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Property Rights, Labour Markets, and Efficiency in a Transition Economy: The Case of Rural China

By: Dwayne Benjamin and Loren Brandt

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PROPERTY RIGHTS, LABOUR MARKETS, AND EFFICIENCY IN A TRANSITION ECONOMY: THE CASE OF RURAL CHINA

Dwayne Benjamin and Loren Brandt*
Department of Economics
University of Toronto

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Abstract

This paper investigates the consequences of imperfect and uneven factor market development for farm efficiency in rural China during transition. In particular, we estimate the extent to which an inverse relationship in farm productivity can be attributed to the administrative (instead of market) allocation of land, and the extent of unevenly developed non-agricultural opportunities. Using a recently collected household survey, we show that a considerable amount of inefficiency exists in the countryside, especially in the employment of labour. Our results show that this inefficiency is alleviated by the development of external labour markets, and that in the context of the current imperfect market environment, administrative reallocations help improve on the margin both efficiency and equity. They do not go far enough, however, which raises important questions about constraints on rental activity, the link between administrative reallocation and decentralized land exchange, and property rights formation more generally.

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1. Introduction

Factor market imperfections are a common feature of developing countries. They have important implications for productivity, growth, and inequality. Indeed, recent work in development economics highlights the sources of these imperfections, their welfare costs, and potential policy interventions.[1] For economies in transition, the problem of factor market imperfections may be even more severe. Well-functioning markets require a system of property rights and an array of inter-connected institutions—economic, legal and even social—that underpin a market economy. After nearly half a century under state ownership and administrative planning, we expect these "supporting" institutions to take time to develop. In still other cases, market development may be deliberately impeded by state policy, as a preference for non-market institutions or administrative measures persists in the context of weakly defined property rights. In analyzing economic transition and development alike, it is important to know how market and non-market institutions interact and affect economic outcomes. In this paper, we examine several dimensions of this relationship in the context of China's rapidly changing rural sector.

1.1 Background

The introduction of the Household Responsibility System (HRS) in rural China in the early 1980s marked a radical change in property rights and organization in agriculture. With the extension of use and residual income rights to agricultural land to rural households—typically on the basis of family size—agriculture shifted from collective to family-based management.[2] However, the HRS did not lead fully to decentralized decisions for farmers: land ownership remains vested in the village. Moreover, village cadres were given discretion over the allocation of use rights and non-residual control rights, including the right to rent. The HRS law originally called for secure land tenure for fifteen years. However, in slightly more than two-thirds of all villages, village cadre have reallocated land amongst households at least once, and on average more than twice. Slightly less than half of

[1] See Bardhan and Udry (1999) for a more detailed review of the various theories of market imperfections in developing countries.

[2] The incentive effects of the institutional change, combined with price and marketing reforms, explain much of the spurt in growth from 1978-1984. On this point, see Lin (1992).

all village land has been reallocated through these village-administered reallocations since the introduction of the HRS.[3] While most villages do not outright prohibit the hiring of farm labour or rental of land, land rental markets especially, are thin in most areas. Village-administered reallocation of use-rights, therefore, is the most important way that land is reallocated across households. This administrative method of land allocation stands in stark contrast to the growth in off-farm (non-agricultural) labour markets and self-employment opportunities.

2.2 Objective

Our objective is to examine the impact of the combination of administrative land allocation and unevenly developed off-farm labour markets on farm inefficiency. In order to identify these linkages, we exploit the extent of an "inverse relationship" between farm productivity and farm size. The inverse relationship is a common empirical regularity in developing country agriculture.[4] One leading interpretation of the correlation between productivity and farm size is imperfect factor markets: With limited off-farm employment opportunities, or constraints on renting land, farmers with less land are more constrained in their labour supply than their larger counterparts. Because their labour is implicitly cheaper, small farms use more labour, produce more output per acre, but have lower labour productivity.

Our empirical strategy rests on the covariation of the inverse relationship with factor market development.[5] Drawing on a recent household survey from North China, we find that there is a great degree of static inefficiency in Chinese agriculture. While output per acre is independent of farm size, labour input per acre is much higher on small farms, implying that small farmers have lower labour productivity. Moreover, this inefficiency can be directly linked to imperfect factor markets and the inherent limitations of administrative land reallocation.

[3] See Turner, Brandt, and Rozelle (2002) for a detailed investigation of the extent and motivation for these reallocations. For a related discussion, see Carter *et al* (1996).

[4] See Berry and Cline (1979) for the classic presentation of this relationship from a variety of developing country contexts.

[5] This basic approach has also been undertaken in other papers. For example, Burgess (1997) compares the degree of the inverse output relationship in two provinces in China with the level of labour market development. In the context of Africa, Udry (1996) points to the possible inefficiency deriving from imperfect property rights assignment between men and women within a household. Neither of these papers formally

Our results also show that off-farm employment opportunities help considerably in alleviating the constraints facing farm households, but that administrative land reallocations play only a modest role in this regard. Households remain seriously constrained, suggesting the need for institutions that help reallocate land among households. An obvious candidate is a system of secure property rights that facilitates the development of a decentralized land rental market. Furthermore, since it is the smaller farms that are most constrained, our findings imply that rental markets can serve both efficiency and equity goals.[6]

Finally, this paper contributes to the understanding of the "inverse relationship" in development economics. It is conventionally assumed that the inverse relationship is a consequence of imperfect factor markets, yet no previous studies provide direct evidence linking exchange constraints and poorly developed factor markets to the inefficiency reflected in the inverse relationship.

2. Empirical Framework

Economists use a variety of approaches to identify inefficiency. Technical efficiency, or "productivity" concerns the level of output that can be produced from a given level of inputs. Technical inefficiency is particularly interesting when it can be linked to the institutional environment. For example, Lin (1992) evaluates the impact of the HRS on agricultural productivity. The interpretation of this type of efficiency is that it reflects unobserved firm inputs—like managerial ability or effort—that may be responsive to incentives under alternative institutional structures. We do not focus on this type of inefficiency: Our interest is in the choice of inputs, and whether these choices are allocatively efficient. While the distinction between allocative and technical efficiency is less clean than traditional usage suggests, it is allocative inefficiency that should be most affected by the factor markets and institutions currently in place in rural China. Allocative efficiency implies that if all farmers in a village face the same factor prices (say, for land and labour), then they will have the same marginal rates of technical substitution (*MRTS*). If we assume that land is exogenously determined, then farmers facing the same wage will

(econometrically) estimate the degree to which the inverse relationship varies with factor market development.

