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## **Are Women Taking Over the Farm in China?**

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### **Abstract**

Development practitioners in the West have proclaimed that an increasing “feminization of agriculture” is occurring in the developing world. In this paper, I use household survey data collected in rural China to empirically test whether or not women have been doing an increasing amount of farmwork. I find exactly the opposite: if anything, the proportion of farmwork being done by women is *declining* over the late 1990s. Furthermore, I find that the future feminization of agriculture in China is unlikely.

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## **Are Women Taking Over the Farm in China?**

Development practitioners in the West have proclaimed that an increasing “feminization of agriculture” is occurring in the developing world. Publications by the FAO, the World Bank, the US Agency for International Development, and the Consultative Group on International Agricultural Research (CGIAR) have all recently proclaimed that women are doing an increasing proportion of farmwork in the developing world, and that policies should be designed to account for the feminization of agriculture (FAO, 2003; Buvinić, Gwin, and Bates, 1996; World Bank, 2002; Simmons, 2002; CGIAR, 2003). Yet, as some of these agencies or authors note, there is little empirical support for a feminization of agriculture hypothesis (e.g. Buvinić et al., 1996).

These studies and others (e.g. Mehra and Gammage, 1999) base statements about the feminization of agriculture largely on aggregated data published by the United Nations that indicate women’s participation in agriculture and presence in rural areas fell more slowly than men in China, sub-Saharan Africa, and South Asia between 1970 and 1990 (UN, 1995). However, these data do not prove a feminization of agriculture, as the men left in rural areas could work increasingly longer hours than women. Surprisingly, to my knowledge no one has used microeconomic data to test whether or not women are doing an increasing amount of farmwork anywhere in the developing world.

From a theoretical perspective, two stories are consistent with women doing an increasing proportion of farmwork. If one assumes that separate off-farm labor markets exist for men and women, then an increasing wage for men relative to women would drive up the proportion of agricultural labor done by women; hence, a feminization of agriculture (e.g. Boserup, 1970). Alternatively, barriers to off-farm entry could be different for men and women, and loosening barriers for men relative to women would also increase the proportion of farmwork done by women. In West Africa, where men and women in rural areas farm separate plots (e.g. Doss, 1996; Goldstein and Udry, 1999) one could potentially test for the feminization of agriculture by testing whether net transfers of land from men to women were occurring over time. Elsewhere, one would ideally find a place with functioning off-farm labor markets in order to test whether or not agriculture is being feminized.

In this paper, I will use household survey data to empirically test whether or not agriculture is being feminized in rural China. China makes a nice case study in which to test for the feminization of agriculture for several reasons. First, there is anecdotal and descriptive evidence that agriculture is being feminized in China.

Judd (1990) and Song and Jiggins (2000) both describe women as taking over farming in specific villages. Jacka (1997) quotes county officials in Sichuan as describing a feminization of the agricultural labor force. Additionally, Rawski and Mead (1998) show provincial aggregate trends suggest that women are taking over farmwork in China. Second, much of the country's labor force still resides in rural areas. According to the National Bureau of Statistics (2002), more than 60% of China's labor force works in rural areas. Finally, China has the right conditions for the feminization of agriculture to be occurring; several authors have detailed growing off-farm labor markets within China (e.g. Parish, Zhe, and Li, 1995; Rozelle et al., 1999; de Brauw et al., 2002) that other authors argue are still quite constrained (e.g. Yang and Zhou, 1996; Mallee, 2000). Specifically, migration is growing rapidly in China, taking laborers out of rural areas where they could continue to work in farming (e.g. Johnson, 1999). Traditionally, authors argue that the feminization of agriculture occurs as a corollary to industrialization, as men leave the farm to seek industrial, urban jobs (Boserup, 1970). The confluence of anecdotal evidence, a large proportion of the labor force in agriculture, and growing migration make China an ideal place to test for the feminization of agriculture.

In contrast to the anecdotal and descriptive evidence, I will use a variety of empirical methods to argue that agriculture is *not* being feminized in rural China. To initially investigate the gender composition of the agricultural labor force in China, I will use a retrospective data set collected in late 2000 to show that the percentage of farmwork being provided by women is constant at best, or even *decreasing* over the late 1990s. I will confirm these findings by comparing cross-sectional data sets collected in 1995 and 2000 in northeast China. The results of these exercises will show that if anything, the proportion of farm labor being done by women has been falling.

Furthermore, I will show that demographic variables indicate that there is little likelihood that agriculture will be feminized in the future. I will use a multivariate analysis to show that the presence of young females in households significantly decreases the proportion of farmwork being done by women in a household. The presence of young men, in fact, has almost exactly the opposite effect, indicating that young people of both sexes are finding or expecting to find jobs off-farm. I find this trend in both data sets used for the analysis, indicating that it has existed since at least 1994.

Besides debunking the idea that China's agricultural labor force is being feminized, the paper makes several contributions to the literature. First, it contributes to the debate regarding women's status in economic transition, and in particular

the debate over women's status in China's transition. Several authors have studied women's status in transition countries by examining gender wage gaps (e.g. Brainerd, 2000; Maurer-Fazio and Hughes, 2002) or unemployment (Ham, Svejnar, and Terrell, 1999). Second, the paper takes a unique perspective on gender differences, by considering labor allocation across sectors rather than wage gaps or labor force participation. By examining the role of women in one particular sector, agriculture, the paper indirectly contributes to building evidence of robust off-farm labor markets, regardless of gender, in rural China (e.g. Rozelle et al., 1999, West and Zhao, 2000).

The paper will proceed as follows. First, I will provide a simple theoretical model that is consistent with institutional features of the Chinese countryside and discusses the conditions necessary for the feminization of agriculture in more detail. Next, I will introduce the data set that I will use for the analysis, and describe labor force trends found in the data regarding farm work. Fourth, I will perform a multivariate analysis on the data to explain what factors in households lead women to do more of the farmwork in China. Using the analysis, I will conclude by describing the implications of this paper for the future of farming in China.

## **1 Modeling Agricultural Production and Labor Supply in China**

Since the decollectivization of agriculture in the early 1980s, also known as the household responsibility system (HRS), individual households in rural China undertake a vast majority of agricultural production (Putterman, 1993). Households were left to make production decisions, including decisions about labor, and became the residual claimant. The changes led to a significant increase in grain production despite a large decrease in the amount of labor in the cropping sector (e.g. Lin, 1992). In part because every rural household initially received land in the reform, agricultural labor markets are quite thin and households are primarily dependent upon their own labor for production (Benjamin and Brandt, 2002).

