.34
Anhui	3.92	-7.71	5.19	0.86
Fujian	2.66	-7.62	4.81	1.12
Jiangxi	3.89	-8.10	5.48	0.91
Shandong	2.79	-7.19	5.11	1.71
Henan	3.33	-7.71	4.81	1.18
Hubei	3.30	-8.00	4.94	1.16
Hunan	3.42	-8.18	4.68	0.57
Guangdong	1.80	-7.47	3.98	0.26
Guangxi	3.79	-7.89	5.10	0.86
Hainan	3.88	-7.49	5.16	0.82
Chongqing	2.22	-7.85	4.57	1.67
Sichuan	6.98	-6.41	8.32	2.45
Guizhou	2.63	-8.68	4.28	0.01
Yunnan	6.24	-6.74	7.66	1.59
Tibet	8.53	-5.89	9.58	1.58
Shaanxi	2.75	-7.53	4.06	0.71
Gansu	5.65	-6.77	6.71	1.02
Qinghai	5.57	-6.88	7.15	0.92
Ningxia	5.22	-6.82	6.42	1.29
Xinjiang	5.54	-6.49	6.27	1.28

Our results also reveal that nearly all the increased production costs arise from primary inputs, which is caused by the agricultural subsidy policies. For all sectors in China, about 77 percent of factor costs increases are due to labour, the remainders are capital (14%) and land (9%). Moreover, as a consequence of the subsidy programme, the real wage of unskilled workers increases, but the real wage of skilled workers is harmed deeply by this policy (Table 2, columns 3). Employment increases more for unskilled workers.

5.1.2. Sectoral Results

Next, we consider the impact of the agricultural support policy scenario on the national outputs of the directly affected agricultural industries. Costs for agricultural

sectors increase because higher input costs arising from lower land productivity, lower labour productivity and intermediate inputs induce losses. However, the subsidies can really stimulate the output of land-intensive products (second column, Table 3).

Table 3. National industry output of different policy experiments (long run, % change relative to base case)

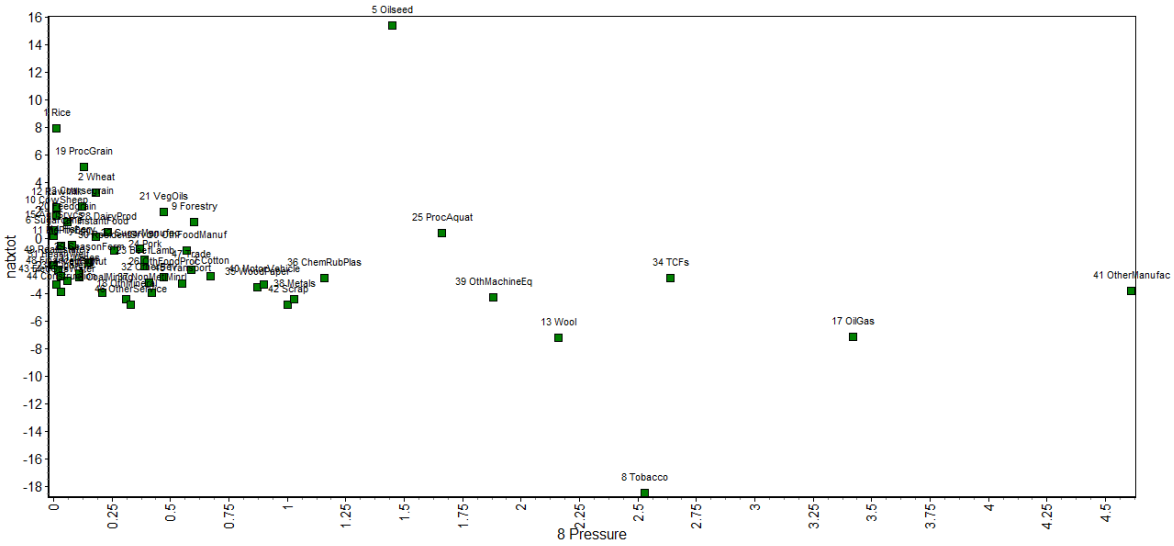
National industry output	Scenario 1	Scenario 2
Rice	7.98	16.43
Wheat	3.32	13.49
Coarsegrain	2.29	11.39
VegFrtNut	-2.83	1.89
Oilseed	15.41	22.53
Sugarcane	0.19	7.14
Cotton	-2.73	4.01
Tobacco	-18.46	1.47
Forestry	1.17	13.21
CowSheep	1.64	8.96
PigPltyEgg	-0.53	4.57
RawMilk	2.23	5.59
Wool	-7.22	17.83
Fishery	-0.49	7.28
AgriSrvcs	0.59	8.36
CoalMining	-3.94	-1.04
OilGas	-7.12	-5.04
OthMineral	-4.44	-1.67
ProcGrain	5.17	11.02
Feedgrain	1.18	7.34
VegOils	1.93	9.26
SugarManufac	-0.79	5.64
BeefLamb	-2.01	4.82
Pork	-1.55	5.86
ProcAquat	0.34	14.22
OthFoodProc	-2.81	2.87
InstantFood	0.12	1.37
DairyProd	0.47	2.98
SeasonFerm	-1.75	0.81
OthFoodManuf	-0.87	2.84
Wines	-2.56	0.46
OtherBev	-3.25	0.13
Cigarette	-3.11	-0.30
TCFs	-2.92	7.04
WoodPaper	-3.56	-0.30
ChemRubPlas	-2.87	0.99
NonMetlMinrl	-3.98	-0.24
Metals	-4.41	-2.40
OthMachineEq	-4.27	-2.15
MotorVehicle	-3.37	-1.10
OtherManufac	-3.80	-2.50
Scrap	-4.81	-2.52
ElecGasWater	-3.33	-0.47
Construction	-3.89	0.88
Transport	-3.29	-0.32
OtherService	-4.84	-0.63
Trade	-2.28	-0.41