[6] For an analysis of the impact of land rental markets on income distribution in a historical context, see Benjamin and Brandt (1997). For more discussion of the role of land property rights, see: Besley (1996), for a prominent example, Binswanger, Deininger, and Feder (1995) for a survey of the related literature, and

have the same marginal product of labour (*MPL*).

One way to test for allocative efficiency is to embed the factor demands within a system of equations including the profit function, and then test for the validity of the cross-equation restrictions (e.g., Lau and Yotopoulos 1971 and 1973; Brandt 1987). A related procedure involves estimating the *MPL*, and comparing it directly to the wage rate (e.g., Jacoby 1993). What these approaches share is the requirement for high quality data on factor prices. But what if factor markets are thin, and wage observations are sparse? The approach we adopt, which has implicitly been used by researchers since Chayanov (1926), relies on comparing the *MRTS* across farms, and does not require price data.

The basic idea is that "identical" farms produce output the same way if they face the same factor prices. If the technology of production is such that a four acre farm is a scaled-up replication of a one acre farm, then we expect the four acre farm to employ four times as much labour and other inputs. However, demonstrating allocative inefficiency requires more than establishing differences in factor ratios across farms (though this is a good start). We want to see whether the patterns of input use correspond to what we expect if farmers face distorted or non-existent markets. In such a case, we expect farmers to equate the marginal product of labour to the *unobserved* shadow wage, which may depend on the actual wage, or a number of other potential "distortion factors" (in the language of Kumbhakar and Bhattacharyya, 1992). There are a variety of candidates for variables that shift shadow wages in ways that may have a predictable influence on factor allocation. For example, household demographic variables (like household size) may work, for example, if bigger families have implicitly cheaper farm labour. This strategy is employed by Benjamin (1992), and more recently by Bowlus and Sicular (2001). We also exploit these variables to a limited extent.

Another candidate is farm size: If we believe that farm size is positively correlated with a farmer's marginal product of labour (and therefore, his value of time), then we expect large and small farms to operate differently. Specifically, in the presence of limited off farm opportunities, farmers with smaller plots of land will drive their marginal products of labour lower. Smaller farms will have higher labour intensity, consistent with a

Feder and Deininger (1999) for some of the policy implications of this research.

lower shadow wage. This yields the "inverse relationship," which has frequently been used as evidence of allocative inefficiency in developing country agriculture.[7]

In summary, the benchmark is a constant returns to scale world where farm size will not matter for input use (notably labour intensity). The alternative is one with imperfect markets. With unequal *MRTS* across farms, efficiency can be improved either by moving labour from the small to large farms, or land from large to small farms. This is the normal function of markets, or careful administrative planning.

2.1 Efficiency and The Inverse Relationship

We formalize the above discussion with a simple model of farm production. Output, Q_i, is produced with land and labour according to a production function, $Q_i = F(h_i, L_i)$. We assume that land, h_i, is predetermined for the farmer (in this case by the village leaders), so his decision only involves choosing the profit maximizing amount of labour, L_i. In a world of imperfect markets, this decision can be characterized as equating the *MPL* to the (endogenous) shadow wage, q_i:

$$F'(L_i; h_i) = q_i \tag{1}$$

In general, the shadow wage will depend on a variety of variables, such as household and farm characteristics, and institutional variables. If markets are complete, the shadow wage equals the market wage.

If the production function is Cobb-Douglas with constant returns to scale, we have:

$$Q_i = A h_i^a L_i^{(1-a)} \tag{2}$$

Taking logs of the first order condition implied by (1) and (2) yields the labour demand and output supply equations:

$$\ln L_i = b + \ln h_i - \frac{1}{a} \ln q_i \tag{3}$$

[7] See Benjamin (1995) for a more detailed discussion of the inverse relationship, including an evaluation of alternative interpretations (besides market imperfections), and a more extensive list of references. Udry (1999) offers a more recent application of the inverse relationship.

$$\ln Q_i = c + \ln h_i - \frac{(1-a)}{a}\ln q_i \tag{4}$$

where b and c are constants that we ignore. The labour demand and output supply functions are decreasing in the shadow wage. Notice that the wage elasticity of labour demand is larger in absolute value than the supply elasticity, unless $a = 0$, when labour is the only input. The most important implication of these equations, however, is that the elasticities of both labour and output with respect to land are one—doubling farm size should double labour input and output. This follows from constant returns to scale and the independence of the optimal input mix from scale.[8]

However, the implication that the land elasticity is one is predicated on holding the shadow wage constant. What if we cannot (because it is unobservable), and the shadow wage depends on farm size? Suppose the shadow wage is related to farm size as:

$$\ln q_i = d + r \ln h_i \tag{5}$$

Then substituting this into the labour demand and output supply equations yields:

$$\ln L_i = b' + \left(1 - \frac{1}{a} r\right)\ln h_i \tag{6}$$

$$\ln Q_i = c' + \left(1 - \frac{(1-a)}{a} r\right)\ln h_i \tag{7}$$

The elasticity of labour and output with respect to land will be less than one, the deviation from one depending on ?, the elasticity of the shadow wage with respect to land, as well as a .

The inverse relationship is characterized by the deviation of the output-land elasticity from one: small farmers optimally cultivate their land more intensively, reflecting the lower marginal value of their time, and output less than doubles when we double farm size. We can interpret ? as capturing the degree of inefficiency caused by imperfect markets and reflected in the degree to which farm size is related to the farmer's opportunity cost of time. The stronger the link between farm size and the shadow wage, the greater will be the degree of the inverse

[8] We explore the consequences of including additional inputs in the production function—especially capital—later in the paper.

relationship. We thus expect that the inverse relationship is greater where factor markets are more poorly developed.

2.2 An additional source of inefficiency

Other sources of inefficiency may accentuate the inverse relationship. For example, farmer effort may also depend on the shadow wage (and thus farm size). A measured day's work may not be the same on farms where farmers' opportunity costs differ. Assume we can decompose the effective labour input, L_i , into measured labour days, L_i^M , and labour efficiency, e_i :

$$L_i = e_i L_i^M \tag{8}$$

In logarithms we have:

$$\ln L_i = \ln e_i + \ln L_i^M \tag{9}$$

Substituting this into the labour demand equation, measured labour demand is thus:

$$\ln L_i^M = b + \ln h_i - \frac{1}{a} \ln q_i - \ln e_i \tag{10}$$

so that measured labour demand is declining in labour efficiency for a given amount of effective labour. Not only will reduced farm size lower the shadow wage, increasing the optimal effective labour per acre, but with lower effort (efficiency), it will take even more measured days of labour per acre. The additional type of efficiency is a close cousin of technical efficiency. If we write the efficiency relationship as:

$$\ln e_i = g + g \ \ln q_i \tag{11}$$

then, substituting equations (5) and (11) into (10), the labour-land elasticity will be reduced further:

$$\ln L_i^M = b'' + \left(1 - \frac{1}{a} r - g r\right) \ln h_i \tag{12}$$

The output elasticity, however, remains as before since it only depends on the response of effective labour to the shadow wage, and not the decomposition of labour into effort and measured labour days.