Household agricultural production is therefore dependent on the amount of land it receives from the village and the amount of labor it has available. Consider a household that has been allocated an amount of land  $A$  and that has endowments of male and female labor  $\bar{L}_m$  and  $\bar{L}_f$ , respectively.<sup>1</sup> Initially, assume that households face separate off-farm labor markets with market determined wages

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<sup>1</sup>The model presented here is qualitatively similar to Rosenzweig (1980).

for men and women ( $w_m$  and  $w_f$ ). Therefore the household must determine how much male and female labor to allocate to farming ( $f$ ) and off-farm work ( $of$ ) such that  $L_i^f + L_i^{of} = \bar{L}_i$ ,  $i = m, f$ . The household must also choose how much capital ( $K$ ) to implement on-farm at a rental rate ( $r$ ). I assume that the household has a concave production function  $F(L_f^f, L_m^f, K; A, \gamma)$ , where  $\gamma$  is a parameter that indicates the substitutability of male and female labor. The production problem is:

$$\begin{aligned} \max_{L_f, L_m, K} \quad & F(L_f^f, L_m^f, K; A, \gamma) \\ & + w_f(\bar{L}_f - L_f^f) + w_m(\bar{L}_m - L_m^f) - rK \\ \text{s.t.} \quad & 0 \leq L_i^f \leq \bar{L}_i; i = m, f \end{aligned} \tag{1}$$

The interior solution to this problem is quite straight forward. The household equates the marginal product of male farm labor with the male wage, the marginal product of female farm labor with the female wage, and the marginal product of capital with the rental rate. We are interested, though, in the proportion of farmwork being done by women, or  $\mu = \frac{L_f^f}{L_m^f + L_f^f}$ . If  $\mu$  is increasing over time, then the feminization of agriculture is occurring. By Cramer's rule, it can be shown that  $\mu$  is increasing in the male wage (e.g.  $\frac{\partial \mu}{\partial w_m} > 0$ ) and decreasing in the female wage (e.g.  $\frac{\partial \mu}{\partial w_f} < 0$ ). Therefore, if there are no constraints on off-farm entry, an increase in the male (female) wage *ceteris paribus* would lead to a higher (lower) proportion of agricultural labor done by females.

Corner solutions to this model are a distinct possibility, if the marginal product of male labor on the farm is still below the wage when all male labor in a household is allocated off-farm. Alternatively, the same could be true for females. Either case is certainly a reasonable outcome, given that the marginal product of labor on farm is reported to be much lower than prevailing wage rates (Cook, 1999). If each household has its own agricultural production function, it is likely that some households will find themselves allocating only male or female labor to agriculture.

Given the institutional nature of farming in rural China, and the lack of employment opportunities in some areas, it is likely that some households face constraints on their off-farm labor market participation. The constraints might take many different forms. It could be that local off-farm labor markets are thin and migrant networks non-existent, limiting off-farm labor market opportunities. Households might have access to off-farm labor markets, but feel constrained to farm

their land prior to working off-farm. Alternatively, households may have access to distant labor markets but limit their participation because they are raising children in the village.

Consider household farm problem (1), with further constraints that  $L_i^{of} \leq \widetilde{L}_i^{of}$ ,  $i = m, f$ . The model is easier to solve in an alternative formulation, as a function of off-farm labor:

$$\begin{aligned}
& \max_{L_{of}, L_{om}, K} && F(\overline{L}_f - L_f^{of}, \overline{L}_m - L_m^{of}, K; A, \gamma) \\
& && + w_f L_f^{of} + w_m L_m^{of} - rK \\
\text{s.t.} & && 0 \leq L_i^{of} \leq \widetilde{L}_i^{of}; i = m, f
\end{aligned} \tag{2}$$

In this formulation of the model, it is interesting to think about the effect of the relaxation of labor market constraints on the household's farm labor mix. Assuming that off-farm labor market participation for men and women is positive, the household will choose male and female off-farm set the marginal product of farm equal to the wage less the Lagrange multiplier  $\lambda$  on the constraint:

$$-F_{L_i}(\cdot) + w_m - \lambda_i = 0; i = m, f \tag{3}$$

If the household is constrained in either male or female labor, then  $\lambda_m$  or  $\lambda_f$  is positive, respectively. As the constraint for one gender relative to the other, the amount of labor supplied off-farm by that gender will summarily increase, as with the model based on wages (e.g.  $\frac{\partial L_i}{\partial L_i} > 0$ ,  $i = m, f$ ). Therefore, if women face tighter constraints to entering off-farm labor markets, loosening that constraint for women would lead to similar allocations of men and women to farm labor.

In summary, either external wages or constraints against off-farm labor may be important factors leading households to allocate more labor from one gender than the other to farming. The feminization of agriculture could be occurring in a number of different ways. If off-farm wages for men and women are diverging, then women may be taking over the farmwork. The same would be true if wages were stagnant but constraints keeping men on the farm were loosening relative to constraints for women. However, if wages are converging, or constraints loosening for women relative to men, one would expect that feminization of agriculture is not occurring. To learn whether women are taking over farming in China, I turn to household survey data.

## 2 Data

The data for this study come from two sources. The primary data set were collected in a randomly selected, nearly nationally representative sample of 60 villages in 6 provinces of rural China during November and December of 2000 (henceforth, the China National Rural Survey– CNRS). The provinces are Hebei, Liaoning, Shaanxi, Zhejiang, Hubei, and Sichuan.<sup>2</sup> To ensure broad coverage within each province, one county was randomly selected from within each income quintile for the province, as measured by the gross value of industrial output. Two villages were randomly selected within each county. The survey teams used village rosters and a census of households not included in the village’s list of households to randomly choose the twenty households; both households with their residency permits (*hukou*) in the village and those without. A total of 1199 households were surveyed.

The CNRS gathered information on household demographics, labor allocation, agricultural production, and non-farm activities. Several parts of the survey were designed to learn about the household’s participation in labor markets over time. For roughly half of the households surveyed (610 out of 1199), a twenty-year employment history form was completed for each household member and each child of the household head (even when they were no longer considered “household members”). For each year between 1981 and 2000, the questionnaire tracked each individual’s participation in farm and off-farm employment, the main type of off-farm work performed, the place of residence while working (within or outside the village), the location of off-farm employment, and whether or not each individual was self-employed or wage earning. All individuals who worked were coded as either working on the farm full time, part time, only during the busy season, or not working on the farm at all.

