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Are China's Farms Growing?

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Abstract

China's agricultural sector faces challenges because most farms are still small scale. China's policy is to encourage the consolidation of farms and promote farms that are larger in scale. A question that arises is: Are China's farms growing? The goal of the present paper is to determine whether large farms in China have emerged or if farms remain small. To meet this goal, we systematically document the trends in the operational sizes of China's farms and measure the determinants of changes in farm size. Using a nationally representative dataset, the study shows that in 2013 China's farming sector was still mostly characterized by small-scale farms. However, at the same time, there is an emerging class of middle-sized and larger-sized farms. Most large farms are being run by households but there is a set of large farms that are company/cooperative-run. Today, farmers on larger farms are younger and better educated than the average farmer.

Key words: emergence, large scale, operational farm size, rural China, small scale
JEL: Q12, Q15, O53

I. Introduction

One of the most salient characteristics of Asian agriculture, especially during periods of development, is the small scale of farm size. Otsuka *et al.* (2014) show that small-scale family farms (mainly managed and operated by family labor) dominate the landscape across

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Asia. The World Bank's Rural Development Strategy defines smallholders as those with a low asset base, operating less than 2 ha of cropland (Csaki and De Haan, 2003). It is estimated that approximately 87 percent of the world's 500 million small farms (less than 2 ha) are in Asia and the Pacific region (Hazell *et al*., 2007). China and India alone account for nearly 300 million small farms.

While there are many advantages to an agricultural system that is based on small farms (Carter, 1984; Lamb, 2003), such an agricultural structure poses challenges on a national scale. For example, it has been argued that it is difficult for small farms to integrate into modern supply chains (Gulati *et al*., 2007; Poulton *et al*., 2010), to adapt to climate change (Ostwald and Chen, 2006) and to deal with market volatility and other risks (Hazell *et al*., 2010; Huang *et al*., 2012). Smallholders have also been shown to use high levels of inputs, such as chemical fertilizers and pesticides, which sometimes have adverse impacts on the environment (Thapa and Gaiha, 2011; Jones and Kimura, 2013).

Another developmental challenge of a small farm-based agricultural structure, especially one based in the context of a rapidly developing economy, is that it is difficult to provide income levels for farm workers that are high enough to attract young, well-educated and innovative farmers (De Janvry and Sadoulet, 2001; Kirstensen and Birch-Thomsen, 2013; Cassidy and McGrath, 2015). The gaps between urban and rural incomes across a large number of countries drive the bias against farming as an occupational choice for young individuals (Yang and Cai, 2003). In many countries, younger and more educated workers are the first to choose to migrate to the cities in search of off-farm jobs (Levy and Wadycki, 1974; de Brauw *et al*., 2002). Because of this trend, rural areas are often populated by older and less educated farmers (Pingali, 1997; Oizumi *et al*., 2006). For example, in 2010, the average age of farmers in Japan was 66 years old and 56 percent of rice farmers were over 70; another 36 percent were between 50 and 70 years old (MAFF, 2010). There is concern by leaders in such countries that having older, less educated farmers could lead to a stagnating agricultural sector and cause a host of developmental, environmental and food security problems (Bennell, 2007; Bezu and Holden, 2014; Folefack, 2015; Qiao *et al*. 2015).

Many developing Asian countries have sought to address the perceived problems associated with having small, farm-based agricultural economies by encouraging the consolidation of farms and the emergence of larger-scale farm enterprises, although, at best, these countries have met with mixed success. For example, Japan has had policies encouraging farm consolidations for more than 50 years; unfortunately, farm sizes in Japan today are still only marginally larger than when these policies were implemented (MAFF, 2012). The same patterns are repeating themselves in other East Asian economies, such as Korea and Taiwan (Kuo, 2014; Seo, 2014). Policies in these countries/regions that have tried to increase the scale of farming have largely failed as the average sizes of farms are still

small and only marginally larger than they were decades ago.

The literature on China's agriculture shows that the nation is following the pattern of its neighbors in East Asia: at least during the early period of economic development (the 1980s to the early 2000s). When China was still a poor economy, its farming sector was characterized by small-scale farms. In 1985, the average farm size in China was only 0.7 ha (Huang *et al*., 2012). In 2000, the average farm size had actually fallen to 0.55 ha (NSBC, 2011).

Due in part to the small scale of farms, as China's economy began to modernize and employment off the farm became available, farming resembled the struggling agricultural sectors that characterized the rest of East Asia. Income inequality between farmers and non-farmers increased significantly between the 1980s and the 2000s (Rozelle *et al*., 2005). Over this period, there was little incentive for rural individuals to work on the farm, especially for younger and more educated individuals. In the mid-2000s, for example, only 6 percent of individuals in the labor force between the ages of 18 and 35 were farming full time (Huang *et al.*, 2012). At the same time, the common perception of those still engaged in farming was that the on-farm labor force was mostly made up of elderly men and middle-aged women (Zhang *et al*., 2004). International research suggests that small and fragmented farming systems cause a number of problems, including issues related to food safety (Huang *et al*., 2008), the absence of innovation in the agricultural sector (Ghadim and Pannell, 1999), low investment by farmers and the private sector (Wiggins *et al*., 2010), and rising imports and falling food security (Masters *et al*., 2013).