We thus have at least two reasons why labour input and output might be subject to an inverse relationship with respect to farm size. We have the further prediction that the inverse relationship can be expected to be stronger for labour, especially if the gap between effective and measured labour days is related to farm size through the shadow price of labour.

2.3 Empirical Implementation

Following the development above, we specify log-linear output and labour demand equations:

$$\ln Q_i = a_0 + a_1 \ln h_i + a_2 \ln q_i + a_3' Z_i + e_{Qi} \tag{13}$$

$$\ln L_i = b_0 + b_1 \ln h_i + b_2 \ln q_i + b_3' Z_i + e_{Li} \tag{14}$$

Z is a vector of other control variables that enter the production function, while e_{Qi}, e_{Li} are unobserved error terms. The model in the previous section provides some predictions on the configuration of the land coefficients, depending on how well we control for the unobserved shadow wage. While the shadow wage is unobserved, we can specify it as a function of observables:

$$\begin{aligned} \ln q_i = {} & l_1 + l_2 \ln h_i + l_3' D_i + l_4' Z_i \\ & + l_5 I_{Li} + l_6 I_{Li} \times \ln h_i + l_7 I_{Hi} + l_8 I_{Hi} \times \ln h_i + v_i \end{aligned} \tag{15}$$

where D is a vector of household demographic variables, Z is a vector of control variables that affect production, and I_L and I_H are institutional variables describing the allocation of land and development of the labour market. We also interact these variables with farm size, since the impact of farm size on the shadow wage might also depend on the extent of factor market development and administrative reallocation. Substituting (15) into (13) and (14), and expressing effective labour in measured days, yields our main estimating equations:

$$\begin{aligned} \ln Q = {} & a_0 + a_1 \ln h + a_2' D + a_3' Z \\ & + a_4 I_L + a_5 I_L \times \ln h + a_6 I_H + a_7 I_H \times \ln h + v_Q \end{aligned} \tag{16}$$

$$\begin{aligned} \ln L^M = {} & b_0 + b_1 \ln h + b_2' D + b_3' Z \\ & + b_4 I_L + b_5 I_L \times \ln h + b_6 I_H + b_7 I_H \times \ln h + v_L \end{aligned} \tag{17}$$

We focus on two main issues: 1) Whether, and to what extent, an inverse relationship exists in output and labour (how do a_1 and b_1 compare to one); and 2) To what extent does this inverse relationship co-vary with institutional variables. This hypothesis can be tested by examining the coefficients on the interaction terms between farm size and institutions (a_5 and b_5 for the labour market, and a_7 and b_7 for the land market).

3 Empirical Implementation

3.1 Survey Data

We use data from a household survey that was carried out in 30 village and 6 counties in the northern provinces of Hebei and Liaoning in the summer of 1995.[9] The survey provides detailed household level income, expenditure, labour supply, and farm management data. The selection of the counties and villages was not entirely random. Each of these counties was the site of an intensive household-level investigation carried out by Japanese investigators in either 1936 or 1937. In our re-survey, five villages in each of the six counties were selected, one of which had been fully enumerated in the 1930s. The other four villages in the county included one village located in the same township as the administrative capital of the county; one located in the same township as the village surveyed in the 1930s; and two villages drawn from a third township. The remaining villages were drawn to provide as representative of a cross-section as possible. A total of 130 households were surveyed in each county: Fifty from the village surveyed in the 1930s, and twenty from each of the remaining four villages. The households themselves were picked on the basis of random sampling using the most recent village registry.

3.2 Overview of the Villages

Agriculture, including farm sidelines, is the primary source of income for households, and represents more than half of household total net income. All but a very small percentage of households engage in farming. Land per household ranges from slightly more than three *mu* (half an acre) to twenty-four *mu* (four acres). As reported in Table 1, the mean cultivated farm size is ten *mu*, with farms larger on average in Liaoning than in Hebei. The smaller farm size in Hebei is largely offset by a longer growing season, and higher multiple cropping index. The other two major sources of household income are family-run enterprises and wages earned from hiring off-farm. Slightly more than forty percent of all households report income from family-run enterprises, and more than half report wage earnings. On average, men work 264 days per year, and women 157 days (excluding

[9] The survey involved a collaborative effort involving Loren Brandt (University of Toronto), Paul Glewwe (World Bank), Scott Rozelle (U-C, Davis), and a team of researchers headed up by Bai Nansheng

housework.) The number of days supplied to farming and sidelines by the two sexes is similar (85 vs 81 days), while men worked considerably more off-farm and in family-run enterprises.

3.3 Quantifying the Institutional Environment

Estimation of equations (16) and (17) requires measures of I_H and I_L, the two institutional variables that describe the development of the land and labour markets. We begin with land.

Land

With fully active rental markets, even with poorly developed labour markets, farmers could rent in land in order to equalize the *MPL* across households. While ownership rights reside with the village, households (in principle) have the right to rent their land to other households. However, only a small percentage of land is actually rented in these villages. Two potentially important reasons are the lack of supporting institutions, as well as a concern of households that they may lose their use-rights if they do not cultivate the land themselves. This is one reason why secure property rights are so important to the functioning of a rental market. Insofar as land moves across households in these villages, the primary mechanism is through a village-wide land reallocation process in which all or part of the land is taken back from households and reallocated to existing and possibly newly formed households. By all indications, relatively well-defined rules are used and villages adjust land in direct proportion to household size.[10] In principle, careful reallocations could replicate a decentralized market.

Summarizing and interpreting these reallocations in a single village-level variable is not easy. From village-level surveys, for example, we know the number of times that land has been reallocated since HRS was introduced, as well as the size of each the reallocations. We also know the percentage of land that is currently farmed by the same households that received the land at the time of HRS. However, it is not just the size of the reallocations that likely matter for the efficiency of the current land allocation. Equally important is the *distributive* dimension of the reallocation of village land-holdings: How is the land being redistributed across

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from the Research Center for Rural Economy, Ministry of Agriculture, Beijing.