The CNRS also collected detailed information about the household members on-farm work in 2000. After asking whether or not they worked on farm, each household member was asked about the number of weeks they worked on the farm during the busy and slack seasons, the number of days they worked in each season, and the hours spent working on the farm on a typical day in each season. By adding up the number of hours they worked overall in the busy and slack

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<sup>2</sup>The data collection effort involved students from the Center for Chinese Agricultural Policy, Renmin University, and China Agricultural University. It was led by Loren Brandt of the University of Toronto, Scott Rozelle of the University of California at Davis, and Linxiu Zhang of the Center for Chinese Agricultural Policy. Households were paid 20 yuan and given a gift in compensation for the time that they spent with the survey team.

seasons, the number of hours each individual in the household worked on the farm in 2000 can be calculated.<sup>3</sup>

The second data source that will be used in the paper are a sample of 787 farm households from 31 villages in Hebei and Liaoning Provinces, collected in the summer of 1995 (henceforth, the Dongbei data). As with the CNRS data, the survey gathered information on household and individual characteristics, household wealth, agricultural production, and non-farm activities. The survey included a module designed to elicit detailed information about the amount of work performed by each household member on-farm, though the questions were asked slightly differently, so the two raw measures are not comparable. In the Dongbei survey, respondents were asked how many days they worked on the farm in the peak season and how many days they worked on farm in the off-peak season during the previous year. As with the CNRS, they were also asked to estimate the number of hours they worked on an average day in the each season. Therefore, a measure of the number of hours each individual within a household worked on the farm in 1994 can be constructed.

### **3 The Proportion of Farmwork done by women in China**

In this section, I will describe patterns of farmwork in the CNRS data, both within the household in 2000 and by household members between 1990 and 2000.<sup>4</sup> After describing the data in the cross-section, I will use the information in the cross-sectional data and the employment history to construct household level measures of the amount of farming done by women in the households in the sample. After interpolating a trend, I will crosscheck the information using the subsample in the CNRS collected in northeast China against the Dongbei data collected in 1995.

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<sup>3</sup>Descriptive statistics for variables constructed from the CNRS are in Appendix Table 1.

<sup>4</sup>I also have employment history data on household members and children of the household head between 1981 and 1989. I discard these data for two reasons. First, I do not have data on household members who passed away prior to 2000. Therefore, as we go back in time, we lose older household members who may have worked on the farm but have passed away, and this bias grows as I go back further in time. Since men are more likely to continue farming in old age than women in China, the measure of the proportion of farmwork done by women is biased slightly upward, and the bias grows as I go back in time. Second, and perhaps more importantly, off-farm work has increased dramatically since 1990, which may have changed the way choices regarding farmwork are made.

By computing the hours of farmwork done by each individual in 2000, we can describe which demographic groups within households are farming, and the intensity by which they are farming (Table 1). The data indicate that men are still more likely to do farmwork than women. Whereas 70% of men in the sample above the age of 16 work on the farm, only 65% of women do (rows 6 and 12). However, women report working slightly more hours than men do on the farm; on average, given doing any farmwork, women work 24 hours more than men in a year on the farm.

Statistics describing the amount of farmwork done by cohort show that the differences are particularly pronounced among certain age and gender cohorts. Among the youngest cohort of the household labor force, both males and females are much less likely than others to perform farm tasks, and they work less hours when they do work on the farm. Women between 16 and 25 are even less likely to work on the farm than men in the same age cohort— only 32.8% of women did any farmwork, whereas 39.5% of men did (rows 1 and 7). Given participation in farmwork, members of both groups did roughly 550 hours of work on average, far below the sample average. Although some of these individuals were still in school in 2000, they are turning in large numbers to off-farm work, and in fact many migrate to find work (de Brauw et al., 2002). Therefore, younger workers are far less likely than other workers to perform farmwork, whether they are male or female.

Although several authors have shown that men are working off-farm in much larger numbers than women (e.g. Rozelle et al., 1999), the data show that among all other demographic groups, men are only slightly less likely overall to have worked on farm than women. These data confirm that men between the ages of 26 and 55 are more likely than other workers to have off-farm jobs; 64% of them work off-farm, whereas only 23% of women between 26 and 55 worked off-farm. Nonetheless, men between 26 and 55 are only slightly less likely to have done farmwork than women in the same demographic groups. Furthermore, they work only slightly fewer hours on average than women do. For example, men between 36 and 45 years old work a mean of 860 hours on farm (row 3). Women between 36 and 45 work an average of 944 hours, or 9% more, and are only 5% more likely to work on the farm.

Men over 55 are likely to make up any difference between farmwork done by men and women, as they significantly more likely to have worked on farm than women. They work, on average, 45% more hours than women over 55, and are 30% more likely to have worked on farm (rows 5 and 11). Therefore, even though men have moved off-farm in large numbers, these data indicate that they have

not typically abandoned farmwork entirely to women; rather, they are typically working off-farm part time and on farm part time. Meanwhile, older women tend not to perform much farmwork at all.

To understand the difference between the effort expended farming by men and women who do farm, I tabulate the data by the self-reported involvement in farming in the employment history subsample (Table 2). Men who report working only on the farm, on average, slightly more—just over 1000 hours per year—than women who do not work off-farm (943 hours; row 1). Individuals who work part-time on the farm sensibly work less hours than their counterparts who solely work on the farm (row 2). Both men and women who work on the farm work similar percentage of the hours of full time workers; part-time men average 70% of the hours that full time men work, whereas part-time women average 64% of the hours of full-time women. Busy season farm workers work significantly less hours, on average, than part-time or full-time farm workers, and busy season women are much less involved in farming than busy season men. Whereas busy season men work 37% of the hours that full time men average, busy season women work only 20% of the hours of full-time women.

The employment history data can be used to create a measure of the proportion of farmwork done by women in years prior to 2000. To do so, I estimate the fraction of a full-time worker that a part-time or busy season worker represents, by gender. Making some assumptions about these fractions, I can extrapolate the percentage of farmwork done in each household by women back in time. First, I assume that men and women work equal numbers of hours if they work full time on the farm. If they work part-time on the farm, I assume that they are equivalent to  $\frac{2}{3}$  of a full time worker, regardless of their gender. Finally, men who work only in the busy season are assumed to be equivalent to  $\frac{1}{3}$  of a full-time worker, whereas women who work only in the busy season are assumed to be equivalent to  $\frac{1}{5}$  of a full-time worker, since they are found to have significantly less farm involvement in 2000. I further assume that the fractions do not change over time. By aggregating the data up to the household level, and measuring the percentage of each household's farm workforce, I can estimate the mean percentage of women involved in farming in each year between 1990 and 2000.<sup>5</sup> Note that according to the means in Table 2, the procedure will systematically overestimate the amount women work on the farm, as full-time men work more hours in 2000 than full-time women. However, the *level* is not important; the interest is in the trend. To

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<sup>5</sup>Alternative assumptions regarding the proportions of full time farmers that part time and busy season farmers represent led to similar results.

generate a confidence interval around the mean, each point was estimated using a simple bootstrap 1000 times.