In the 2000s, as China moved into the ranks of upper-middle income countries, leaders began to consider policies to manage agriculture, focusing in particular on how to expand the scale of farming. For example, China's government enacted the *Rural Land Contracting Law* (2003) and the *Property Law* (2007) to intensify the protection of land rights, to permit transfers of lands between households and to promote land consolidation (Li, 2003). In 2014, the central government released a new policy aimed explicitly at expanding the operational size of farms as a way to improve agricultural efficiency and raise the income of farmers (Chen *et al.*, 2015; Shen, 2015). The Ministry of Agriculture has determined the expansion of farm size to be one of its main goals in the upcoming 13th Five-year Plan. [1]

However, evidence of the success of these policies at expanding farm size is lacking. To our knowledge, there has been no academic paper published using data from after 2010. We believe that 10 years is the minimum amount of time that it would take for the effects of the farm scale policy initiatives of the early 2000s to manifest, and, therefore, the results of

[1]See: http://finance.sina.com.cn/china/20150807/085722903392.shtml?qq-pf-to=pcqq.c2c .

the previous research on this topic cannot speak to the current situation of China ’s agricultural sector.

Recently, there have been a number of reports in the media of successes in expanding farm size and increasing the income of farmers (Xu and Yin, 2010; Chen and MOA, 2013; Tan, 2013; Song, 2014). However, the evidence presented by these sources is anecdotal at best. Without empirical studies on this topic using large-scale representative data collected within recent years, many questions concerning the effect of farm size are left unanswered. In particular, little is known about the current operational size of farms in China and whether there has, indeed, been an increase or decrease in farm size in recent years. In addition, research is warranted on the scale of large farms and the exact nature of their ownership (i.e. are the large-scale farms household-run, company-run or run under some other form of ownership, such as a cooperative).

The purpose of the present paper is to examine whether there is a new reality in China ’s farming sector in terms of the emergence of large-scale farming. We attempt to do this by examining whether there has been any serious movement towards the emergence of large farms since the implementation of new policies in 2000. To meet this goal, the present paper has several specific objectives. First, we will systematically document the empirical trends of the operational sizes of China ’s farms over the past decade. In doing so, we will also seek to identify who is becoming involved in operating larger farms in contemporary China. In addition, we will measure the determinants of the operational farm size and seek a better understanding of the decisions of farmers concerning farm size.

The rest of the paper is structured as follows. Section II describes the data used in this paper. Section III documents the trends of China ’s operational farm size from 2007 to 2013. Section IV provides the descriptive statistics of typical farmers and explores the methodology and the results of the estimation from the regression analysis. Section V concludes.

II. Data

Our main data source is the 2008 and 2014 China Rural Land Survey (henceforth, 2008/2014 CRL Survey). This survey was run by the authors in collaboration with colleagues at the Center for Chinese Agricultural Policy at the Chinese Academy of Sciences (CCAP-CAS). In this survey, 60 villages were randomly selected from 30 towns in 15 counties located in five provinces. The fieldwork team was comprised of staff members from CCAP-CAS and 30 graduate students and research fellows. This fieldwork team chose the sample and implemented the survey.

The sample villages were selected following a detailed protocol. First, five provinces

were each randomly selected to represent five of China's major agro-ecological zones: Jiangsu in the eastern coastal region; Sichuan in the south-west; Shaanxi in the north-west; Hebei in the central region; and Jilin in the north-east. Next, 3 counties were selected from each province, 1 from each tercile from a list of counties arranged in descending order according to per capita gross value of industrial output (GVIO).[2] GVIO was used because this measure has been shown to be one of the best predictors of the standard of living and development potential and is often more reliable than net rural per capita income (Rozelle, 1996).

After the counties were selected, the sampling protocol continued to systematically create a representative sample. Within each county, the survey team chose 2 townships, one from each half of a list of townships arranged in descending order of per capita GVIO. Finally, within each township, the survey team chose 2 villages, following the same procedure as the township selection. In each village, 20 sample households were randomly chosen from each village using the village's hukou roster. In total, 1200 households were surveyed. Because of data problems with 1 household, in the end we collected valid information on 1199 households.

In the 2014 survey we went back to the same villages that were surveyed in 2008. Survey questionnaires in both rounds of surveys were kept as similar as possible. Because of attrition in the second round (mainly due to households moving out of the village and deaths of several of the elderly respondents), we collected valid information on 1163 households, which are included as a part of our household-level data.

Our analysis makes use of these household-level data to create two datasets, which we refer to as our ***full dataset*** and our ***true panel dataset***. In part of our analysis, we use our full dataset, which includes the full samples from both waves (1199 households in 2008 and 1163 households in 2014). From these two waves of data, we also constructed a true panel dataset. This dataset includes 916 households due to the fact that we had to drop a number of households that could not be compared over time. Specifically, we excluded households that belonged to any one of the following groups: households that divided up property and "split their household" (in Chinese, fenjia) between 2007 and 2013 (due to reasons such as marriage or the death of a family member); households that had any missing records of land property by plot (e.g. own land, renting-in land and renting-out land); and households that had any missing records of off-farm employment status.

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[2]Specifically, we divided the list of all counties into groups of three: the richest one-third (or top tercile) in terms of income/GVIO; the group of counties that were in the middle one-third of the income/GVIO distribution (second tercile); and the poorest one-third (or third tercile). We then randomly selected 1 county from each tercile.

At the same time as the household-level data collection, enumerators also executed a village-level survey form. This survey asked questions of the village leader and village accountant and, where possible, solicited village records. In total we collected 60 village forms in 2008 and 60 village forms in 2014. In the rest of the paper this is referred to as the *village-level data*.