[10] In regressions (not reported) of the log of household allocated land on household demographic structure and other controls, we cannot reject the hypothesis that land is allocated in direct proportion to household size.

households within the village? Is it going to a relatively small percentage of households, or is a much larger percentage of households benefiting from the reallocation?

For each household we collected information on their current land-holdings, and all of the changes that occurred in their cultivated area in the last three years, i.e. 1991-1994. The former comes in the form of detailed plot-by-plot information, including the number of years that the household has farmed each plot. The latter documents any increase or reduction in the last three years in land the household farms, and provides the reason for the change. As noted above, most of the household-level changes are associated with village-wide reallocations. We experimented with a number of alternative measures of land reallocation, but in this paper only report the results from using a measure (*Re_all*) that is the product of two components[11]:

1) The percentage of village land reallocated within the past three years.[12] This will be higher in those areas where village governments are more "meddlesome" in allocating land; or alternatively where village leaders are reacting to opportunities to allocate land on an efficiency basis, or possibly on more egalitarian grounds. On its own, the effects of this particular measure are difficult to predict.
2) The proportion of households receiving positive increases in allocated land. We expect this variable to be highest in those areas with more egalitarian-motivated reallocations.

Re_all is designed to capture a number of alternative village scenarios regarding land reallocation decisions. At one extreme is a policy of "benign neglect" in which villages either do not reallocate, or reallocate relatively small amounts of land. *Re_all* in this case will be near zero. Broad-based reallocations in which more land changes hands, and more people receive land from the reallocations will result in higher *Re_all*. There are two intermediate cases: One in which a relatively high percentage of households receive relatively small amounts

[11] Our empirical results are robust to the choice of reallocation measure, though the "*Re_all*" effect yields the largest effects of the measures we experimented with.

[12] A couple of points of qualification. First, the extent of reallocation in the past three years may not fully capture long-term differences in land policy between villages. For example, all villages may pursue the same policies, but differ (*ex post*) only in the timing of their reallocations. Second, we only measure changes in the size of the household land endowment. We net-out the fact that a household may have the same amount of land before and after a reallocation, but that this might be comprised of different plots. This consideration is especially important if we were looking at issues of "dynamic" efficiency.

of land and the second in which a relatively small percentage of households are targeted for a major increase in land-holdings. The former is consistent with an egalitarian-motivated land reallocation designed to make modest adjustments for household size, while the latter might be more efficiency-oriented, with the land perhaps targeted to the most efficient farmers. Of course, there is no way by looking at the reallocations alone to be sure of the motivation, or the consequences.

In Figure 1, we graph for each village the two components of *Re_all*: 1) the proportion of land reallocated by each village; and 2) the proportion of households that reported an increase in their cultivated holdings. The contrast between the provinces of Hebei and Liaoning is striking: Over the course of the last three years, administrative reallocation in villages in Hebei has been minimal, with little overall change in the allocation of landholdings.[13] In a majority of the villages in Liaoning, on the other hand, reallocations have been fairly common, with a sizable percentage of both land and households affected by reallocation behaviour.

Off-farm Employment Opportunities

Outside of crop production, households found alternative outlets for their labour: farm-related sidelines, family-run businesses, and hiring-out off the farm, usually in local enterprises. There is considerable heterogeneity across villages in employment patterns and connections with off-farm opportunities. In several villages, in upwards of a third of all household members worked off-farm; in nearly a quarter of all villages, however, the proportion was less than ten percent. In our estimation, I_L is measured at the *household level* by the percentage of household members working off-farm. This variable reflects variation of off-farm opportunities across and within villages. Because this is a household level variable, it may be endogenous to the labour input equation, and needs to be instrumented.

3.4 Dependent Variables

Two other key variables required for the estimation of equations (16) and (17) are farm output and labour input in agriculture. Farm output is the total value of crop production measured at market prices.[14] Total labour is

[13] In fact, a majority of the Hebei villages have not reallocated land since the HRS was introduced.

[14] Farm output that was sold at quota prices, which are below market prices, was re-valued at

the sum of the household's own labour employed on the farm, plus labour hired-in, either for a wage, or as exchange labour. Hired labour (for a wage) averaged less than five days per farm, and exchange labour was six days per year. In contrast, household-supplied labour was 130.3 days across a variety of tasks.

3.5 Other Control Variables

The following is a list of the control variables that we use: 1) $\ln h$: Log farm size (area cultivated); 2) Demographic variables: a) Log household size; b) The proportions of male and female children (0 to 10 years of age), male and female teens (11 to 19 years of age), prime age males and females (20 to 59 years old), and the proportion of elderly men (60 and older; elderly women are the excluded group). These variables help control for the productivity of family labour, and should also be insignificant in the regressions if labour markets are perfect. 3) Village fixed effects in some of the specifications, as well as farm level measures of land quality ("low, medium, high", irrigated), and village level measures of soil characteristics (pH level, levels of potassium, nitrogen, and phosphates). These coefficients are not shown in the tables.

4. Results

4.1 Inverse Relationship: Output and Labour

The main results for the inverse relationship, the estimation of equations (16) and (17), are presented in Tables 2 and 3. We begin with the output equation in Table 2. The first column shows the OLS estimates, without controls for land quality. The coefficient on land is 0.833, which is significantly below one. This suggests that there is a strong inverse relationship in output. However, farm size might be correlated with omitted measures of land quality. If small farms are systematically of better quality than large ones, then the land coefficient will be biased, at least in terms of the interpretation developed in the modeling section. To address this possibility, we first add village fixed effects, which absorbs the village-level land quality characteristics. With these controls, the inverse relationship vanishes. The land elasticity is 1.009, and precisely estimated.[15] In the third column, instead

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market prices. The actual market prices that farmer's received for their crops were used for valuing production except in the case when no output was actually sold. In this case, village-level averages were used.

[15] To evaluate the possible consequences of crop aggregation, we use separate plot-level data

of village fixed effects, we add direct controls for land quality. Here, the results are equally striking: The inverse relationship also disappears. Apparently, the entire inverse relationship for output can be explained by omitted land quality.