FinanceInsur	-2.77	-0.17
RealEstate	-1.96	0.11
ResidentSrvc	-0.91	-0.24
HealthWelf	-2.28	-0.27

On the other hand, movements in international competitiveness, as indicated by increases in the export prices, strongly influence outcomes for traditional traded agricultural industries in China. The traditional export products such as vegetables, fruits, pig, poultry and egg, and aquatic sectors are harmed by this agricultural support strategy. Because these products are chiefly labour-intensive, high-value (per unit of land) products. More specifically, the agricultural support strategy hurts China's internationally competitive commodities rather than enhances them because of the increases in real wage of unskilled workers. For example, vegetables have traditionally been considered one of most international competitive agricultural products in China since their production is labour intensive. However, labour costs have been soaring as agricultural support policies implemented.

CGE analysis also allows us to examine non-agricultural industries that are indirectly affected by the agricultural support policy shocks. Results from second column of Table 3 show that almost all manufacturing and services sectors are hit because of the increases in labour costs. The reason is that agricultural support policies push the labour wages up quickly in agricultural industries. As a consequence, the higher labour wage increase draws back the rural migrant workers who worked in non-agricultural industries into agriculture. And this further causes the labour shortage in non-agricultural sectors, which then pushes up the exports price. Therefore, increased price of labour also raises production costs for non-agricultural industries, raises price of manufacturing and services goods, and reduces the output of manufacturing and services goods.

Figure 1. Relationship between trade pressure and output (Scenario 1)



Furthermore, an increase in domestic costs to foreign prices induces a deterioration in international competitiveness in traditional export-oriented industries in China. This results in export decreases. The competitiveness deterioration in manufacturing industries harms the trade-exposed industries as it is shown in Figure 1. This graph shows the change in output of each industry as a result of the real wage rise, which is caused by the agricultural subsidy policies in our simulation, plotted against its trade pressure value. With a few exceptions we would be able to say that the higher the trade pressure value, the larger the drop in output if production costs would rise. The cost of production rise makes China's trade-exposed industries suffer and become less competitive in the global market.