1. Household-level Variable Definition

Using our household-level data, we created our main outcome variables: operational farm size, contracted farm size and land rental activities. To create these variables, we relied on information collected from the "cultivated land" block of the household survey form. To obtain information on the total amount of cultivated land that a household contracted-in, we asked the household to count each plot that the village assigned to him/her for cultivation. Where possible, this total was verified by the contract land that was specified in a villager 's contract. We then asked the farmer-respondent to tell us the size (in mu) of every contracted-in plot. The sum of the sizes of the individual contract plots became our measure of *contract farm size*. In the paper, we convert mu into hectares by multiplying by a factor of 15 (15 mu = 1 ha).

We also used the same block of data to produce estimates of *operational farm size* and *net rented farm size*. After enumerating each of the contracted-in plots of a respondent, we asked if any of them was rented out (henceforth, *rented-out land*). We also asked if beyond the contracted-in cultivated land, did the farmer rent in land from other farmers (*rented-in land*). The difference between the sizes (measured in hectares) of all of the *rented-out land* plots and the size of all of the *rented-in land* is *net rented farm size. Operational farm size* (measured in hectares) is just *contract farm size* plus *net rented farm size*.

The household-level dataset was also used to create a series of variables that we can use as measures of the characteristics of the sample households and the head of the household. Specifically, we measured the household *head's age* (in years) and the household's *highest education* level (measured as the highest level of education attained among the household members and reported in years). We also asked the household head if he/she was involved with working on the household 's own farm (*head works on farm*; yes = 1; no = 0). The household-level dataset was also used to produce measures of the *share of household members that work off farm* which is calculated by the number of household members that work off farm divided by the size of the household (measured as the sum of all core household members and other individuals that resided in the household during the survey year for more than 3 months).

2. Village-level variable definition

The village-level dataset was used to create five variables that are used in the analysis. Village accountant records were used to obtain measures of average ***village land endowment per household*** (in hactares) and ***village net income per capita*** (in thousands of yuan). Village leader interviews produced information that was used to create variables on the ***distance from village office to the nearest asphalt road*** (in kilometers) and the ***number of enterprises*** in the village (each). Finally, we also used data from the 2008 and 2014 village-level surveys to create a variable called ***forested land per household*** as a measure of unarable land within each village.

III. Change of Operational Farm Size in China, 2007–2013

1. Household-level Changes in Operational Farm Size

According to our data, although the scale of farming in China has been increasing, this increase has been occurring at a modest rate. Using all households in our sample, [3] data from the full dataset show that the average operational size of a farm was 0.59 ha in 2007. By 2013, the average operational size of a farm had risen to 0.62 ha (Table 1, row 1, columns 1 and 2). In percentage terms, the increase in size of operational farms must be characterized as best as "modest." Between 2007 and 2013, the operational size of China 's farm on

Table 1. Change of Farm Size in Rural China, 2007 and 2013

Province	All households				Households with farming			
	Operational farm size (ha)		Number of households (*n*)		Operational farm size (ha)		Number of households (*n*)	
	2007	2013	2007	2013	2007	2013	2007	2013
Sample total	0.59	0.62	1199	1163	0.64	0.68	1105[a]	1056[b]
Jiangsu	0.45	0.42	239	240	0.49	0.50	217	201
Sichuan	0.22	0.22	240	232	0.24	0.24	223	215
Shaanxi	0.48	0.47	240	230	0.49	0.47	236	227
Jilin	1.25	1.38	240	227	1.41	1.56	214	202
Hebei	0.53	0.61	240	234	0.59	0.67	215	211

Note: [a]7.8 percent non-farming households in 2007. [b]9.2 percent non-farming households in 2013.

[3]In 2007, of the 1199 households in the sample, 94 households did not engage in farming. In other words, 7.8 percent of the households in the sample were non-farming households. In 2013, the share rose slightly. In 2013, of the 1163 households in the sample, 107 households did not engage in farming. Hence, 9.2 percent of households in the sample were non-farming households.

average rose by around 5 percent or 0.03 ha. In short, this can be considered modest because, on average, farm scale is rising (which was different than the situation in the 1980s and 1990s in China, where farm size was falling, and which also was different to the case in other East Asian countries, as discussed above), but, in no way can this be considered a systematic shift towards large-scale farming for the typical farming household.

Due to concerns that using the full sample may underestimate our results we remove the non-farming households from our sample and find that the measured operational farm size trends are roughly the same. According to our data, of the 1199 households in the 2007 sample, 7.8 percent were non-farming families. In 2013, of the 1163 households in our sample, 9.2 percent were non-farming families. Therefore, while the share of non-farming households rose between 2007 and 2013, the rise was only modest (1.4 percentage points). When we remove these households from the dataset, the average size operational farm is 0.64 ha for 2007 and 0.68 ha for 2013 (a rise of approximately 6 to 7 percent). Hence, even controlling for the influence of non-farming households, farm size appears to have only increased modestly between 2007 and 2013. Our findings are likely truly nationally representative as our measures of operational farm size are close to those that are calculated with data released by the State Council. According to the State Council ’s official website, China’s average operational farm size was around 0.6 ha in 2013. [4]

While the rise of operational farm size has been modest, when we disaggregate our results in terms of villages, we find that there are two distinct patterns in the change of operational farm size between 2007 and 2013. According to our data, 32 villages (53 percent) experienced a fall in the operational sizes of their farms between 2007 and 2013. In these 32 villages, farm size fell by 0.09 ha on average. In contrast, operational farm size rose in 28 villages (47 percent) during the same period. In these 28 villages, the operational size of the farm rose by 0.2 ha.

