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Capital deepening, land use policy, and self-sufficiency in China's grain sector

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ABSTRACT

The objectives of this paper are twofold. First, we aim to clarify the mechanism by which use of farm machinery in Chinese agriculture has grown rapidly over the past decades, using a separate Cobb–Douglas (SCD) production function. Second, we determine under what condition will China's grain self-sufficiency be secured in the next decade. Our empirical results reveal that the supply and factor demand functions based on the SCD form can significantly explain the reality, in particular, the capital demand function. This finding suggests that the recent capital deepening in Chinese agriculture is caused by farmers' behavior in response to the government's directives aimed at securing arable land. Our simulation analysis reveals that the attainment of a 95% self-sufficiency rate would be quite challenging for China, unless the terms of trade in agriculture improve substantially in favor of producers. China's policy makers must therefore seriously reconsider whether adhering to the policy goal of grain self-sufficiency is worth the effort.

1. Introduction

All member countries of the World Trade Organization (WTO), including China, are restricted more or less to employing interventional and/or protectionist policy measures, such as price support and subsidy payments, in boosting domestic agricultural production (Zhu, 2004).[1] Meanwhile, there are many countries in the world that try to sustain or improve food self-sufficiency, in spite of the fact that their comparative advantage in agriculture is on the verge of being eroded or has been lost entirely. The State Council of the People's Republic of China reiterated in 2008 that the government pursues a national goal of maintaining a self-sufficiency rate for grain at the level of 95%, and complete self-sufficiency for food staples, even under the current circumstances where the grain sector is barely able to sustain its international competitiveness.[2]

When the land-using characteristics of grain production are taken into consideration, one of the most effective measures to secure self-sufficiency, compatible with the international treaty, is to regulate the conversion of farmland for other uses, and then to enhance land productivity. However, in order for the protected farmland not to be left fallow, a certain amount of resources, including farm labor and machinery, have to be mobilized for work on the fields. Owing to considerable increase in the opportunity cost of farm labor in China for the past few decades, rural labor has significantly migrated out of agriculture. This necessitated the replacement of decreasing labor with capital-intensive technologies (Van den Berg et al., 2007). In fact, the past 20 years witnessed a rapid capital

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[1] China's AMS (Aggregate Measurement of Support) commitment is insignificant in the WTO Agreement on Agriculture. Thus, the government subsidies cannot exceed the de minimis exemption for product-specific support of 8.5% of the total value of farm product. Moreover, other stringent restrictions on investment and input subsidies are imposed on Chinese agriculture (Huang & Rozelle, 2008).

[2] China's soybean production has completely lost its international competitiveness recently, the consequence of which is a substantial increase in importation from abroad. Production of maize, one of the most important cereals in China, is also on the verge of losing its international competitiveness.

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deepening in Chinese agriculture, and the speed with which farm machinery spread throughout the country during the period has outpaced that of other factor inputs.

The objectives of this paper are twofold. First, we aim to clarify the mechanism by which use of farm machinery has grown rapidly over the past decades, depending on the production function analysis. This paper, on this regard, hypothesizes that the recent capital deepening in grain production is caused by not so much a simple factor substitution induced by a rise in the wage–rental ratio, but rather by farmers' behavior in response to the government's directives aimed at securing arable land. To verify the hypothesis, we specify the production function in a separate Cobb–Douglas (SCD) form. Although it has rarely been used in empirical studies, our results show that the SCD outperforms the CD in terms of an explanatory power of the time-series movement of farm machinery input.

Second, we determine under what condition China's grain self-sufficiency will be secured in the next decade, with a special emphasis on the terms of trade in agriculture, land use policy, and technological progress. Analysts who tackle this important question usually employ computable general equilibrium (CGE) models (e.g., Chen & Duncan, 2008; Felloni, Gilbert, Wahl, & Wandschneider, 2003; Yang & Tyers, 1989). However, considering the fact that the large variations in projected supply–demand balance come primarily from the production side (Fan & Agcaoili-Sombilla, 1997), we shed light only on supply responses to price changes, land use, and technological change, relying on an outside source for the demand analysis. The major goal of this paper is not to predict the self-sufficiency rate accurately, but rather to identify the key factors that influence grain supply capacities. Our simulation analysis reveals that China would find it very difficult to maintain the grain sufficiency rate at the current level, even if the terms of trade in the next decade follow a similar track in the past 20 years. Although it is possible that the more stringent regulations on farmland conversion and accelerated productivity increase can help attain the policy goal, this is not likely to occur without a more serious commitment by the government to farmland preservation and intervention in grain market.

The remainder of this paper is organized as follows. In Section 2, we provide relevant background information on grain production and land use policy in China. Section 3 contains a brief explanation of the empirical model. In Section 4, we estimate the two types of production functions, the SCD and CD, and compare their explanatory powers for grain supply and factor demands. This section also shows the simulation results with respect to grain self-sufficiency. Finally, Section 5 concludes with a brief summary of our results and draws some policy implications.

2. Grain production and land use policy

2.1. Grain production

Fig. 1 illustrates how the producer's price of grain, prices of fertilizer and farm machinery, and the non-farm wage rate in rural areas have changed over the past two decades. We computed the Laspeyres index of grain price using FAOSTAT (Food and Agriculture Organization Statistical Database) that provides data on domestic producer's prices of wheat, rice, maize, soybean, tubers (starchy roots) and others (barley, oats, and rye), and the corresponding output quantities. Data on factor input prices are obtained from the China Statistical Yearbook (CSY) published by the National Bureau of Statistics. The non-farm wage rate in rural areas is measured by rewards of township and village enterprise (TVE) employees divided by the total number of employees (the data source is the Statistical Year Book of China's TVEs). Over the past two decades, the prices of fertilizer and farm machinery were relatively stable, while that of grain fluctuated significantly. The non-farm wage rate has consistently increased for the period 1991–2009 with an annual rate of more than 10%.

The year 1991 is a turning point for China's agricultural price policy in the sense that the government introduced the price-support program for the first time in the interest of farmers, putting an end to the scissors-form differential price system (or the below-market procurement pricing system) that had been in place. However, the reform, accompanied by a rapid rise in producer's prices and

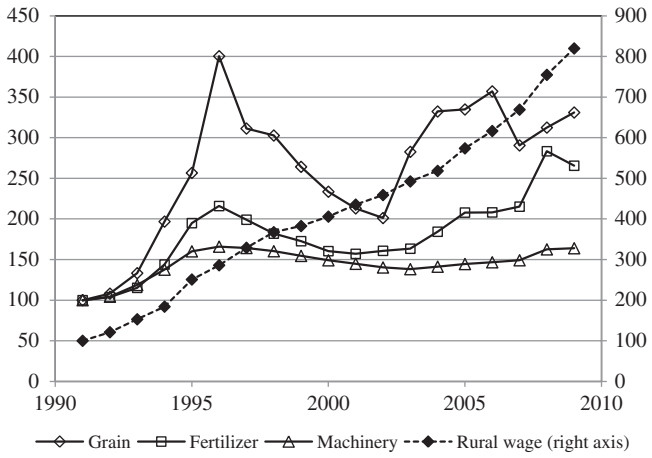

Fig. 1. Price indexes.
Sources: China Statistical Yearbook (CSY), Statistical Year Book of China's Township and Village Enterprises (TVEs), and Food and Agriculture Organization Statistical Database (FAOSTAT).