In Table 3 we report the corresponding results for labour. The conclusions differ sharply from the output equations. In the first column, we see a dramatic inverse relationship, with the land elasticity less than 0.5. Furthermore, household demographic variables are significant determinants of farm labour use. As discussed in Benjamin (1992), this can be interpreted as further evidence that labour is inefficiently applied to the farms, and that trade in labour (or land) across farms is somehow restricted.[16] These results, while slightly attenuated, are essentially the same once we add controls for land quality or village fixed effects. The land elasticity lies between 0.5 and 0.6, suggesting significant inefficiency in labour use. The difference in inverse relationships between the output and labour equations, however, suggests that most of the inefficiency is related to "effort" rather than the application of effective labour.

Before turning to our estimates that exploit spatial variation in institutional development, it is worth illustrating our methodology with a simple figure, which essentially captures the main result of our paper. Our empirical methodology is based on identifying "systematic" variation of the degree of the inverse relationship across households facing possibly different constraints. One source of this variation is spatial differences in the degree of labour market development, and spatial (village) differences in administrative land reallocation. In its simplest terms, we wish to see whether the inverse relationship is weakest where shadow wages are likely to be highest, that is, where markets are most developed.

In the two panels of Figure 2 we plot the estimated *village level* inverse relationship against our village-

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collected in the survey, and estimate the land coefficient for each of the main crops. The estimated land coefficients (and standard errors) are 1) For rice, 1.01 (0.03); 2) For corn, 0.97 (0.02); and for soybeans, 1.04 (0.18). Thus, the estimated land coefficient is basically the same for individual crops as the aggregate value.

[16] Bowlus and Sicular (2001) expand on this methodology, exploring the degree to which the demographic variables (and thus possible market imperfections) vary across three samples of Chinese farm households, divided according the likely extent of constraints in the labour market.

level institutional variables.[17] In panel 1 we plot the estimated land coefficients for 30 villages against the village-level *Re_all*. The land coefficients range from essentially zero, to one, with a mean around 0.5 (which is unsurprising, given the results in Table 3). However, there is no obvious correlation between the land coefficient (inverse relationship) and *Re_all*. The more interesting picture emerges in the second panel, where we plot the same land coefficients against our measure of off-farm employment opportunities. It appears that there is a generally positive relationship, suggesting that the inverse relationship is weakest in villages where off-farm employment opportunities are greatest.

Returning to Table 2, and the output equation, we see that the land coefficient remains close to one, and none of the institutional variables are significant. This means that the relationship between output and farm size does not vary across villages in these dimensions. In the last column, we address the possible endogeneity of household participation in off-farm employment. We use household education and village measures of labour market activity to instrument household participation in non-agriculture.[18] These variables should be correlated with the household non-agricultural participation rate, but independent of the unobservables that jointly affect this decision as well as farm output. In this case, the 2SLS results line up with the OLS findings. Furthermore, in testing the validity of the instruments, we find that the instruments are significant in the first stage equation, but can be excluded from the second stage estimation, i.e., subject to the general weaknesses of overidentification tests, the instruments appear to be reasonable.

In the fourth column of Table 3, we add the institutional variables and their interactions with farm size to the labour equation. We find that widespread village reallocations of land tend to reduce the inverse relationship, as the interaction between *Re_all* and farm size is positive and slightly significant. Since we are controlling for the extent of off-farm employment, the interpretation is that in villages with widespread land reallocation, (for reasons

[17] The estimated coefficients are retrieved from a regression identical to the specification in column 2, with village fixed effects, but with interaction effects between village and farm size. As an aside, F-tests for the significance of the interaction effects suggest that the inverse relations does indeed vary significantly across villages.

[18] This methodology is reminiscent of that used by Ham (1986) and Ham and Reilly (2002). For example, Ham (1986) uses local unemployment rates to instrument individual weeks of unemployment in a labour supply equation.

independent of off-farm employment patterns, such as adjusting to demographic changes) inefficiency is reduced. Thus, uneven factor market development allows these reallocations to improve efficiency by providing employment for otherwise underemployed small farmers.

The results for off-farm employment are even stronger. The inverse relationship is significantly reduced for those farmers with outside opportunities, i.e., farm efficiency is higher where off-farm employment opportunities are most developed. Again, the 2SLS results strengthen this finding. Furthermore, the interpretation of the 2SLS overidentification tests is that the effect of education on farm production primarily lies in its generation of non-farm opportunities, and a more economical application of farm labour. These findings thus reinforce the interpretation of the inverse relationship as reflecting inefficiency.[19]

4.3 *Labour Productivity*

In Table 4 we summarize these findings by looking at labour productivity—that is output per day worked. The coefficients are the difference in coefficients between the output and labour regressions (Tables 2 and 3). In the first columns, we see that output per worked-day is significantly related to farm size: Small farmers produce significantly less per day worked. Secondly, larger households tend to produce less output per day worked. This is also consistent with these households having lower shadow values of labour. Once we add the institutional variables, we recover the other findings. Labour productivity is higher when farmers have other activities in which to spend time productively, and the relationship between farm size and productivity is significantly reduced in those villages with more widespread land reallocation, and greater off-farm opportunities.

4.4 *How serious is the inefficiency?*

The pattern of no inverse relationship for output, but a strong one for labour input, is consistent with wasted days of labour, akin to old-fashioned “surplus labour.” One way to evaluate the implicit economic cost of this inefficiency is to value the wasted labour at a “reasonable” opportunity cost. Our thought experiment is as

[19] In addition to the effect of off-farm opportunities on the inverse relationship (and thus efficiency), off-farm opportunities are also correlated with the *level* of labour application. By itself, the coefficient is negative, which suggests that households with greater opportunities apply less labour to their farms. In the 2SLS specification, this implies that households living in villages with more active labour markets, and households with more educated members, use less total labour on the farm, in addition to using less labour per mu.

follows: How much wasted labour do we see reflected in the inverse relationship *within* a village; and how much income is thus forgone, assuming that we could eliminate the inefficiency through some combination of land reallocation within the village and the creation of off-farm opportunities. Essentially, we are asking how much of the wasted labour can be freed for off-farm employment, and how much it would earn. Note that this "back of the envelope" calculation does not identify "absolute," but only "relative" inefficiency. We find that small farms use disproportionately too much labour relative to larger farms: If farm size is cut in half, labour input is cut by less than half. In order to pin down an absolute level of inefficiency, we need to identify an "efficient" land-labour ratio, and then estimate the implicit excess labour applied by all of the smaller farms. Obviously, there will be some sensitivity of our conclusions to the choice of benchmark.