5.1.3. Regional Results

We now examine the impact of the agricultural subsidy scenario on aggregate consumption at the regional level and regional economies. Table 4 shows that the provinces in which agriculture has the largest share of regional GDP are Xinjiang (30.1%), Guangxi (24.4%) Tibet (24.1%), Henan (23.3%), and Anhui (22.0%). Shanghai (1.0%), Beijing (1.1%), Tianjin (2.6%), Zhejiang (4.4%) and Guangdong (5.0%) have the smallest agricultural shares among 31 regions.

Table 4. Broad sectoral contributions to regional GDP (%, long run)

	Agriculture	Mining	Food processing	Textiles, clothing & footwear	Other manufacturing	Services	Regional total
Beijing	1.1	1.2	1.2	0.5	29.4	66.5	100.0
Tianjin	2.6	8.5	2.0	0.9	44.3	41.7	100.0
Hebei	18.9	6.9	3.6	2.0	37.6	31.0	100.0
Shanxi	7.3	16.9	0.9	0.2	24.9	49.9	100.0
Inner Mongolia	16.3	11.4	4.7	0.8	21.5	45.3	100.0
Liaoning	10.7	5.5	2.9	1.4	35.4	44.2	100.0
Jilin	16.7	5.8	3.0	0.3	27.6	46.6	100.0
Heilongjiang	18.3	17.5	2.9	0.1	19.7	41.6	100.0
Shanghai	1.0	0.1	1.7	2.1	43.6	51.6	100.0
Jiangsu	7.7	1.0	1.9	6.5	51.0	31.9	100.0
Zhejiang	4.4	0.5	1.6	10.1	47.4	35.9	100.0
Anhui	22.0	3.6	3.5	1.1	32.4	37.4	100.0
Fujian	12.4	1.9	3.7	7.2	32.4	42.6	100.0
Jiangxi	21.0	3.9	2.4	2.1	30.3	40.4	100.0
Shandong	14.1	7.6	5.7	5.2	40.5	27.1	100.0
Henan	23.3	8.5	5.8	1.5	30.9	29.9	100.0
Hubei	19.0	2.6	3.3	2.4	31.1	41.5	100.0
Hunan	21.1	3.5	3.6	0.9	26.9	44.1	100.0
Guangdong	5.0	2.0	2.3	3.9	46.6	40.2	100.0
Guangxi	24.4	1.8	5.3	0.3	23.8	44.6	100.0
Hainan	20.5	1.3	2.2	0.1	18.6	57.4	100.0
Chongqing	11.5	1.7	1.8	1.1	33.0	51.0	100.0
Sichuan	18.7	4.8	3.6	0.8	28.4	43.8	100.0
Guizhou	19.1	3.8	2.5	0.1	22.8	51.6	100.0
Yunnan	21.6	3.4	5.8	0.1	21.9	47.3	100.0
Tibet	24.1	1.7	1.1	0.0	8.1	64.9	100.0
Shaanxi	13.2	14.4	2.6	0.6	25.7	43.5	100.0
Gansu	16.4	6.2	2.4	0.1	29.8	45.2	100.0
Qinghai	11.9	18.5	0.6	0.6	26.5	41.9	100.0
Ningxia	15.9	6.0	2.1	0.8	30.8	44.3	100.0
Xinjiang	30.1	17.4	2.3	0.5	15.6	34.2	100.0
National	15.2	6.1	2.9	1.8	30.3	43.8	100.0

The most trade-exposed regions in China are Guangdong (1.73), Shanghai (1.63), Jiangsu (1.54), Tianjin (1.39), Zhejiang (1.28), Fujian (1.16) and Shandong

(1.15)[2]. The least trade-exposed regions are Tibet (0.24), Guizhou (0.52), Shanxi (0.54), Yunnan (0.56), Guangxi (0.57), and Hainan (0.57).

As Table 5 shown, no regions can gain from these agricultural support policies under the current agricultural production condition in China. The least loss provinces are Tibet (-1.109%), Shanghai (-2.472%) and Sichuan (-2.580%). The most damaged regions are Guizhou (-4.647%), Hunan (-4.577%) and Henan (-4.318%).