Next, we seek to determine what types of villages experienced increases and decreases in operational farm sizes over the past several years. To do so, we use our village-level data (n =60) to examine what village characteristics are associated with changes in operational farm sizes between 2007 and 2013.

According to our data, between 2007 and 2013 there is a clear correlation between changes in the operational size of a village ’s average farm and changes in the village ’s forested area. Specifically, the average size of a village ’s forested land in the 32 villages that experienced falling operational farm sizes actually rose by 0.75 ha per household (Table 2, panel A, row 1, column 7). In contrast, in the 28 villages that experienced rising operational

[4]See: http://www.gov.cn/gongbao/content/2014/content_2644805.htm .

Table 2. Characteristics of Villages with Increasing and Decreasing Operational Farm Sizes, 2007 and 2013

	Forested land (ha)		Number of households		Forested land per household (ha)		
	2007	2013	2007	2013	2007	2013	Difference
Panel A: 60 villages							
Villages that had decreased operational farm size (32)	207	375	405	479	0.62	1.37	0.75
Villages that had increased operational farm size (28)	165	141	434	573	0.66	0.58	−0.08
Panel B: 56 villages[a]							
Villages that had decreased operational farm size (31)	211	383	405	453	0.63	1.41	0.78
Villages that had increased operational farm size (25)	180	158	418	438	0.73	0.65	−0.08

Note: [a]The sample villages do not include the four villages that were involved in mergers between 2007 and 2013.

farm sizes, the average size of the village's forested land decreased (Table 2, panel A, row 2, column 7).[5] In short, villages that experienced changes in the average operational size of their farms appear to have experienced offsetting changes in their village 's forested area.

While we cannot tell from our data, the changes in the allocation between forested and cultivated land may occur for a number of reasons. For example, the implementation of China's Conservation Set Aside Program (or Grain for Green [Uchida *et al.*, 2005]) aimed to increase forested area at the expense of cultivated area. Apart from Grain for Green, the emergence of local agricultural economies may have induced changes in village land allocations. It is possible that in certain areas farmers moved away from cultivating hilly, terraced land in row crops or moved into orchards or other tree crops/forest activities, which are both changes that could result in a decrease in cultivated area.

Although farm size has not risen dramatically for the average household, there is a rise

[5]Furthermore, in performing the analysis on the relationship between operational farm size and forested area, we discovered that in the case of 4 villages overall area (and the overall number of households) rose due to the fact that the 4 villages were part of a village merger initiative (in which 2 or more villages in a town are combined into 1, often doubling the number of households and cultivated area in village-level statistics). As part of a robustness check, we re-did our analysis on forested land per household using data excluding the 4 villages that were involved in mergers between 2007 and 2013. According to our data (Table 2, panel B, rows 3 and 4, column 7), the results from the data without the 4 villages are almost the same as the results with the 4 villages (the results reported immediately above). From 2007 to 2013, the average area of forested land in the 31 villages that experienced falls in operational farm sizes rose, while the average area of forested land in the 25 villages that experienced rises in operational farm size decreased.

Table 3. Operational Farm Size in Rural China (Sample Size, *n* and ha), 2007 and 2013

	(0, 0.1]		(0.1, 0.5]		(0.5, 2]		(2, 4]		(4 ha and larger)		
Province	Households (n)	Average farm size (ha)	Households (n)	Average farm size (ha)	Households (n)	Average farm size (ha)	Households (n)	Average farm size (ha)	Households (n)	Average farm size (ha)	*N*
Panel A: 2007											
Sample total	99	0.06	560	0.28	393	0.96	47	2.7	6	5.57	1105
Jiangsu	11	0.07	119	0.32	86	0.76	1	2.67	0	0.00	217
Sichuan	50	0.06	153	0.24	20	0.64	0	0.00	0	0.00	223
Shaanxi	18	0.07	143	0.28	73	0.94	2	2.43	0	0.00	236
Jilin	16	0.04	40	0.26	109	1.28	43	2.72	6	5.57	214
Hebei	4	0.06	105	0.32	105	0.86	1	2.27	0	0.00	215
Panel B: 2013											
Sample total	126	0.06	512	0.28	362	0.92	40	2.71	16	6.65	1056
Jiangsu	24	0.04	93	0.34	81	0.72	2	2.17	1	5.20	201
Sichuan	46	0.05	152	0.25	17	0.64	0	0.00	0	0.00	215
Shaanxi	30	0.06	128	0.27	66	0.94	3	2.92	0	0.00	227
Jilin	20	0.05	37	0.24	97	1.34	35	2.72	13	6.08	202
Hebei	6	0.08	102	0.31	101	0.86	0	0.00	2	11.10	211

in the number of large farms within our study period (Table 3). According to our data, the number of farms with operational sizes greater than 4 ha more than doubled, increasing from 6 households in 2007 to 16 households in 2013 (Table 3, rows 1 and 7, column 9). In terms of farms with operational sizes greater than 2 ha, the number of households also rose slightly, increasing from 53 in 2007 to 56 in 2013 (Table 3, rows 1 and 7, columns 7 and 9).