Figure 1 shows the estimated change in the proportion of the household farm workforce that is female over time. I account for households that are formed after 1990 and for members of the household alive in 2000 that leave or return to the household. The data indicate that the amount of farmwork being done by women is either level or increasing slightly between 1990 and 1995. Although the proportion is likely overestimated, it indicates that women do roughly 54% of the farmwork in the average household in 1995, which had increased from 53% in 1990. As the percentage of female members of the household over 16 is relatively constant at 49% throughout the sample, these data would indicate that women may have done slightly more than their share of farmwork over the early portion of the data period.

However, beginning in 1995 the proportion of farmwork being done by women begins to *fall*, dropping below 51% in 2000.<sup>6</sup> A drop in the percentage of farmwork being done by women, on average, is certainly not consistent with a story that women are taking over the farmwork in rural China. Furthermore, a simple regression of the mean percentage against a time trend gives a negative coefficient of  $-0.0015$  with a t-ratio of 2.29. If the first five points are excluded from the regression, the coefficient decreases to  $-0.0046$  with a t-ratio of 5.44, which suggests the amount of farmwork being done by women was decreasing each year by almost a half percent between 1995 and 2000. In both cases, the coefficient is significant at the 95% level. The observation that the percent of farmwork done by women is falling is actually consistent with the nascent literature on off-farm labor market trends in the late 1990s, which describe increasing off-farm opportunities for women (de Brauw et al., 2002). If barriers to entry are falling for women in off-farm work, it is consistent with the theoretical finding that the proportion of farmwork done by women should decrease as constraints are weakened. Regardless, the retrospective data are not consistent with the story of the feminization of agriculture.

There are two further potential sources of bias in Figure 1 related to the use of retrospective data; however, neither of them are likely to affect the general finding described above. The first possible source of bias is difficult to address convincingly, so I discuss it here. Because I use retrospective data related to employment,

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<sup>6</sup>The estimated percentage in 2000 is about 3% higher than the average percent of farmwork being done by women in the CNRS data, 48%, which may represent the systematic bias in my calculation.

the workers who have passed away since 1990 in households that have formed are missed. In other words, I systematically underweight the elderly who work at the beginning of the data, and the bias decreases over time. However, the bias is not large. The NBS (1999) reports that nationally 10.3% of the population was above “working age,” which they define as 60 and over for men and 55 and over for women. In these data, 6.8% of the sample in 1990 fits that definition of working age. Since older men on average do two and a half times the farmwork older women do (Table 1), an upper bound on the bias would be 0.25, the difference between the average amount of farmwork done in the sample less the proportion of farmwork done by women above working age, multiplied by the difference in the above proportions, 0.035. Therefore, the bias may be as large as 0.875% in 1990, and falling over time. However, it is likely that life expectancy is higher in urban than rural areas, so the proportion of people over working age is likely lower in rural areas. Furthermore, the people who have passed away by 2000 may have systematically been less able to work in 1990 than those that did.<sup>7</sup> The findings, therefore, are likely to be robust to the aging of the sample.

To confirm that women are doing less farmwork over the late 1990s, I compare findings from the Dongbei data with the CNRS data collected in Hebei and Liaoning provinces in 2000 (Table 3). Consistent with the observations from the more nationally representative retrospective data, men are more likely to work on the farm in Dongbei in 2000 than they were in 1994, whereas women are somewhat less likely to work on the farm (row 4). The most interesting differences in participation rates are for women; both younger (16-25) and older (over 55) women are less likely to work on the farm in northeast China in 2000 than they were in 1995 (rows 1 and 3; columns 1 and 3). Meanwhile, men between 26 and 55 are over six percent more likely to work on the farm in 2000 than they were in 1994 (row 2, columns 2 and 4). Given an overall movement off the farm over the late 1990s, the increase is surprising, but it could be due to massive layoffs that began in state industry in the mid 1990s; northeast China has traditionally been more industrialized and urban than the rest of China. Regardless, the data do not show women doing more farmwork in 2000 than in 1994; if anything they show women doing less farmwork.

Although demographic differences in farm labor participation between age cohorts exist, the evidence is not as conclusive regarding the average amount

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<sup>7</sup>The second potential bias relates to recall. As younger workers are more likely to work off-farm, their parents may have answered questions related to their off-farm employment status incorrectly. To control for this bias, I use the Dongbei data collected in 1994 as a check. Further research on the magnitude of recall bias in rural China would be useful.

of farmwork being done by women. Whereas 48.5% of farmwork was done by women in 1994, in the CNRS I find that on average 47.3% of farmwork was done by women. Although the estimate is lower, the difference is not statistically significant, so I cannot conclude that women are actually doing less farmwork in 2000 than they were in 1994. However, it does not seem like they are doing more farmwork either.

### 3.1 Are there outliers at the village level?

Although women's participation in agriculture is not growing (and may be declining) in the aggregate, it could be that women are taking over agricultural production in some areas of the country while leaving agriculture in others. For example, it could be that women in poorer villages are taking over agricultural production as men leave, while men and women are using capital to substitute for labor in other areas of the country. There is, in fact, tremendous variation in the amount of labor input into agriculture across the villages in the CNRS. In the richest village in the sample (in Zhejiang), the average household farm reports 492 hours into farming, whereas the average is 4280 hours in the most labor intensive village in Sichuan.<sup>8</sup> As there are officially 700,000 villages in China and the CNRS only surveyed 60 villages, even the presence of one outlier could represent a large movement of women into farming in villages with similar characteristics. In this subsection I will analyze trends at the village level.

If women are taking over farming in certain villages and not others, one would expect that the proportion of farmwork done by women will exceed their share in the village workforce by a significant amount. To understand whether some villages have such conditions, I simply plot the proportion of farm hours worked by women against their share in the village workforce (Figure 2).<sup>9</sup> The data show that most villages have nearly a 1:1 correspondence between the proportion of farm hours worked by women and their proportion of the workforce. Therefore our descriptive findings above, that women are not doing an undue proportion of the farmwork in most villages, is confirmed.

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<sup>8</sup>The average is 1955 hours.

<sup>9</sup>Defining who is a member of the village workforce is not trivial. I define the village workforce as anyone aged 16 and up, which certainly includes some students, and some people who do not work due to health problems related to old age. I *include* migrants who have left the village in the measure, because I model the decision to migrate as endogenous to the farmwork decision. Excluding migrants or non-workers from Figure 2 do not significantly affect the trend, nor change the outliers.