There are several reasons to explain this. At first, real wages increase mostly and CPI increases slightly in Tibet and Sichuan. When we investigate it further, the results show that the decrease in the supply of capital and the rise in the aggregate employment imply that the marginal product of labour is rising in these areas. The rise in the marginal product of labour accounts for the movement in the real wage, which rises by 3.687 percent in Tibet and 4.094 percent in Sichuan respectively. Therefore, household consumption in these two regions rises up ranked top two among 31 regions. Secondly, real investment in these two regions declines least.

Shanghai is a special case. Its CPI decreases slightly by 0.371% and household consumption declines most among 31 regions. However, since household consumption only accounts for 13.7 percent of its GDP, the negative impact on its regional economy is limited. As one of the most trade-exposed and urban regions in China, Shanghai has the least decline in exports. This can explain why its real GDP declines relatively slightly compared to the other regions. The reason for this is that the contraction of export-oriented industries in Shanghai leads to the aggregate employment and real wage decrease.

Puzzles arise when we look at the ranking of regional losses. As relatively agriculture-intensive regions in China, we expect the real GDP decline in these regions is small. However, the largest real GDP decrease regions are Guizhou (-4.647%), Hunan (-4.577%) and Henan (-4.318%). Because they are the least traded-exposed regions and the shares of household consumption to GDP in these regions are very high, the highly increased CPI in Guizhou (1.409%), Henan (1.187%) and Hunan (1.096%) is the main reason to cause the significant decline in real GDP in these three areas.

[2] The number in each pair of brackets states the average trade pressure for each region.

Table 5. Macroeconomic effects of agricultural support strategy by region (long run, % change relative to base case)