Significant variations exist between provinces in regards to the change in the number of large farms between 2007 and 2013 (Table 3, rows 2 –6 and rows 8–12). By far, the largest rise in the number of operational farms larger than 4 ha was observed in Jilin Province (from 6 households in 2007 to 13 households in 2013). The number of large farms also rose in Hebei (from 0 to 2) and Jiangsu (from 0 to 1) within this time period (Table 3, column 9). In terms of the number of farms larger than 2 ha, the number rose slightly in Jilin, Shaanxi and Hebei (Table 3, columns 7 and 9). The province with the largest number of farms that grew from 2 ha to 4 ha was Jilin.

So how do we characterize the growth of large farms? On the one hand, the increases in the number of large farms are still modest and concentrated in specific parts of the country (i.e. in the north-east). In relative terms, only 0.54 percent of households operated farms that were greater than 4 ha in size in 2007; by 2013, this percentage had only increased to 1.52 percent of households (Table 4, rows 1 and 7, column 9). The number of farms that grew from larger than 2 ha to larger than 4 ha was even less in percentage point terms, rising from 4.79 percentage in 2007 to 5.31 percentage in 2013 (Table 4, rows 1 and 7, columns 7

Table 4. Operational Farm Size in Rural China (Percent and Ha), 2007 and 2013

	(0, 0.1]		(0.1, 0.5]		(0.5, 2]		(2, 4]		(4 ha and larger)		
Province	Households (n)	Average farm size (ha)	Households (n)	Average farm size (ha)	Households (n)	Average farm size (ha)	Households (n)	Average farm size (ha)	Households (n)	Average farm size (ha)	%
Panel A: 2007											
Sample total	8.96	0.06	50.68	0.28	35.57	0.96	4.25	2.7	0.54	5.57	100
Jiangsu	5.07	0.07	54.84	0.32	39.63	0.76	0.46	2.67	0.00	0.00	100
Sichuan	22.42	0.06	68.61	0.24	8.97	0.64	0.00	0.00	0.00	0.00	100
Shaanxi	7.63	0.07	60.59	0.28	30.93	0.94	0.85	2.43	0.00	0.00	100
Jilin	7.48	0.04	18.69	0.26	50.93	1.28	20.09	2.72	2.80	5.57	100
Hebei	1.86	0.06	48.84	0.32	48.84	0.86	0.47	2.27	0.00	0.00	100
Panel B: 2013											
Sample total	11.93	0.06	48.48	0.28	34.28	0.92	3.79	2.71	1.52	6.65	100
Jiangsu	11.94	0.04	46.27	0.34	40.30	0.72	1.00	2.17	0.50	5.20	100
Sichuan	21.4	0.05	70.70	0.25	7.91	0.64	0.00	0.00	0.00	0.00	100
Shaanxi	13.22	0.06	56.39	0.27	29.07	0.94	1.32	2.92	0.00	0.00	100
Jilin	9.901	0.05	18.32	0.24	48.02	1.34	17.33	2.72	6.44	6.08	100
Hebei	2.844	0.08	48.34	0.31	47.87	0.86	0.00	0.00	0.95	11.10	100

and 9). In addition, most of this large farm growth came from Jilin Province, which suggests that such development is not characteristics of China's agricultural sector as a whole.

Moreover, while there has been a measureable rise in the number of large farms, the fact remains that even in 2013 a large number of the farms in China are still less than 0.5 ha in size (Table 3, columns 1 and 3). According to our data, there were 638 households with operational farm sizes less than 0.5 ha in 2013. Only 21 households expanded their operational farm sizes to more than 0.5 ha between 2007 and 2013. The number of households with less than 0.5 ha of operational farm land did not change much within this time period, as it only decreased from 659 in 2007 to 638 in 2013. In other words, in both periods around 60 percent of households were operating farms that were less than 0.5 ha in size (Table 4, columns 1 and 3, rows 1 and 7).

Although there are still a few large-scale farms in China, when we look at the share of the overall cultivated area, larger farms appear to be at a stage of early emergence. If we take the share of farms in each size category and multiply by the average farm size, we see that there has been an appreciable rise in the share of overall cultivated land that is farmed by those households with operational farm sizes greater than 2 ha. According to our data, 4.79 percent farmers who operated farms greater than 2 ha farmed 14 percent of the cultivated land in China in 2007 (Table 4, row 1, columns 7–10). By 2013, a slightly higher share of farmers (5.31 percent) that were operating farms greater than 2 ha and were farming 20 percent of the cultivated land (Table 4, row 7, columns 7–10). In other

words, there was a 6-percentage-point (43 percent) increase in the share of overall cultivated land that was operated by China's largest farmers.

In summary, China's household-level farming sector is still characterized by small-scale farming. However, there are signs that a new class of farmers is emerging. This rise is modest: both in terms of the increase in the number of farms and the average size of farms. However, according to our data, around 5 percent of China 's farmers are now cultivating approximately 20 percent of China 's cultivated area. This increase is non-trivial in comparison to the shifts in operational farm size experienced in many other agricultural economies in East Asia.[6]

2. Non-household Farming Entities

In the previous section we focused exclusively on household farms. This approach is reasonable because most farms in China have been household-operated since the mid-1980s and, therefore, the household is the most appropriate unit of analysis. However, our survey data also includes information on non-household farming entities. It is these non-household farms that are the focus of this subsection of the paper.

In our survey we solicited information from village leaders to better understand the current state of farming companies within China. Specifically, the village leader reported whether there were any farming companies that were cultivating land in the village and how much land the companies were farming. We also asked questions concerning the source of the land of these companies. For example, we solicited information on whether the companies cultivated land rented-in that was from farmers or under the direct control of the village (*jidongdi*). In addition, enumerators asked village leaders about the existence of farming cooperatives and how much land was farmed under the cooperatives. Because there are many different types of cooperatives in China, to understand the average size of land each person in the cooperative was farming, we also gathered information on the number of cooperative members that were active in the cooperative 's farming activities.