In one village in Sichuan province, the proportion of farmwork done by women exceeds their proportion of the workforce by more than ten percent (Figure 2–SC1).<sup>10</sup> There are two main reasons to believe that agriculture is not being unduly feminized in that village. First, fifteen percent of households in that village (3 of 20) had female household heads. In the remaining villages in the sample, only three percent had female heads. As women can be expected to do more farmwork in female headed households than other households, it is likely that the particular sample has led to an overestimate. Second, there are two further households in which women are reported to do well over 2000 hours of farmwork, which may be an overestimate as well. When these two households are eliminated from the sample, women do 53% of the farmwork on average, as opposed to 64% when all households are aggregated. No other households share this feature, so it seems that the large percentage of farmwork done by women is due to random factors, rather than women systematically doing more farmwork than men.<sup>11</sup>

Although visually observing the trends can help us figure out whether or not women are doing more farmwork than their share, a multivariate framework that controls for demographic and provincial differences. To do so, I run a simple regression:

$$\mu_{pv} = \alpha_p + P_{pv}\gamma + X_{pv}\beta + \varepsilon_{pv} \quad (4)$$

where  $p$  indexes provinces and  $v$  indexes villages,  $P_{pv}$  represents the proportion of women in the village labor force,  $X_{pv}$  represents the demographic composition of the village, and  $\varepsilon_{pv}$  is an error term.<sup>12</sup> The null hypothesis associated with the feminization of agriculture is that  $\gamma = 1$ . To reject the hypothesis would indicate that, on average, women are doing more than their share of farmwork. In estimating equation (4), I try two different definitions of  $P_{pv}$ —one using all household members in the village labor force, and an alternative definition that excludes migrants. Since migrants are more likely to be male in China (e.g. Zhao, 1999), the second definition would seem more likely to yield a coefficient significantly different than one.

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<sup>10</sup>There is also an outlier village in Zhejiang in which women do a great deal less farmwork than would be their share—I will neglect that village in the analysis.

<sup>11</sup>In other ways, the village workforce in village SC1 mirrors trends in the rest of the data. The village has a high off-farm employment rate, and although men are more likely to work off-farm, they are also almost as likely to do farmwork as women.

<sup>12</sup>I do not do the logistic transformation typically done for proportional variables on  $\mu_{pv}$ , because the coefficient estimate for  $\gamma$  would not be easily interpreted. I do the transformation for household regressions.

I only find mild evidence that women are doing more farmwork than their share, in one specification of the model (Table 4). When I do *not* control for provincial fixed effects, and measure  $P_{pv}$  as the proportion of females in the whole village workforce, I estimate that each percent that the female share of the labor force grows, the amount of farmwork done by women increases by 2.09 percent (column 1). The p-value on the F-test that  $\gamma = 1$  is 0.16, indicating mild evidence that women may do more farmwork than their share.

However, when I control for provincial differences using fixed effects, and perhaps more surprisingly, when I use the alternative definition for  $P_{pv}$ , I cannot reject the null that  $\gamma = 1$ . The p-values on the F-test for  $\gamma = 1$  are all greater than 0.5 (row 11, columns 2-4). The large point estimate for  $\gamma$  in column 1 appears to result from a lack of provincial controls. Somewhat surprisingly, the estimates for  $\gamma$  are actually *smaller* when using the second definition for the proportion of workforce variable. A closer analysis of the migrant labor force in the sample makes it less surprising, however. Whereas men are more likely to migrate for part of the year, 43 percent of full year migrants are women.<sup>13</sup> Therefore, subtracting them from the village labor force does not affect the proportion of women in the labor force a great deal. Regardless, it seems quite safe to conclude that women are doing a share of farm labor close to their proportion in the labor force, at the village level.

In summary, there is no empirical evidence at the village level that women do more farmwork than their proportion in the labor force would indicate, and the only outlier can be explained by random variation in the sample. Furthermore, I cannot reject the null hypothesis that women work on the farm in the same proportion as men. In the next section, I will explain the variation in the proportion of hours worked on the farm at the household level, again controlling for a number of factors, both using the CNRS and Dongbei data.

## 4 The Future of Household Farming, by Gender, in China

Although the retrospective and cross-sectional analysis in the previous section shows that agriculture is not being feminized in China, it does not control for household level factors that may affect the proportion of farmwork done by women. In this section, I will analyze the determinants of the proportion of farmwork done

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<sup>13</sup>Full year is defined as nine months or more; most full year migrants only return for holidays.

by women at the household level. In order to analyze the persistence of the results, after looking at the full CNRS sample I will compare the Northeast China subsample with the Dongbei data.

To understand the determinants of the proportion of farmwork done by women at the household level, I will regress the proportion at the household level  $\mu_h$  on the proportion of women in the household labor force  $P_h$ , a vector of household characteristics  $Z_h$  and a vector of demographic characteristics  $X_h$ :

$$\mu_h = \alpha + P_h\gamma + Z_h\beta_1 + X_h\beta_2 + \varepsilon_h \quad (5)$$

Since the dependent variable in equation (5) is a proportion, predictions after estimation may exceed the boundaries (0 and 1). Therefore I estimate it using both OLS and using a logistic transformation of the dependent variable ( $Y_h = \ln\left(\frac{\mu_h}{1-\mu_h}\right)$ ). Since women do no farmwork in about 10 percent of the sample and all of the farmwork in about 6 percent of the sample, I use an estimating algorithm that can deal with those observations.<sup>14</sup>

First, I use the CNRS cross sectional data to estimate equation (5) (Table 5).<sup>15</sup> Both estimation procedures give the same general results; coefficients have the same signs and generally coefficients on the same variables are significant. Referring to the OLS estimate, the point estimate indicates that an increase of 10% in the females in the household labor force leads to about a 7% increase in the amount of farmwork done by women (column 1, row 1). The signs on coefficients on the household characteristics are sensible as well. I find that women do more of the farmwork when households are headed by females (row 2), while they do less farmwork in households with more experienced, older heads (column 3). Women are likely to do more farmwork in wealthier and more educated households, *ceteris paribus* (rows 4 and 6).

The most interesting coefficient estimates are found on some of the demographic variables. The presence of 16 to 25 year olds in the household have significant effects on the proportion of farmwork done by women. This finding is not in itself surprising; if farming was the major source of income for most households, we would expect the addition of a new male laborer to the household (upon turning 16) to decrease the share of farming done by women, and the addition of

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<sup>14</sup>The algorithm is contained in the GLM procedure in Stata.

<sup>15</sup>I include provincial level fixed effects in estimating equation (5). The primary results are robust to the inclusion of village fixed effects. I use provincial fixed effects in lieu of village level effects to measure potential cultural differences in household organization across provinces.

a female laborer to increase the share of farming done by women. In fact, I find exactly the opposite (rows 7 and 8).