Scenario 1	Real GDP	Rural household consumption	Urban household consumption	Real investment	Real government spending	Export volumes (international)	Import volumes (international)	Aggregate employment	Real wage	Aggregate capital stock	GDP deflator	CPI	Export price index
Beijing	-2.654	-7.366	-7.184	-3.899	-7.195	-2.120	-2.391	-1.752	-1.303	-3.086	0.070	0.449	0.314
Tianjin	-2.620	-6.505	-6.365	-3.419	-6.377	-2.895	-1.886	-1.615	-0.579	-2.871	0.218	0.399	0.425
Hebei	-3.152	2.093	2.196	-2.684	2.163	-5.817	-2.570	2.686	3.904	-3.539	1.026	0.631	0.850
Shanxi	-2.623	-3.188	-2.772	-3.053	-2.880	-4.719	-2.006	0.288	1.154	-3.030	0.596	0.420	0.778
Inner Mongolia	-2.606	0.844	0.910	-2.391	0.895	-4.537	-1.954	2.099	3.207	-2.749	0.293	0.689	0.641
Liaoning	-2.979	-2.021	-1.248	-3.051	-1.409	-5.026	-1.537	0.959	1.996	-3.219	0.447	0.716	0.778
Jilin	-2.934	0.592	0.993	-2.634	0.905	-4.975	-1.413	2.131	3.185	-3.102	0.221	0.971	0.789
Heilongjiang	-3.502	0.816	1.444	-2.998	1.289	-5.275	-1.553	2.311	3.393	-4.121	-0.566	0.703	0.806
Shanghai	-2.472	-6.688	-6.708	-3.338	-6.707	-2.352	-1.725	-1.666	-0.874	-2.787	0.076	0.371	0.348
Jiangsu	-2.924	-4.976	-4.562	-3.324	-4.678	-2.851	-2.142	-0.844	0.426	-2.928	0.021	0.549	0.404
Zhejiang	-2.829	-5.967	-5.918	-3.802	-5.931	-2.551	-1.832	-1.450	-0.276	-3.047	0.121	0.465	0.385
Anhui	-4.036	-2.783	-2.271	-4.093	-2.432	-2.586	-2.484	0.302	1.603	-3.855	-0.402	0.944	0.424
Fujian	-3.556	-4.856	-4.496	-4.394	-4.588	-3.446	-2.735	-0.758	0.432	-3.536	0.088	0.586	0.591
Jiangxi	-4.296	-3.462	-2.477	-4.493	-2.797	-3.455	-2.826	0.171	1.358	-4.135	-1.412	1.199	0.650
Shandong	-3.372	-4.044	-3.804	-3.633	-3.866	-3.017	-2.265	-0.565	0.992	-3.094	0.673	0.654	0.425
Henan	-4.318	-3.685	-2.799	-4.244	-3.160	-2.431	-2.582	-0.199	1.356	-3.781	0.738	1.187	0.316
Hubei	-4.165	-4.409	-3.353	-4.374	-3.702	-3.264	-2.626	-0.307	0.901	-3.936	-0.374	1.115	0.551
Hunan	-4.577	-4.159	-3.203	-4.805	-3.519	-3.979	-2.993	-0.239	1.023	-4.408	-0.860	1.096	0.790
Guangdong	-3.335	-6.542	-6.063	-4.547	-6.119	-2.912	-2.390	-1.393	-0.531	-3.745	-0.030	0.440	0.439
Guangxi	-4.197	-3.713	-2.520	-4.245	-2.931	-4.105	-2.675	0.131	1.259	-3.761	-0.632	1.151	0.842
Hainan	-3.545	-3.017	-2.345	-3.364	-2.526	-4.214	-0.832	0.313	1.495	-2.891	0.217	0.878	0.928
Chongqing	-3.826	-7.016	-5.190	-4.290	-5.600	-3.917	-2.487	-1.174	-0.207	-3.781	-0.049	0.971	0.701
Sichuan	-2.580	2.217	3.169	-1.720	2.863	-6.500	-1.364	3.200	4.094	-3.034	0.320	1.122	1.134
Guizhou	-4.647	-6.981	-4.951	-5.581	-5.671	-8.130	-3.463	-1.082	-0.374	-4.458	-0.499	1.409	1.750
Yunnan	-3.122	1.027	1.603	-2.138	1.370	-13.113	-2.049	2.467	3.319	-3.041	0.229	0.940	2.939
Tibet	-1.109	3.994	3.107	-1.182	3.438	-3.228	0.307	4.183	3.687	-2.100	-1.644	0.322	0.149
Shaanxi	-3.750	-4.766	-4.538	-4.399	-4.600	-4.469	-2.111	-0.646	0.308	-3.958	0.717	0.543	0.747
Gansu	-2.865	0.418	0.000	-2.776	0.131	-4.739	-1.314	1.932	2.596	-3.280	0.680	0.532	0.725
Qinghai	-3.108	0.016	-0.381	-3.348	-0.257	-4.436	-1.801	1.808	2.323	-4.026	-0.212	0.392	0.588
Ningxia	-2.784	-0.595	-0.382	-2.409	-0.441	-4.822	-1.542	1.575	2.370	-3.048	0.437	0.716	0.809
Xinjiang	-4.025	1.304	1.124	-2.964	1.181	-6.335	-1.116	2.029	3.569	-4.067	0.710	0.710	0.932

Columns 3 and 4 in Table 5 show that because of a rise in CPI, rural households gain less or lose more in regional aggregate consumption than urban households exception Tibet, Gansu, Qinghai and Xinjiang. The households in these four regions benefits more from the subsidies as the increases in rural household CPI is less than the urban households.

5.2. Effects of agricultural domestic support policies with import increase and growth of agricultural productivity (Scenario 2)

In scenario 2, column 3 in Table 1 indicates that real GDP increases by 0.33 percent. On the supply side of the economy, the increase is mainly determined by real wages. Results in Table 1 show that the real wage increases by 4.38 percent due to the growth in derived demand for labour as a result of considerable expansions in activities of agricultural sectors, food processing sectors, and some labour-intensive manufacturing sectors. Unskilled labour real wage increases much higher than skilled labour's. From the expenditure side, increase in real investment by 0.77 percent results in the growth of real GDP. The rise in agricultural labour productivity induces a small rise in real investment and capital stock. Also, there is a reduction in CPI by 1.27 percent because of the increasing imports based on the significant improvement in terms of trade and increasing output of agricultural sectors, food processing sectors and some labour-intensive manufacturing sectors (column 3 in Table 3).