According to our data, there are farming companies actively farming in our sample villages. Of the 60 villages in our sample, 8 villages (13 percent) reported the presence of

[6]It should be noted that, while the percentage rise that we measure is most likely relatively accurate (using our data), it may be that we are overestimating the shares of cultivated area (in 2007 and 2013) that are cultivated by the large farmers. This is because in our sample these larger farmers are almost all in our Jilin sample. In our sample, the observations in Jilin are 20 percent of our total number of observations. However, if Jilin is considered to be representative of the north-east provinces (Liaoning, Jilin and Heilongjiang), the north-east actually only accounts for approximately 15 percent of China 's cultivated area (and a smaller share of China 's sown area).

Table 5. The Scale and Source of Cultivated Land of Company-run Farms in Rural China, 2013

Province	Village code	Size of cultivated land farmed by company-run farms (ha) (1)	Average operational farm size of household-run farms (ha)			Total size of cultivated farm land in the village (ha) (5)	Cultivated land available for households (ha) (6) = (5) − (1)	The percentage of total cultivated area operated by company-run farms (%) (7)=[1 − ((6)/(5))]
			Before renting out to company (2)	After renting out to company (3)	Households renting land to company (4) = (2) − (3)			
Jiangsu	1121	13	0.33	0.26	0.07	268	256	5
	1122	207	0.30	0.09	0.21	221	15	93
	1312	39	0.69	0.69	0	369	331	—
	1411	15	0.31	0.29	0.02	108	93	14
Sichuan	3312	2	0.18	0.18	0	199	197	—
	3321	15	0.21	0.19	0.01	75	60	20
Jilin	5211	61	0.30	0.22	0.09	125	65	48
	5212	20	0.65	0.56	0.09	70	50	29

companies that were engaged in farming. To the best of our knowledge, there were almost no companies farming in 2007. Therefore, this agricultural business sector has been developing within our study period.

We also found that the emergence of company-run farms does not necessarily crowd out the operations of household farms. Specifically, in 2 of the 8 villages with company-run farms, companies were cultivating land that they rented directly from the village (*jidongdi*) and did not rent-in land from households. Due to the fact that China's land contracting laws and policies restrict the amount of land that can be held as *jidongdi*, the size of these company farms is modest, at only 20.5 ha per farm on average (Table 5, rows 3 and 5, column 1).

Moreover, although the share of villages with farming companies increased, the share of the village's household-cultivated land that is operated by these farming companies is actually quite small. According to our data, the average size of company-run farms using household-controlled land was 55 ha on average (Table 5, rows 1, 2, 4, 6, 7 and 8, column 1). [7] In addition, 1 of the 6 villages with company-run farms was more than half of the village's cultivated land (93 percent) cultivated by company farms (Table 5, row 2, column 7). Given that, on average, the company-run farms cultivate 35 percent of a village's land and company-run farms using household-controlled land are present in only 10 percent of our sample

[7]While a 55-ha farm is not small, in fact, the farm size in 1 of the villages with company-run farms using household-controlled land was extremely large (207 ha). When looking at the other 5 villages with company-run farms using household-controlled land, the size of the company-run farms is 24.8 hectares, much nearer the average size in the size of the company-run farms in the villages with the company run farms using village-controlled land (20.5 ha).

villages, our survey suggests that only 3.5 percent of all of China ’s cultivated land is being cultivated by large company-run farms who rent land from households.

Our research finds that large farms run through cooperatives are farming an even smaller share of China’s cultivated area. According to our data, 18 villages reported that some type of cooperative was engaged in land-based farming activities in the village in 2013. However, as seen from our data (Table 6), most of the cooperatives were still being organized around small-scale household farms. In only 2 of the villages (village 5212 and village 6121) were the average per capita farms larger than 2 ha (Table 6, rows 13 and 18, column 3). In each of these 2 villages, the total size of cultivated areas under the control of the cooperatives was only 23 ha on average (Table 6, rows 13 and 18, column 3).

In summary, if we calculate the share of cultivated land farmed by company-run farms and cooperatives, only around 4 percent of China ’s cultivate land is cultivated by these non-household entities. This is assuming our data are representative of China ’s farming sector.

Table 6. Scale of Farms That Are Being Operated as Cooperatives, 2013

Province	Village code	Number of persons in each farmer cooperative	Size of land in cooperative (ha)	
			Total	Per capita[a]
Jiangsu	1111	250	66.7	0.27
	1121	160	203.3	1.27
	1312	2000	200.0	0.10
	1411	73	1.0	0.01
	1412	15	8.0	0.53
	1422	8	0.3	0.04
Sichuan	3521	360	66.7	0.19
Shaanxi	4211	160	13.5	0.08
	4412	36	14.0	0.39
	4421	21	0.9	0.04
	4422	61	17.1	0.28
Jilin	5211	80	2.0	0.03
	5212	12	33.3	2.78
	5222	7	1.0	0.14
	5321	50	0.4	0.01
	5421	130	110.0	0.85
Hebei	6111	16	0.7	0.04
	6121	6	13.3	2.22

Source: Authors’ survey.

Notes: [a]Column (4) is derived by dividing column (3) by column (2). The number of villages in sample is 60.