Using the results from the logistic transformation, I created a hypothetical household with parents between the ages of 46 and 55, at the mean level of all other variables in the sample. The addition of a 16 to 25 year old male or female to the household changes the percent of farmwork done by women by about 20 percent. In other words, if half of the household farmwork was done by the woman without the child, 70 percent was done by the woman if the child was male and 30 percent was done if the child was female. The result was similar if a sibling of the opposite sex also existed. The findings are consistent with a story that robust off-farm labor markets are available to younger workers, and they seem available to *both* men and women. Younger workers tend to be more educated, an important factor in finding off-farm work in China (Yang, 1997). However, if a gender wage gap existed, one would expect the presence of 16 to 25 year old women to have a smaller effect on the proportion of farmwork done by women than 16 to 25 year old men. The finding of coefficients of opposite sign and almost equal in magnitude implies that off-farm labor markets work for both young men and women.

The second interesting finding regarding household demographics is that the presence of older women in the household has a negative effect on the amount of farmwork done by women. According to both specifications estimates, an additional woman over 55 in the household decreases the amount of farmwork done by women (Table 5, row 15). However, the same is not true for men; the estimated coefficient on the men over 55 variable is positive, but statistically insignificant. The finding can be explained as follows. When women reach older ages, they either stop working altogether or shift their time into providing household goods. Men do not stop working; rather, they continue to work in the fields. The finding is consistent with research on labor allocation patterns among the elderly found by other researchers (e.g. Benjamin et al., 2000).

#### **4.1 Comparing 1994 with 2000 in Northeast China**

To assess whether the same demographic trends were affecting household farmwork allocations by gender in 1994 and 2000, I re-estimate equation (5) using the subsample of the CNRS collected in Northeast China to compare directly with the Dongbei data (Table 5). Many of the household characteristics have similar effects on the proportion of farmwork done by women in 1994 and 2000. In both samples, I find that women do less farmwork in households with less experienced

heads (row 3). Other coefficients have similar signs, but are not statistically significant across both samples. For example, the coefficient on the mean education variable is positive and significant in the 1994 data, but not in the 2000 subsample (row 6). However, it was significant in the full CNRS sample, which can be interpreted as a sign that women do more farmwork in more educated households in both samples.

Several of the estimated coefficients on demographic variables seem to indicate different off-farm market conditions in Northeast China in 1994 than in 2000. Specifically, the three variables measure the number of men in prime working ages (between 26 and 55) have a positive, statistically significant effect on the proportion of farmwork done by women in 1994, whereas their point estimates are much smaller in 2000, and they are largely statistically insignificant.<sup>16</sup> These estimates can be interpreted in the context of off-farm opportunities. If men's wages were much higher than women's wages in 1994, we would expect to see their presence in a household increase the amount of farmwork done by women, as they would allocate their labor off-farm. Alternatively, barriers to entry could restrict women from working off-farm. The insignificant coefficients in 2000 therefore indicate that either women's off-farm wages have risen with respect to men's, or that barriers to off-farm entry for women have fallen.

However, the coefficients on the variables measuring the number of younger workers in the household indicate similar effects in 1994 and 2000. The estimated coefficients for male and female laborers between ages 16 and 25 are similar in 1994 and 2000. Therefore, it seems that young men and women were already leaving farmwork by 1994, and had similar barriers to entry, or a similar lack of barriers. If panel data were available, one would see more than half of each cohort move to the following cohort between 1994 and 2000. Therefore the finding, in particular, that the number of males aged 26 to 35 have a significant effect on farmwork done by women in 1994 but not 2000 is not surprising, as many of the women who were 16 to 25 in 1994 moved into the next cohort by 2000, and faced similar constraints as men. However, as Table 1 shows, they are far more likely to work on farm than they were when they were younger.<sup>17</sup>

In summary, I find that the presence of younger men and women in households in rural China increase and decrease the share of farmwork done by women, respectively. The point estimates for the two effects are of opposite sign and are

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<sup>16</sup>Only the number of men between 36 and 45 have a statistically significant effect in the tobit specification in 2000, and it is only significant at the 10 percent level.

<sup>17</sup>I also find evidence that the presence of older men in the household increases the amount of farmwork done by women in 1994, but not in 2000.

of similar magnitude, which implies that men and women are equally likely to leave the farm at a young age in China. Indirectly, the findings show a similar lack of constraints to off-farm work for both men and women, or that wages for young men and women are similar. Moreover, the findings are remarkably robust to choosing a subsample and appear in the mid-1990s, indicating that gender has not been a factor for off-farm employment, at least for young people, throughout the late 1990s. The persistence of the results through time implies that younger people in rural China will continue moving away from farming in the future.

## 5 Conclusion

In this paper, I have used household survey data to investigate whether or not agriculture is being feminized in China. I have found almost no evidence to support a feminization hypothesis. Both an analysis of retrospective and village level data do not suggest that women are doing an increasing proportion of farmwork in China. In fact, if anything, the average amount of farmwork being done by women is, if anything *decreasing*. This observation is consistent with descriptive statistics from data collected in two Northeast provinces, Hebei and Liaoning, in both 1994 and 2000.

From the perspective of an agricultural household in China, theoretically the findings of the paper are consistent with either convergence in wages for men and women off-farm, or with barriers to off-farm entry decreasing faster for women than for men. The findings are consistent with the literature that claims such barriers exist (e.g. Mallee, 2000), that men were significantly more likely to work off-farm in the early 1990s (e.g. Yang, 1997; Zhao, 1999), as well as the more recent literature that shows women's off-farm labor participation has increased in the late 1990s (de Brauw et al., 2002). Indirectly, while showing that women are not taking over the farmwork as reforms continue, I argue that the paper adds to evidence that off-farm labor markets have begun to develop for both men and women during the 1990s.

However, the findings do lead to another question. As households continue to farm in rural China, if the women are not taking over farming, who is? There are two potential answers to this question raised, but not discussed in detail, in the paper. First, it could be that capital is substituting for labor. The theoretical model developed in the paper can be used to show that both male and female labor allocations to farming decrease as the relative price of capital decreases. However, as discussed by Benjamin and Brandt (2002), empirically it is not clear

*how* they use more capital. Do households purchase more capital? Do they rent capital? Has it been allocated by the village? Further research would be necessary to investigate the answers to these questions.

Second, older men could be taking over the farmwork. This hypothesis would be supported in particular by Table 1, which shows that men over 55 in particular participate in agriculture in much higher rates than older women, and they work more when they do. If this hypothesis is correct, China's policy makers should be concerned about its farm sector in the long-term, as these men age and become unable to work, while younger men and women do not begin farming. However, it could be that capital is used more and more in some areas and not others, where older men take over farmwork. Further research is necessary to explore these hypotheses.