We divide the sample into three farm sizes: small, medium, and large, according to the criteria in Table 5, labeling the "large" farms as those in the top decile, i.e. with $\ln h > 3.135$ (or 33 mu). Assume that these farms are efficient. Their mean log labour input is 5.203 (per year). If there is no inverse relationship, we expect that the labour input of medium-sized farms, with an average $\ln h$ of 2.512 to be:

$$5.203 - 1.0 \times \Delta \ln h = 5.203 - (3.505 - 2.512) = 4.210 \tag{18}$$

or 67 days per year. But, given the inverse relationship apparent in Table 3 (estimated within-villages), we estimate that the actual average labour input for medium farms to be:

$$5.203 - 0.60 \times \Delta \ln h = 5.203 - 0.6(3.505 - 2.512) = 4.607 \tag{19}$$

or 100 days per year, which is significantly more than predicted. Thus, for medium sized farms, we estimate they are wasting 33 days per year of labour input (i.e., employing 33 days of labour without any corresponding additional output.) If the opportunity cost of labour is the daily wage of a manual worker (on average, about 20 Yuan per day), then this works out to 660 yuan per year, or about 8% of median household income (8362 Yuan) for medium-sized farms. For small-sized farms, we calculate that about 29 days of labour are wasted, which represents a higher share of their farm labour input, and 9.3% of median household income (7090 yuan) for small-sized farms. In summary, the estimated inverse relationship for labour implies significant income losses, in terms of forgone labour income.

5. Caveats of Interpretation

Taken together, our estimated coefficients are consistent with the story outlined in the first part of the paper. Nevertheless, alternative explanations exist. In this section we explore a number of these alternatives. Our limited objective is to assess whether our interpretation is misleading. Are farmers in our sample wasting their time to the extent we estimate?

5.1 Measurement Error of Farm Labour

There may be measurement error in reported labour input that is systematically related to farm size. For example, small farmers might exaggerate their labour input. Perhaps there are indivisibilities in labour input (especially by task), and smaller farmers "round up" their reported days on the farm. In this case, we might observe a spurious inverse relationship for labour, but not output. However, if reported farm-days are exaggerated for small farmers, then total days worked in all activities should also be higher for small farmers (controlling for family size). Stated differently, with no measurement error, one day spent on the farm is one less day available for other activities, and total work days and farm size should be unrelated (unless farm size affects labour supply).

We thus look at how total household labour supply varies with farm size, controlling for the same factors as in the other tables. We are interested in whether the coefficient on land is negative, i.e., that smaller farmers work more total days, as implied by the exaggeration-based measurement error model. The results are shown in the first column of Table 7.[20] The coefficient on land is small and statistically insignificant. This suggests that per-capita labour supply is independent of farm size, so that there is no obvious evidence of exaggerated labour supply for small farmers.[21]

5.2 Seasonal Application of Labour

One implication of our results is that there are efficiency gains from reallocating land from larger to smaller farmers. What if labour is efficiently applied in the busy-season, and only wasted in the slack-season? In this case, extra land acquired through rental (for example) will not improve the efficiency of small farmers. A

[20] First note that mean total days worked are 414 per household (median = 350), versus mean farm labour of around 144 (median=117).

[21] In other specifications (not shown) we find that where off-farm opportunities are greatest, farmers

simple way to test for this possibility is disaggregate the labour input by busy and slack season. If the seasonal efficiency hypothesis is true, we will only observe an inverse relationship in the slack season. We report the results of this exercise in Table 6. In columns 2 and 4, while the inverse relationship is weaker in the busy season, it is still large and significant. This suggests that the shadow wage of labour is higher in the busy season, which seems perfectly reasonable. Further support for this is provided by the coefficient on family size, which is larger in the slack season, suggesting that larger families waste more labour in the slack season. During the busy season, off-farm employment opportunities have much the same effect as before in reducing the inverse relationship, but the effect is most pronounced in the slack season, when on-farm opportunities are lowest. In the slack season, land reallocations have no effect on reducing the inverse relationship, but in the busy season, it appears that extensive reallocations improve the efficiency of small farmers. This suggests that improved access to land can significantly improve the labour-efficiency of small farmers, especially in the busy season, when labour input is most valuable.[22]

5.3 *Endogenous Land Reallocations*

Our interpretation of the interactions between farm size and the land reallocations (*Re_all*) suggests that the reallocations are only weakly positively related to efficiency, principally through improved labour allocation. Might this be misleading? There are two possibilities. First, if reallocations actually reduce productivity, but are only conducted where the efficiency cost is low (and productivity is high), then we will get biased, and potentially incorrectly-signed estimates. Second, if reallocations are conducted where there is considerable inefficiency (say, where job opportunities are lowest) then the potentially positive effect of reallocation on efficiency will be understated.

One solution is to instrument *Re_all* and its interaction terms. We need instruments that are correlated with the frequency, extent, and nature of reallocations, but are also independent of the farm-productivity levels in the village. Our strategy is to use instruments that should be correlated with the preferences of village leaders, and

work more overall, but less on their farm, and this is consistent with our interpretation.

[22] Our results contrast with one dimension of Bowlus and Sicular's findings from a different part of China, where they argue that labour shortages (and inefficiency) may occur during the busy season.

the *costs* of reallocation (rather than the *benefits*). We use two different sets of instruments, one we call the "extended" set, and the other is a smaller "limited" set. The extended set includes 1) the number of plots in the village (which increases the administrative cost of reallocations); 2) an indicator of whether the township (not the village) makes the reallocation decision; 3) the number of households in the village (which increases the administrative cost); 4) the number of production teams in the village; 5) the number of village cadres; 6) an indicator of whether the last village election was contested; and 7) the age, education, tenure, and farming-status of the village head and party secretary.[23] For the limited instrument set, we use only indicators of whether the township makes reallocation decisions and the number of households in the village. These variables are also all interacted with log farm size in order to aid the prediction of the interaction term between *Re_all* and farm size.

In Table 7 we show results from 2SLS estimation. The "extended" set has the benefit of predicting reallocations better, but is riskier in terms of correlation with error term. The limited set is chosen to satisfy the overidentification test, but at the price of weaker predictive power in the first-stage regressions. In the first column for each specification we show the F-tests for how well the excluded instruments help predict each endogenous regressor in the first stage regressions. The instruments (extended and limited) are both significant predictors of the endogenous variables, though the extended set is much better. The extended set of instruments fails the overidentification test for output, but passes for labour (our main equation of interest anyway). The lean set (marginally) passes the overidentification test in both equations.[24]

The two sets of instruments lead to qualitatively similar results, both with each other, and with the results in previous tables. The standard errors, however, are quite large, reflecting the imprecision with which we estimate this effect. With the extended set of instruments, we continue to find that the inverse relationship for labour is significantly reduced where reallocations are more extensive. With the limited instrument set, the

[23] See Turner, Brandt, and Rozelle (2002) for a more detailed discussion of the determinants of village-wide reallocation decisions, including a discussion of these variables (though, from a different survey).