IV. The Determinants of Operational Farm Size in China

1. Who Is Farming?

This section aims to describe who the typical farmer in China is. We will do this by examining the demographic characteristics of the households that are operating farms, both in terms of all farm sizes and exclusively large farms. To do this, we first present descriptive statistics of the average farmer/farming household in our sample (Table 7).

According to our data, the average age of the household head of the total sample is 51 years old (Table 7, row 2, column 1). Our data suggest that the operators of China 's farming sector are ageing. Within our study period the share of household heads under the

Table 7. Characteristics of Farmers, Farming Households and Farming Villages by Operational Farm Size, 2007 and 2013

Variables:	Total Sample		Up to 0.5 ha		Greater than 2 ha		(7) *p*-value (3) versus (5)
	(1) Mean	(2) Standard deviation	(3) Mean	(4) Standard deviation	(5) Mean	(6) Standard deviation	
Operational farm size (ha)	0.62	0.85	0.22	0.15	3.11	1.67	<0.01
Head's age	50.98	10.06	51.70	10.50	46.37	8.21	<0.01
Highest education (years)	10.46	23.28	9.91	2.95	10.01	2.38	0.73
Head works on farm (yes = 1; no = 0)	0.84	0.37	0.78	0.41	0.93	0.25	<0.01
Share of household members that work off farm (%)	36.39	27.43	40.31	27.71	27.00	25.25	<0.01
Village land endowment per household (ha)	0.59	0.74	0.43	0.78	1.44	0.70	<0.01
Village net income per capita (1000 yuan)	5.49	4.21	5.63	4.32	4.86	3.32	0.07
Distance from village office to nearest asphalt road (km)	0.88	2.77	0.64	2.37	0.82	1.82	0.45
Number of enterprises in the village	4.32	11.45	5.56	13.16	2.42	9.91	0.02
Forested land per household (ha)	0.81	2.19	0.96	2.47	0.78	0.81	0.46

age of 35 fell from 56 household heads in 2007 to only 15 household heads in 2013. In contrast, the share of farms operated by household heads that were older than 55 years old rose from nearly 40 percent in 2007 to 55 percent in 2013.

Our data also show that China's typical farmer has a fairly low level of education. Specifically, the average level of educational attainment of the sample farming households is approximately 10 years (Table 7, row 3, column 1). This level of education implies that the typical farmer has graduated from junior high school, but has not completed high school. According to our data, 84 percent of household heads in our sample work on the farm (Table 7, row 4, column 1). In addition, farmers in China today appear to have fairly good access to roads. According to our data, the average distance from the village center to the nearest asphalt road is only approximately 0.88 km (Table 7, row 8, column 1).

Table 7 also allows us to examine the characteristics of those farmers that are operating larger farms. According to our data, households with younger household heads tend to operate larger farms (Table 7, row 2, columns 3 and 5) and a higher share of their household heads work on the farm (Table 7, row 4, columns 3 and 5). The average age of a household head cultivating land greater than 2 ha is 6 years younger than those operating farms less than 0.5 ha. Interestingly, there were no clear differences in the educational levels between small-scale farmers and large-scale farmers. However, households with larger farms have a higher share of their household heads that work on farms (Table 7, row 4, columns 3 and 5).

The emergence of large farms is also related to a number of village characteristics. As shown in columns 3–6 of Table 7, large-scale farmers operate in those villages that are farther away from roads than small-scale farmers. According to our data, the difference in the distance is 0.18 km (Table 7, row 8, columns 3 and 5). In addition, we found that the share of villages with large farmers is lower in villages with more enterprises, less land endowment per household and more forested land per household (Table 7, rows 6, 9 and 10, columns 3 and 5).

2. Multivariate Analysis

The purpose of this subsection is to identify the main determinants that affect the decision to operate large-scale operational farms using a multivariate framework. To do this, we present the results of the OLS (household fixed effects and cross-section) regression, which will help us identify the correlates of farm size. We use the following empirical model:

$$L_{it}=b+\sum_{h=1}^{4} l_h H_{it}^{h}+\sum_{v=1}^{5} g_v V_{jt}^{v}+f_i+e_{it} \tag{1}$$

$$L_i=a_0+\sum_{h=1}^{4} d_h H_i^{h}+\sum_{v=1}^{5} q_v V_j^{v}+\sum_{d=1}^{4} w_d D+T_{2013}+u_i\,. \tag{2}$$

In Equations (1) and (2), subscript i represents the ith household and j stands for the jth village. The symbol t refers to the study year; that is, 2007 or 2013. The dependent variable, L_{it} or L_i, is the actual operational farm size (measured in hectares). H_{it} or H_i is a vector of variables that measures the characteristics of the household and includes ***head's age***, ***highest education*** level of a household member (linear and squared terms), ***head works on farm*** and ***share of household members that work off farm***. V_{jt} or V_j is a vector of village-level variables that includes five village-level variables: ***village land endowment per household***, ***village net income per capita***, ***distance from village office to the nearest asphalt road***, ***number of enterprises in the village*** and ***forested land per household***. D represents four province-level dummy variables. T_{2013} is a year dummy. The term f_i is an unobserved time-invariant effect used to control household fixed effects. The symbols e_{it} and u in Equations (1) and (2) are the disturbance terms.

To estimate the models from Equation (1) we use an OLS regression approach with the dependent variable, L_{it}, measured as a continuous variable with our true panel dataset. Methodologically, using these data (and including household-level dummy variables) allows us to use our estimation model to control for unobserved, time-invariant household characteristics. The results are presented in column 1 of Table 8. Furthermore, we use the cross-section dataset to estimate Equation (2), the results of which are presented in columns 2 and 3 in Table 8.