Finally, this paper shows that if policy makers or development practitioners are concerned about a feminization of agriculture, they should not rely on aggregate data or descriptive analyses. It would be useful to study whether or not women are taking over farmwork from a more disaggregated perspective in other economies with different institutions than China as well. Such studies could help policy makers and development practitioners better design policies to help rural areas in the future.

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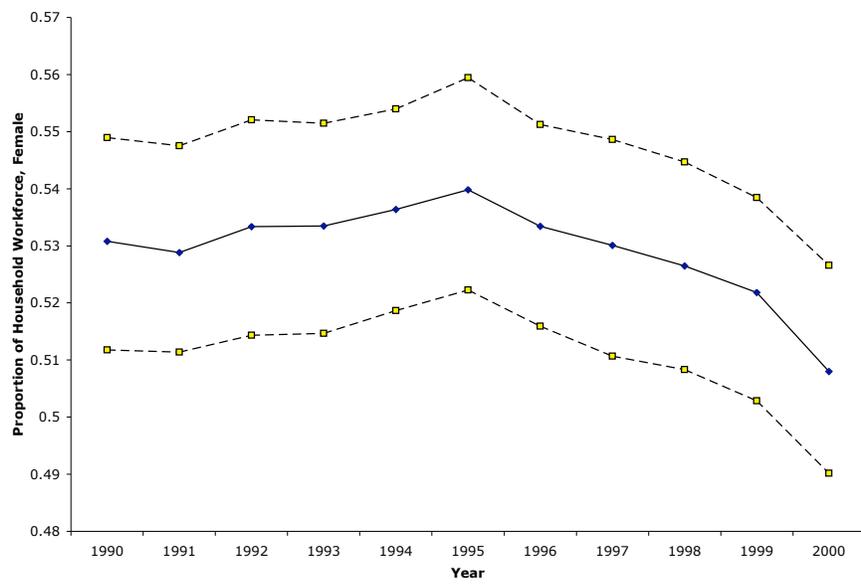
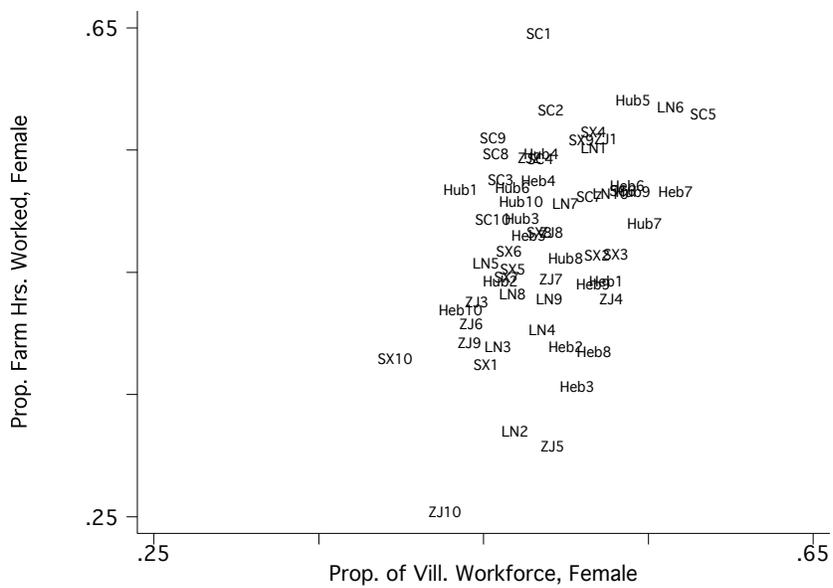


Figure 1: Estimated Proportion of Household Farm Labor Force that is Female, 1990 to 2000



Notes: Villages are plotted and named with two letters that represent the province name. For example, ZJ is Zhejiang. The exceptions are Hebei (Heb) and Hubei (Hub).

Source: CNRS

Figure 2: Comparison of Amount of Farmwork done by Women with Proportion of Workforce, Village Level, 2000

Table 1: Farm Hours Worked and Percent of People Working on Farm, by demographic group, 2000

<i>Demographic Group</i>	Percent Working on Farm	Mean Hours in 2000	Standard Deviation
<b>Men aged:</b>			
16-25	39.5	550.8	523.5
26-35	76.5	792.9	677
36-45	86.7	860.7	696.1
46-55	90.3	891.9	697
over 55	69.2	832.6	665.5
<i>All Men</i>	70	803.3	671.9
<b>Women aged:</b>			
16-25	32.8	543.7	533.9
26-35	81.2	849.2	684.9
36-45	91.2	944.1	698.5
46-55	86.0	911.1	688.6
over 55	40.4	574.9	503.2
<i>All women</i>	65	827.1	673.7

Notes: Means and standard deviations are measured only among individuals working on farm. Sample size is 3794.

Source: CNRS.

Table 2: Farm Hours Worked by Level of Involvement in Farming, by gender, 2000

<i>Level of Involvement</i>	Men	Women
Farm Work Only	1022.4 (682.7)	943.3 (672.0)
Part-Time Farmer	711.9 (570)	598.6 (555)
Busy Season Only	378.4 (408.9)	197 (172.2)

Notes: Standard deviations in parentheses. Sample size is 1620, and only includes the subsample for which employment history data is available.

Source: CNRS.

Table 3: Participation in Farm Work by Age Cohort and Gender in Northeast China, 1995 and 2000

Age Cohort	Dongbei, 1994		CNRS, 2000	
	Women	Men	Women	Men
16-25	46.4	49.4	40.2	49.2
26-55	85.1	80.2	87.5	86.8
over 55	41.7	65.4	34.7	66.4
<i>overall</i>	69.0	70.6	66.0	74.9

Notes: In the Dongbei data (columns 1-2), percentages are adjusted so that each village in the sample receives the same weight, as in the CNRS data. The CNRS data (columns 3-4) only include observations in Hebei and Liaoning provinces. Sample size in the Dongbei data is 2384, and in the CNRS it is 1212.

Sources: Dongbei data set and CNRS.