Sectoral results in scenario 2 (column 3 in Table 3) reveal that this strategy further increases land-intensive grain production and the output of labour-intensive traditional internationally competitive agricultural industries compared to their output in scenario 1. This is because of the improvement of labour productivity in agriculture. Additionally, most trade-oriented non-agricultural industries also expand their outputs because the increase in imports reduces the costs of intermediate inputs. And this costs reduction offsets the labour costs rises in these industries.

We report regional macroeconomic outcomes in Table 6 for scenario 2. The highest real GDP gains regions are Tibet (2.415%), Sichuan (1.861%) and Shandong (1.060%). In comparison with scenario 1, Shanghai is replaced by Shandong in this simulation. Tibet and Sichuan experience the highest growth in real GDP and real consumption, also employment and capital stocks are the most responsive to the strategy in these two regions. Shandong is a different case compared with these two

regions. The increase of its real GDP is mainly determined by the highest real investment increase among 31 regions and the growth of its international trade. As we discussed in section 5.1.3., Shandong is one of the most trade-exposed regions in China, the expanding of its exports contributes to the real GDP. A careful observation of total exports and total imports reveals that balance of trade improvement has come from the increase in exports relative to imports. Besides, the agricultural labour productivity increase leads to the rise of marginal product of capital in Shandong. Regions suffering most from this strategy are Guangdong, Shanghai and Guizhou: real GDP falls by 0.887 percent, 0.625 percent and 0.517 percent respectively.

Table 6. Macroeconomic effects of agricultural support strategy with labour productivity growth in agriculture and import prices decrease (long run, % change relative to base case)