Most of the multivariate findings (reported in Table 8) are consistent with the descriptive results from Table 7. For example, Table 8 demonstrates that there is a negative relationship between the age of the household head and the household 's operational farm size that is significant at the 1-percent level (Table 8, row 1, columns 2 and 3). In addition, our multivariate results also suggest that larger-scale farms are positively correlated with the farm labor of the household head (Table 8, row 4, columns 2 and 3) and negatively and significantly related to the share of household members that work off the farm (Table 8, row 5, columns 2 and 3).

Our multivariate analysis also produced findings different from those of the descriptive statistics. Specifically, our results show that there is an inverse U-curved relationship between the level of education and operational farm size (Table 8, rows 2 and 3). The coefficient on the linear terms of the household head 's education level variable is positive, while the coefficient on the squared term is negative, and both are statistically significant. This means that as the level of education of rural farmers moves from low to middle levels, operational farm size rises; however, after a certain point (as the level of education continues to rise from middle to higher levels), operational farm size levels out and then falls.

Importantly, the year dummy is positive and significant (Table 8, row 15, column 3).

Table 8. Determinants of Operational Farm Size, 2007 and 2013

	Dependent variables: Operational farm size (ha)		
	Household fixed effects	OLS	
	(1)	(2)	(3)
Head's age		−0.011***	−0.008***
		(0.002)	(0.002)
Highest education	0.020***	0.012*	0.015**
	(0.008)	(0.007)	(0.006)
Highest education squared	−0.001**	−0.001*	−0.001**
	(0.001)	(0.001)	(0.001)
Head works on farm	0.087	0.272***	0.260***
	(0.067)	(0.050)	(0.054)
Share of household members that work off	0.003	−0.453***	−0.415***
farm	(0.087)	(0.075)	(0.068)
Village land endowment per household	−0.106	0.374***	0.228***
	(0.079)	(0.071)	(0.048)
Village net income per capita	−0.001	−0.001	−0.020***
	(0.003)	(0.004)	(0.006)
Distance from village office to nearest asphalt road	0.001	0.005	0.020***
	(0.005)	(0.006)	(0.006)
Number of enterprises in the village	0.002	0.003	0.003
	(0.003)	(0.004)	(0.004)
Forested land per household	−0.033	−0.015***	−0.023***
	(0.024)	(0.004)	(0.006)
Sichuan			−0.266***
			(0.051)
Shaanxi			−0.214***
			(0.058)
Jilin			0.657***
			(0.061)
Hebei			−0.040
			(0.055)
Year dummy		0.164***	0.229***
		(0.048)	(0.049)
Constant	0.430***	0.686***	0.598***
	(0.119)	(0.136)	(0.127)
Probability > *F*	0.000	0.000	0.000
Adjusted R^2	0.026	0.304	0.176
Number of observations	1832	1832	1832

Notes: Standard errors are in parentheses. ***, ** and * represent significance at 1, 5 and 10 percent, respectively.

This means that, holding other factors constant, the operational size of China 's farms is rising. We cannot identify exactly what factors may be influencing this finding from our analysis. However, it is certainly possible that the rise of farm size in China today (i.e. the part that is being measured by the time trend variable) could be due to any number of new policies that the government is promoting to encourage larger farm sizes.

V. Concluding Remarks and Policy Implications

In this paper we examine whether farms are increasing in size in China. This topic is important in assessing whether China's farms are moving toward sizes that are able to produce higher levels of income for those engaged in farming. If this is the case, the situation in China would stand in contrast to other international examples where policy efforts have been unsuccessful in increasing the size of farms.

Although the experiences of other East Asian countries would suggest that China 's efforts to increase the average farm size would be difficult, policies implemented in recent years have still sought to increase the average farm size. Although anecdotal evidence provided in the media suggests that large farms are becoming increasingly common, there have been no rigorous, nationally representative studies on this topic in recent years. Using a nationally representative dataset which includes a panel over two time periods, we find that China's household-level farming sector was still characterized by small farms in 2013. In most of our sample provinces, the increase in the number of farms larger than 2 ha has been negligible. Average farm size did rise, but it was only by 0.03 ha over 7 years. Hence, based on these findings, it appears that there has been little change in farm size over our study period.

However, our data also demonstrate that there is an emerging class of middle-sized and larger-sized farms. Although the share of farms greater than 2 ha is still low (around 5 percent), the share of farms of this size is growing. According to our data, these farms now account for approximately 20 percent of China 's cultivated area. In addition, another 4 percent of China's cultivated area is being farmed by a new class of company-run farms. Compared to the situation in 2007, the scale of large-scale farming appears to have developed in recent years.

Although our research is able to determine trends in sizes of China 's farms since new policy was implemented in the early 2000s, there are still policy issues that our work cannot address. For example, we cannot speak to mechanisms through which these farms have emerged, and, therefore, cannot determine whether or not they emerged as a result of policy initiatives and support programs. Moreover, we are unable to report on whether these

larger farms are helping reach the goals of recent policy. Specifically, further research is needed on the efficiency of large farms, the relative income they provide to farmers, their competitiveness within China's agricultural market place and their impact on food security. Finally, future research that continues to track the emergence of these farms would be beneficial to determine whether this is truly a shift in China's agricultural structure or just a short-term phenomenon.

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