Table 4: Regressions Explaining the Percent of the Village Farm Workforce that is Female in Rural China, 2000

Specification	(1)	(2)	(3)	(4)
Percent Workforce, Female	2.09 (2.75)**	1.38 (1.92)*	–	–
Percent Workforce, Female, no migrants	–	–	0.78 (1.77)*	0.75 (1.89)*
Number of Men, aged 16-25	0.007 (1.19)	0.003 (0.48)	–0.004 (1.31)	–0.003 (1.35)
Number of Women, aged 16-25	–0.02 (2.24)**	–0.009 (1.37)	–0.003 (0.72)	–0.002 (0.56)
Number of Men, aged 26-55	0.02 (2.62)**	0.01 (1.60)	0.008 (1.47)	0.005 (0.92)
Number of Women, aged 26-55	–0.01 (1.40)	–0.004 (0.58)	0.002 (0.35)	0.003 (0.70)
Number of Men, over 55	0.01 (1.78)*	0.004 (0.68)	0.003 (0.61)	0.0002 (0.05)
Number of Women, over 55	–0.02 (2.71)**	–0.01 (1.66)	–0.01 (1.84)*	–0.008 (1.37)
Provincial Fixed Effects?	No	Yes	No	Yes
<i>Regression Statistics</i>				
$R^2$	0.38	0.57	0.32	0.57
p-value, $\gamma = 1$	0.16	0.60	0.65	0.53

Notes: \*- significant at the 10 percent level; \*\*- significant at the 5 percent level.

Source: CNRS.

Table 5: Determinants of the Proportion of Farmwork Done by Women, 2000

Explanatory Variable	OLS (1)	Logistic (2)
Proportion of Labor, Female	0.69 (8.11)**	2.96 (6.10)**
<i>Household Characteristics</i>		
Female Head (1=yes)	0.073 (1.82)*	0.287 (1.69)*
Experience of Head	-0.002 (1.57)	-0.007 (2.14)**
Log, Household Wealth	0.015 (1.84)*	0.066 (2.79)**
Responsibility Land (mu)	-0.002 (1.88)*	-0.009 (1.60)
Mean education, household (years)	0.009 (2.10)**	0.038 (2.53)**
<i>Household Demographics</i>		
Number males, aged 16-25	0.048 (2.27)**	0.215 (2.53)**
Number females, aged 16-25	-0.054 (3.74)**	-0.235 (2.95)**
Number males, aged 26-35	0.014 (0.53)	0.067 (0.57)
Number females, aged 26-35	0.016 (0.61)	0.051 (0.43)
Number males, aged 36-45	0.038 (1.81)*	0.194 (1.52)
Number females, aged 36-45	0.042 (1.40)	0.147 (1.13)
Number males, aged 46-55	-0.015 (0.63)	-0.038 (0.34)
Number females, aged 46-55	0.025 (0.95)	0.083 (0.68)
Number males, over 55	-0.001 (0.02)	0.016 (0.15)
Number females, over 55	-0.060 (3.11)**	-0.267 (2.83)**
<i>Summary Statistics</i>		
N	1131	1131
Adj. $R^2$	0.221	

Notes: t-ratios in parentheses; standard errors calculated correcting for clustering at the village level. \*- significant at the 10 percent level; \*\*- significant at the 5 percent level. Provincial fixed effects are included in all equations but not reported. Column (1) reports results using OLS, and column (2) reports results after transforming the dependent variable using the logistic transformation.

Source: CNRS.

Table 6: Determinants of the Proportion of Farmwork Done by Women, Northeast China, 1994 and 2000

Variable	CNRS, Northeast China		Dongbei data	
	(1)	(2)	(3)	(4)
Proportion of Labor, Female	0.857 (4.45)**	3.98 (3.97)**	0.87 (7.91)**	3.55 (6.87)**
<i>Household Characteristics</i>				
Female Head (1=yes)	0.053 (0.56)	0.229 (0.57)	0.17 (3.81)**	0.70 (3.75)**
Experience of Head	-0.004 (2.76)**	-0.023 (3.00)**	-0.002 (1.95)*	-0.010 (2.06)**
Log, Household Wealth	0.028 (2.62)**	0.131 (2.76)**	0.010 (0.75)	0.030 (0.69)
Responsibility Land (mu)	-0.002 (1.01)	-0.009 (1.11)	-0.001 (1.62)	-0.004 (1.57)
Mean education, household (years)	0.006 (0.95)	0.016 (0.59)	0.013 (3.03)**	0.052 (3.04)**
<i>Household Demographics</i>				
Number males, aged 16-25	0.096 (2.57)**	0.463 (2.59)**	0.063 (3.11)**	0.262 (2.86)**
Number females, aged 16-25	-0.070 (2.09)**	-0.334 (2.11)**	-0.087 (4.64)**	-0.356 (4.29)**
Number males, aged 26-35	-0.014 (0.28)	-0.139 (0.55)	0.075 (3.20)**	0.31 (3.08)**
Number females, aged 26-35	0.033 (0.66)	0.137 (0.58)	-0.032 (0.99)	-0.141 (1.00)
Number males, aged 36-45	0.081 (1.56)	0.329 (1.33)	0.066 (2.12)**	0.284 (2.21)**
Number females, aged 36-45	-0.003 (0.06)	-0.044 (0.18)	0.049 (1.29)	0.201 (1.27)
Number males, aged 46-55	-0.031 (0.64)	-0.109 (0.48)	0.052 (1.76)*	0.230 (1.86)*
Number females, aged 46-55	0.015 (0.30)	0.054 (0.23)	0.010 (0.33)	0.041 (0.33)
Number males, over 55	0.052 (1.20)	0.270 (1.36)	0.078 (2.61)**	0.330 (2.60)**
Number females, over 55	-0.082 (2.14)**	-0.389 (2.25)**	-0.074 (2.69)**	-0.305 (2.65)**
<i>Summary Statistics</i>				
N	379	379	730	730
Adj. R <sup>2</sup>	0.247		0.194	

Notes: t-ratios in parentheses; standard errors are clustered at the village level. \*- significant at the 10 percent level; \*\*- significant at the 5 percent level. Results in column 3 are weighted so that each village has the same weight in the regression. Provincial fixed effects are included in all equations but not reported.

Sources: CNRS (columns 1 and 2) and the Dongbei data set (columns 3 and 4).

Appendix Table 1: Descriptive statistics

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>
Proportion Farmwork, done by Women	0.474	0.251
<i>Household Characteristics</i>		
Proportion of Farm Workforce, Women	0.485	0.146
Experience of Head	33.063	12.608
Female Head (1=yes)	0.033	0.177
Mean Education, Household (years)	5.919	2.446
Responsibility Land (mu)	6.009	5.809
Log, Household Wealth (yuan)	6.92	1.492
<i>Household Demographics</i>		
Number of Males, aged 16-25	0.399	0.604
Number of Females, aged 16-25	0.366	0.599
Number of Males, aged 26-35	0.305	0.475
Number of Females, aged 26-35	0.279	0.458
Number of Males, aged 36-45	0.314	0.47
Number of Females, aged 36-45	0.352	0.478
Number of Males, aged 46-55	0.312	0.472
Number of Females, aged 46-55	0.274	0.446
Number of Males, over 55	0.281	0.464
Number of Females, over 55	0.265	0.464

Notes: Sample size is 1199, except for the first variable, which is 1131, because 68 households do not farm.