[24] Note that critical values could be adjusted upwards with the use of Schwarz criterion (that accounts for sample size), in which case, overidentification tests would pass in all equations.

reallocation interaction effect is still positive, but is insignificant. Our conclusions regarding off-farm employment opportunities are unaffected compared to the previous tables.

5.4. Substitution with Capital

Can the inverse relationship in labour reflect "efficient" substitution of labour for capital? Instead of hiring a tractor, a small-scale farmer might choose a more labour-intensive method of farming, but still produce as much output per acre as a large (more capital-intensive) farmer. More formally, with efficient factor markets, the capital-labour ratio depends only the ratio of factor prices (*w* and *r*), which is constant across farms:

$$MRTS = \frac{MP_L}{MP_K} = \frac{w}{r} \tag{20}$$

As long as the *MRTS* is independent of scale (as it is with Cobb-Douglas technology), then the capital-labour ratio (and input mix more generally) is independent of farm size. But if the shadow wage varies with farm size:

$$MRTS = \frac{MP_L}{MP_K} = \frac{q_L(h;z)}{r} \tag{21}$$

If $q_L(h;z)$ is increasing in h (farm size), the capital-labour ratio is optimally lower on small farms. This is consistent with the original story underlying the inverse relationship, but implies an inverse relationship in both labour and output which we do not observe.

Of greater concern for our interpretation is that there is a strong technological complementarity of capital with land. A similar pattern would be observed if the price of capital varied with farm size. However, there are simple suggestions that differences in technology do not drive the inverse relationship. First, we are not comparing Saskatchewan wheat farms to Ontario vegetable gardens. The variation in scale of Chinese farms is limited: small farms (the 10th percentile) are 2.8 mu (half an acre) while large farms (90th percentile) are 23 mu (3.8 acres). Second, most farmers in a village grow the same crops: corn, rice, or soybeans. The inverse relationship patterns (for output and labour) are the same for farmers growing different crops. Third, average farm size (and possibly technology) varies more across than within villages, yet the inclusion of village fixed effects does not significantly attenuate the inverse relationship for labour. Finally, the extent of the inverse relationship co-varies with development of the off-farm labour market. This squares with the traditional inverse relationship interpretation, not one based on technology.

Still, we consider the possibility that capital prices vary systematically with farm size: there may be indivisibilities such that the effective price of capital is higher on small farms, or credit constraints may yield higher capital rental rates.[25] The optimal capital- labour ratio is given implicitly by:

$$MRTS = \frac{MP_L}{MP_K} = \frac{q_L(h;z)}{q_K(h;z)} \tag{22}$$

where $q_i(h,z)$ is the shadow price of input *i*. With q_K decreasing and q_L increasing in farm size, we expect an even more severe inverse relationship than implied by the two-input model. But this need not be the case, since output is not held constant. Consider the Cobb-Douglas case, with the additional input, *K*:

$$Q = AK^{a_1}L^{a_2}h^{1-a_1-a_2} \tag{23}$$

In this case, optimal labour input is given by[26] :

$$\ln L = c + \ln h + \frac{1-a_1}{a_1+a_2-1}\ln q_L + \frac{a_1}{a_1+a_2-1}\ln q_K \tag{24}$$

Labour demand is decreasing in *both* input prices. This arises from the scale effect: even though capital and labour are substitutes (output constant), higher capital prices reduce the profit maximizing output level, offsetting the substitution effect. More expensive capital for small farmers actually attenuates the inverse relationship.

Of course, the capital-labour ratio will vary with farm size. For the Cobb-Douglas case, we have:

$$\ln\left(\frac{K}{L}\right) = c + \ln q_L(h;z) - \ln q_K(h;z) \tag{24}$$

Clearly, if q_L is increasing, while q_K is decreasing in farm size, the combined effect is a positive relationship between the capital-labour ratio and farm size. We conduct two empirical exercises to explore this possibility.

First, we expect to see a weaker inverse relationship in villages where the price of capital is relatively

[25] More expensive capital for smaller farmers will mimic (as the dual) the effect technological complementarity of land and capital.

[26] Note that the prediction of no inverse relationship (for a given set of input prices) generalizes to the

homogeneous across farms. In villages where the village (as opposed to a private market) provides major capital services, we expect the inverse relationship to be attenuated if it is driven by unequal access to capital. We estimate our inverse relationship equations, interacting farm size with indicators of whether the village government provides capital services for cultivation, harvesting, and irrigation. The F-test for the interaction terms indicates that there is no significant relationship between the degree of the inverse relationship and the village provision of these capital services.[27] This suggests that the variation of capital prices is orthogonal to the inverse relationship, and hints that capital has little to do with it.

Second, we estimate the relationship between the capital-labour ratio and farm size. We calculate the capital-labour ratio based on (1) hired capital services, and (2) the current value of owned capital. The specification is the one with full controls in Tables 3 and 4. For purchased capital services, we find that 60 percent of farmers purchased services, and that there is no significant relationship between farm size and the probability of hiring these services. The regression of $\ln(K/L)$ in this case yields a positive, but insignificant (t=1.3) coefficient on land. For "owned capital," which may be correlated with the flow of own-provided capital services, a similar regression of $\ln(K/L)$ yields a positive but insignificant coefficient on land (t=1.6) for the 86% of farmers who own capital. Even this coefficient may be biased upwards if capital ownership is positively related to wealth (and land).

While there are difficult problems in measuring capital inputs, the conclusion we draw from this exercise is that there is no strong evidence of systematic, disproportionate use of capital on larger farms. Together with the previous arguments, this suggests that the extreme inverse relationship we observe for labour is consistent with "wasted labour", and that the explanation unlikely lies with technology or capital prices that vary systematically with farm size.

6. Conclusions

The persistence of administrative forms of land allocation in the face of rapid commercialization is a

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case of three or more inputs.

[27]For the labour equation, the p-value of the F-test (3 interaction terms) is 0.52.

central feature of China's rural economy during transition. Our purpose in this paper has been to examine the effect that this non-market form of allocation and labour market development have on efficiency in the agricultural sector. Drawing on the inverse relationship, we find no inverse relationship for output, but a significant one for labour input and labour productivity. These findings can only be reconciled by a view of labour inefficiency in the rural sector, with constrained households working more days per acre, but earning virtually nothing in return for the extra time farming. However, certain kinds of village-wide land reallocations and, more importantly, off-farm opportunities help attenuate the severity of the inefficiency.