Scenario 2	Real GDP	Rural household consumption	Urban household consumption	Real investment	Real government spending	Export volumes (international)	Import volumes (international)	Aggregate employment	Real wage	Aggregate capital stock	GDP deflator	CPI	Export price index
Beijing	0.093	-2.256	-2.649	0.783	-2.624	-2.459	0.010	-0.990	3.131	0.845	1.052	-0.924	0.387
Tianjin	-0.410	-1.948	-3.049	0.212	-2.955	-2.636	0.302	-1.286	3.089	0.086	0.721	-1.111	0.366
Hebei	0.642	3.409	2.730	1.219	2.949	-0.255	0.433	1.711	6.117	0.230	-0.831	-1.255	-0.159
Shanxi	-0.352	-0.176	-1.019	0.201	-0.801	-3.683	0.131	-0.142	4.159	-0.297	0.439	-1.106	0.530
Inner Mongolia	0.743	3.186	1.862	1.379	2.159	4.600	0.381	1.331	5.699	0.620	-0.932	-0.820	-0.877
Liaoning	0.240	1.601	0.870	0.976	1.022	-1.678	1.165	0.771	5.106	0.266	-0.252	-1.297	0.108
Jilin	0.546	3.067	1.686	0.933	1.986	1.453	1.409	1.252	5.603	0.287	-1.216	-0.849	-0.612
Heilongjiang	-0.058	2.679	2.086	0.470	2.232	1.690	0.935	1.372	5.732	-0.938	-2.253	-1.342	-0.594
Shanghai	-0.625	-3.100	-3.343	-0.385	-3.328	-1.954	-0.708	-1.435	2.852	-0.202	0.784	-1.067	0.298
Jiangsu	0.397	-0.752	-1.109	0.918	-1.009	0.804	0.128	-0.313	4.120	0.957	-0.065	-1.287	-0.128
Zhejiang	0.951	-0.996	-1.103	1.680	-1.075	2.910	1.700	-0.320	4.059	1.761	0.643	-1.171	-0.352
Anhui	0.360	-0.053	-0.910	0.599	-0.641	4.189	0.759	-0.139	4.324	0.511	-2.498	-1.419	-0.703
Fujian	0.612	-0.715	-1.363	0.875	-1.198	2.703	0.349	-0.395	4.008	1.209	-0.604	-1.398	-0.383
Jiangxi	0.303	0.191	-0.407	0.633	-0.214	2.682	0.506	0.111	4.509	0.459	-3.272	-1.502	-0.316
Shandong	1.060	0.051	-0.532	1.751	-0.383	3.980	1.109	-0.043	4.493	1.788	-0.238	-1.286	-0.740
Henan	0.665	-0.896	-1.180	0.968	-1.064	7.872	1.178	-0.405	4.158	1.192	-1.683	-1.361	-1.506
Hubei	0.530	-0.753	-1.055	0.938	-0.956	4.163	1.254	-0.275	4.137	0.999	-2.119	-1.554	-0.676
Hunan	-0.110	-1.182	-1.815	0.056	-1.606	2.652	0.232	-0.631	3.825	0.152	-2.870	-1.327	-0.388
Guangdong	-0.887	-1.880	-3.117	-0.864	-2.974	-0.476	-1.010	-1.263	3.046	-0.615	0.213	-1.025	0.062
Guangxi	0.368	-0.456	-1.058	0.248	-0.852	4.385	0.504	-0.212	4.180	0.530	-3.106	-1.700	-0.775
Hainan	0.224	0.345	-1.142	0.095	-0.744	0.485	1.667	-0.171	4.249	0.197	-1.804	-1.730	-0.002
Chongqing	0.557	-0.595	-1.579	1.200	-1.360	-0.313	1.243	-0.427	3.871	1.221	-0.639	-1.596	0.038
Sichuan	1.861	5.955	4.538	3.157	4.990	0.370	1.925	2.824	7.049	1.523	-1.581	-1.551	-0.156
Guizhou	-0.517	-2.224	-2.985	-0.955	-2.717	2.219	-0.232	-1.096	3.142	-0.379	-2.099	-1.389	-0.490
Yunnan	0.964	4.141	3.019	2.090	3.471	-1.501	0.792	2.058	6.293	0.684	-1.796	-1.619	0.255
Tibet	2.415	5.812	4.855	2.881	5.212	16.704	2.549	3.193	6.893	1.513	-3.318	-1.770	-2.234
Shaanxi	-0.409	-2.297	-2.716	0.038	-2.603	0.591	0.745	-1.092	3.259	-0.187	-0.179	-1.113	-0.272
Gansu	0.276	2.669	1.044	0.920	1.553	0.965	1.169	1.108	5.306	-0.086	-0.658	-1.440	-0.310
Qinghai	-0.272	2.957	1.663	0.597	2.065	0.311	0.656	1.405	5.527	-0.942	-0.692	-1.405	-0.002
Ningxia	0.756	2.004	1.042	1.358	1.310	1.208	1.169	0.961	5.207	0.727	-0.782	-1.174	-0.264

Xinjiang	0.456	2.370	1.071	0.649	1.483	4.433	2.035	0.896	5.454	-0.642	-2.433	-1.408	-0.673

By improving agricultural labour productivity and subsidies, this strategy causes a regional redistribution of national employment. Results from column 9 in Table 6 show that employment tends to mobile from economic developed regions to the western and northern areas in China due to relatively higher real wage increases in these regions. Additionally, rural household group in each region can benefit more from the expanding imports and agricultural labour productivity increases because of the decline in CPI.

6. Conclusion and Future Directions

Our results reveal that the agricultural support policies ultimately push up production costs in all sectors and erode the international competitiveness of export-oriented industries. If world grain prices fall relative to Chinese prices, this support strategy cannot be sustainable. Actually, this has been proven by the reality in China now. Another important finding is that, in most regions, the agricultural support strategy even damages the rural household benefits more than urban household under the current agricultural production constraints in China. It will be a wise choice for the central government to readjust its agricultural policies to focus on improving agricultural technology and labour skills. Moreover, implementing land fallow policy is an imperative task to deal with land degradation problems. In order to put this policy into effect, the Chinese government needs to utilise the international market and domestic grain production capacity properly to achieve self-sufficient goal.

To develop the model further for particular areas of research, we will combine the satellite land accounts and additional theory to estimate the effects of rural land reforms policy. A disaggregation of the labour market from two occupations to more skill types can also enrich modelling scenarios that concern Household Responsibility System (HRS) reform.

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