

Off-Farm Employment and Technical Efficiency on China's Farms: The Case of Jiangsu

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Abstract

This paper examines whether and to what extent off-farm employment affects the technical efficiency of agricultural production. The level of technical efficiency is measured using a stochastic frontier production function approach. We find that there is a positive significant effect of off-farm employment on the level of technical efficiency. We also find that fragmentation of farmland is a barrier to the improvement of technical efficiency. Additionally, we find a concerning downward trend in the level of agricultural technical efficiency among our sample.

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Keywords: Off-farm employment; Stochastic frontier analysis; Technical efficiency

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1. Introduction

Rapidly increasing off-farm employment may not only profoundly affect economic development of the non-agricultural sector, but also influence intra-household resource allocation in agricultural production (Qiao, 2015; Cai, 2015), especially in terms of food security. Pressure on food security arises due to fact that on-farm labor supply decreases as off-farm employment increases (Pfeiffer et al., 2009). Increases in off-farm employment increase food demand, especially the demand for grain due to the growing demand of off-farm employees who live in urban areas (Christiansen, 2009). Additionally, rapid urbanization increases demand for land and water, which are essential factors of agricultural production (Chen, 2007). Consequently, expanding urbanization and increasing off-farm employment may endanger food security (Khan et al., 2009).

Technical efficiency represents the ability to minimize the amount of inputs used in the production of a given amount of output, or the ability to maximize output with a given set of inputs (Kumbhakar and Lovell, 2003). The level of agricultural technical efficiency is important for food security, especially in China where constraints exist in terms of limited farmland and water resources. In a study on the productivity of China's grain production at the province level in 1987-1992, Yao and Liu (1998) emphasize that China's growth in grain output depends on improvements in long-run technical efficiency.

With growing demands placed on food supply, it is of great importance to improve and to understand the determinants of agricultural technical efficiency, especially in light of the increasing number of off-farm employees in rural areas. In other words, the development of off-farm employment may play a significant role in determining the level of agricultural efficiency. However, most of studies of the impact of off-farm employment have been concerned with its impact on agricultural fixed assets (Takahashi and Otsuka, 2009; Su et al., 2015), renting of land (Deininger and Jin, 2005; Kung, 2002; Ji et al., 2016), and time allocation of on-farm labor (Chang et al., 2011; Mu and van de Walle, 2011). The impact of off-farm employment on agricultural technical efficiency has received less attention.

The majority of studies on the impact of off-farm employment on technical efficiency are from outside of China and the results are mixed. A number of studies from African countries find that off-farm employment has a positive effect on technical efficiency in terms of off-farm income (Mochebelele and Winter-Nelson, 2000; Kibaara, 2005; Tijani, 2006; Haji, 2007; Essilfie et al., 2011). At the same time, studies from Europe and North America show that technical efficiency is negatively related to off-farm employment in terms of off-farm income and labor (O'Neill and Matthews, 2001; Goodwin and Mishra, 2004; Yee et al., 2004). Still, a third group of studies find no significant association between technical efficiency in terms of off-farm income and off-farm labor (Chavas et al., 2005; Bozoğlu and Ceyhan, 2007; Chang and Wen, 2011).

Thus, to date no consensus has been reached on the effect of off-employment on technical efficiency. This could be due to at least three factors. First, it could reflect differences in the institutional set up of agricultural production between Africa, Europe, North America, and Asia. Second, it may be that these studies employed different methods for measuring technical efficiency. Finally, a reverse-causal relationship may exist between off-farm employment and technical efficiency, a possibility that has largely been ignored.

In this study we attempt to examine the impact of off-farm employment on agricultural technical efficiency within the setting of rural China. This paper offers contributions to the literature in two dimensions. First, we measure the level of agricultural technical efficiency and describe its distribution. Second, we examine the effect of off-farm employment on the level of agricultural technical efficiency. Estimates of the extent of technical efficiency will help to assess whether improving efficiency or developing new technologies to raise agricultural productivity is an appropriate response to increasing off-farm employment. Moreover, establishing the relationship between off-farm employment and agricultural technical efficiency also has policy implications for agricultural development arising concurrently with urbanization.

The remainder of the paper proceeds as follows. Section 2 provides a brief introduction of the data used and definitions of the key variables. Section 3 describes the method for measuring technical efficiency and the econometric methodology for

estimating the impact of off-farm employment on both the level of and changes in agricultural technical efficiency. Section 4 presents the results and Section 5 concludes.

2. Data

The data used in this study come from the last three rounds of an agricultural household survey in four villages of Jiangsu province (Jiangsu Agricultural Household Survey, JAHS) collected by Center for Chinese Agricultural Policy (CCAP) of Chinese Academy of Sciences (CAS) in 2003, 2007, and 2011. The very first round was conducted in 1988. For more details on the exact survey process, please see Ye and Rozelle (1994). After omitting observations that lacked household farming activities and accounting for sample attrition, we have a three-wave balanced panel dataset of 69 agricultural households containing information from years 2002, 2006, and 2010.

The sample area of the JAHS is typical of rural areas in Eastern and Central China, which contain well-developed agricultural infrastructure and a rapidly developing rural industrial base. In addition, off-farm employment is common as a consequence of a great number of industrial firms in Jiangsu province. Hence, the results from this study have implications for other regions as well, especially for the rapidly developing rural areas of Central and Western China that are in the midst of urbanization and industrialization.

In terms of survey questions on agricultural production, the JAHS asked farmers what kind of crops household are growing and their use of inputs in and outputs

of production. In the survey questionnaires, these crops include rice, wheat, other coarse grains, buckwheat, maize, cotton, other grain, potato, soybean, rapeseed, mulberry leaf, and vegetables. In the survey region of Jiangsu province, the normal cropping system is double cropping, in which households plant rice during a period spanning from spring to fall and then plant wheat or rapeseed during period from fall to the following spring. According to our data, the proportions of households who harvest wheat and rapeseed in spring are about 83 percent and 14 percent, respectively, while 88 percent households harvest rice in fall. Obviously, compared to the three kinds of crops mentioned above, planting scales for other crops are very small. In addition, we have price information on rice, wheat, and rapeseed which stems from the village questionnaire survey. We define the agricultural output as the aggregated output value of rice, wheat, and rapeseed.

Besides output in the agricultural sector, the JAHS also collected information on agricultural inputs such as farmland size, labor (measured as days of farming times for crops, including days of work by family members and hired labor), and capital (agricultural fixed assets, flexible inputs, and expenditure on agricultural services). Agricultural fixed assets include draft animals, agricultural machines, and tools for agricultural transport. Flexible inputs include expenditures on seeds, fertilizers, pesticides, and herbicides. Expenditure of agricultural services is represented by the expenditure for purchases of machinery services for cultivation and harvest. Table 1 presents the summary statistics of the agricultural inputs and outputs mentioned above.