Mechanization outsourcing clusters and division of labor in Chinese agriculture

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ABSTRACT

Despite small landholdings, a high degree of land fragmentation, and rising labor costs, agricultural production in China has steadily increased. If one treats the farm household as the unit of analysis, it would be difficult to explain the conundrum. When seeing agricultural production from the lens of the division of labor, the puzzle can be easily solved. In response to rising labor costs, farmers outsource some power-intensive stages of production, such as harvesting, to specialized mechanization service providers, which are often clustered in a few counties and travel throughout the country to provide harvesting services at competitive prices. Through such an arrangement, smallholder farmers can stay viable in agricultural production.

1. Introduction

In the Wealth of Nations (Smith, 1776), Adam Smith emphasized the gains from specialization arising from two types of division of labor. The first type is division of labor within the firm, as famously illustrated in the example of pin making in a workshop, where ten workers, each doing a specialized task of the set of tasks to make a pin, could make hundreds of times more per day than the ten workers working independently, each doing all the tasks. The second type refers to division of labor across producers as shown in the linen shirt example in Smith’s book. The production of linen shirts was dispersed over many workshops. Smith posited that market size determines the division of labor. Due to a lack of scale, the division of labor in agricultural production is not as common as in industrial production.

Marshall (1920, 167) echoed Smith’s viewpoints in his Principles of Economics:

“In agriculture there is not much division of labour, and there is no production on a very large scale; for a so-called ‘large farm’ does not employ a tenth part of the labour which is collected in a factory of moderate dimensions.”

The latter vision of farming—and its implications for the division of labor and mechanization—was manifest again in Asia from the 1950s to the present. Ruttan (2001) puts forward nearly the same ideas and terms as Smith and Marshall. He emphasizes that using machines for the series of short tasks on tiny farms would imply costly investment in specialized machinery that small
farmers would be loath to make. While recognizing the important role of mechanization in various steps of agricultural production, Pingali (2007, 2790) holds a similarly pessimistic view on rice harvesting mechanization in Southeast Asian countries:

“In the absence of land consolidation and the re-design of the rice land to form large contiguous fields, the prospects for large-scale adoption of the harvester-combines are limited.”

Otsuka (2012) goes further along those lines to note that only on larger farms would the mechanization investment, at least for large machines, pay off to farmers—and thus the path to efficient mechanization must have as a first step a sharp increase in Asian farm size from the current 1 to 3 hectares (ha) average to considerably more. Given that China’s farm size is only one-third that of Japan’s, he warned that Chinese agriculture would likely repeat the path of Japan to rely heavily on subsidies and experience low growth in labor productivity.

Standing in contrast with the above prognosis for the Asian small farm sector to develop a division of labor and to mechanize, this paper shows that China—with farm sizes averaging only about 0.5 ha—has both evolved a division of labor and experienced rapid farm mechanization. There is a paradox: despite rapid increase in real wages in the past decade, China has seen steadily climbing farm output and yields. We show that the explanation of the paradox is that since circa 2004, there has been rapid farm mechanization in the form of both ownership and rental of machines, plus rapid development of farm mechanization “outsource” services that combine the provision of specialized labor and the services of large harvesting machines. The increasing trend of outsourcing mechanization services primarily reflects the second type of division of labor as implied by Adam Smith. Although at the farm level the scale of production is small, certain stages of production, such as harvesting, can be undertaken at a much larger scale, allowing for a division of labor between farmers and mechanization service providers to take place.

This paper focuses on the second type of division of labor in Chinese agricultural production, in particular the emergence of a cluster of farmer cooperatives that sell outsourcing harvesting services (as harvesting is the most “heavy” of the tasks) across provinces for up to eight months a year. By availing of a national labor-cum-machine services market, these migratory specialized mechanization service providers have overcome the small scale of agricultural production at the farm level logically identified by the economists cited above. This has precedent, for example, Akinola (1987) documents how the operators of tractors traveled across regions to provide land preparation services in the 1970s and 1980s in Africa. Even in the US where farm size is much larger than many developing countries, migratory wheat harvesting service was present a century ago (serving farms that were smaller than those today and farmers who did not yet own their own machinery) (Olmstead & Rhode, 1995).

Our paper makes two contributions. First, the paper shows that for China, agricultural production can be as divisible as industrial production; this point has been largely neglected in the history of economic thought. When looking at production of small farmers from this lens, farm size will become a less limiting factor to scale of production if some steps of production can be outsourced. Although our paper is about China, the findings may shed some light on the debate as to whether smallholder farmers are efficient in developing countries in general and sub-Sahara African countries in particular, a topic much debated recently, for example by Collier and Dercon (2013).

Second, the paper contributes to the literature on agricultural mechanization. In the 1980s there was a wave of literature on mechanization and farming systems change in the wake of the Green Revolution (for example, Binswanger, 1986; Jayasuriya & Shand, 1986, and Jayasuriya, Te, & Herdt, 1986). After a mainly dormant period of some three decades, there has been a second wave of literature on mechanization (for example, Takahashi & Otsuka, 2009; Pingali, 2007, and Diao et al., 2012). An important motivation for the second wave of literature has been, as for example Takahashi and Otsuka note, that a spur to and acceleration of mechanization have been driven, on the capacity side, by investment from the investable surplus from the Green Revolution and in labor market development from the rapid spread of rural nonfarm and migration employment, and on the incentive side, by the rural wage increase prompted by this labor market development. This second wave has treated the surge in machine ownership and conventional rental, but not yet the relatively new arrangement of outsourced services provided pan-territorially and pan-seasonally by clusters of service providers, as has been the case in China over the past decade. This paper extends Yang, Huang, Zhang, and Reardon (2013) by offering more detailed information about the inner workings of mechanization harvesting service clusters and developing a conceptual framework to understand the underlying mechanism.

The paper proceeds as follows. Section 2 explores in greater detail the three trends noted above. Section 3 explains the economics of mechanization harvesting services. Section 0 describes the supply of mechanization services based on a primary survey in Peixian County in Jiangsu province. The survey covers farmer cooperatives supplying migratory labor-cum-machine services to a number of provinces in China. Section 0 concludes.

2. The Chinese agricultural paradox and mechanization

There is a paradox in Chinese agriculture in the past three decades—despite the small farm size and massive exodus of labor out of agricultural production, farm output has steadily gained over time. This section explores and explains this paradox and its relation to mechanization.

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1 See [https://uschi.com/index.php]. Interestingly, farmers in the U.S. outsource not only mechanization services but also pollination services. Migratory beekeepers provide pollination services to commercial fruit and nut producers from one area to another (Chang, 1973; Muth, Ruckers, Thurman, & Chuang, 2003).
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