Despite the positive role of these factors, our findings suggest that there remain significant efficiency gains to be realized by reallocating land from bigger to smaller households. From a policy perspective, then, there is a need for the development of institutions that promote an efficient reallocation of land among households. It is highly unlikely that growth in off-farm opportunities by itself will be able to eliminate the inefficiency. Parameter estimates suggest that off-farm opportunities will have to double from their current levels. Moreover, we expect that as these labour market opportunities continue to develop, opportunities for specialization will emerge, and the need for reallocation of land will only increase.

The critical question is: Why don't we see more land reallocation carried out either administratively, or more likely, through a system of well-defined rental-rights and decentralized exchange? One thing that we can probably rule out is equity considerations. Our findings suggest that since it is smaller farmers who are most constrained, land reallocation from big to small farms, regardless of the method, will improve both efficiency and overall equity in these villages.[28] For future policy formulation, it is critical that we know the source of these underlying constraints on land rental and the interactions between the administrative reallocation and decentralized exchange.

[28] See Benjamin, Brandt, Glewwe, and Li (2002) for a discussion of income inequality issues exploiting these same data.

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TABLE 1
HOUSEHOLD LEVEL SUMMARY STATISTICS

	Mean	Percentage Not Zero
Value of Farm Output (*Yuan*)	6505.0	93.2
Household Size	3.72	100.0
Family Labour:		
Male days to farm	67.8	89.2
Female days to farm	62.5	87.3
Male days to sideline activities	16.9	59.1
Female days to sideline activities	18.1	67.6
Male days to off-farm wage labour	105.4	42.3
Female days to off-farm wage labour	39.4	16.3
Male days to family enterprise	73.3	40.7
Female days to family enterprise	36.9	20.2
Total Male Days	263.5	98.6
Total Female Days	156.9	94.5
Hired-in Labour:		
Hired labour days (on farm)	4.4	14.6
Exchange labour days (on farm)	6.4	43.6
Land:		
Cultivated land (*mu*)	10.5	93.3
Land Rented-in (*mu*)	0.45	10.8
Land Rented-out (*mu*)	0.21	6.0
Increases in allocated land (past 3 years, in *mu*)	1.81	22.5
Decreases in allocated land (past 3 years, in *mu*)	1.21	30.1

Notes: 1) Sample size is 787; 2) In 1995, one *Yuan* equaled 0.158 Canadian Dollars. 3) One *mu* is approximately one sixth of an acre.

TABLE 2
LOG FARM OUTPUT REGRESSIONS
(standard errors in parentheses)

	OLS	OLS-FE	OLS	OLS-C	2SLS
Ln Land (ln h)	.833*	.971*	1.071*	1.028*	1.149*
	(.035)	(.022)	(.037)	(.050)	(.103)
Ln Family Size	.137*	-.003	-.183*	-.204*	-.194*
	(.076)	(.054)	(.057)	(.059)	(.068)
Re_all				-.249	.019
				(.487)	(.557)
Re_all × Ln Land				-.093	-.142
				(.138)	(.164)
Off-farm employment				-.404*	.620
				(.176)	(.597)
Off-farm employment × Ln Land				.163*	-.035
				(.073)	(.178)
Cluster FE	No	Yes	No	No	No
Land quality	No	No	Yes	Yes	Yes
R-Squared	.63	.87	.82	.82	.80

Notes: 1) *Re_all* is the product of the fraction of village land reallocated within the past 3 years and the proportion of households receiving positive increases in allocated land. 2) Off-farm employment is a household level variable indicating the percentage of household members working off the farm. 3) The column headings refer to the estimator: OLS is ordinary least squares; OLS-FE adds village fixed effects; OLS-LQ adds village and farm-level measures of land quality; OLS-C corrects standard errors for village clustering; 2SLS is IV estimation, with off-farm employment (and its interaction with farm size) treated as an endogenous variable. The excluded instruments are: village measures of household labour market participation, age and education of the household head, as well as the fraction literate. These variables are also interacted with log farm size. The standard errors are corrected for village-level clustering. 4) The overid test is 12.13 ($?^2(6)$ and the F-statistic (df=8,699) for the excluded instruments in the first stage regressions is 11.98 and 7.78 respectively for off-farm employment and its interaction with ln h. 5) Land quality indicates controls for village and farm level land quality. 6) All specifications include controls for household demographic composition (as listed in table 2); 7) Sample size is 731; 8) * indicates the estimated coefficient is statistically significantly different from zero at the 5% level.

TABLE 3
LOG LABOUR INPUT REGRESSIONS
(standard errors in parentheses)

	OLS	**OLS-FE**	**OLS**	**OLS-C**	**2SLS**
Ln Land (ln h)	.495*	.558*	.591*	.424*	.170
	(.034)	(.033)	(.039)	(.068)	(.137)
Ln Family Size	.470*	.322*	.343*	.351*	.329*
	(.095)	(.079)	(.080)	(.081)	(.110)
Re_all				-.366	-.916
				(.707)	(.690)
Re_all × Ln Land				.321*	.433*
				(.157)	(.164)
Off-farm employment				-.810*	-2.895*
				(.214)	(.977)
Off-farm employment × Ln Land				.282*	.717*
				(.093)	(.266)
Cluster FE	No	Yes	No	No	No
Land quality	No	No	Yes	Yes	Yes
R-Squared	.33	.60	.53	.55	.42

Notes: 1) *Re_all* is the product of the fraction of village land reallocated within the past 3 years and the proportion of households receiving positive increases in allocated land. 2) Off-farm employment is a household level variable indicating the percentage of household members working off the farm. 3) The column headings refer to the estimator: OLS is ordinary least squares; OLS-FE adds village fixed effects; OLS-LQ adds village and farm-level measures of land quality; OLS-C corrects standard errors for village clustering; 2SLS is IV estimation, with off-farm employment (and its interaction with farm size) treated as an endogenous variable. The excluded instruments are: village measures of household labour market participation, age and education of the household head, as well as the fraction literate. These variables are also interacted with log farm size. The standard errors are corrected for village-level clustering. 4) The overid test is 4.89 ($?^2(6)$ and the F-statistic (df=8,699) for the excluded instruments in the first stage regressions is 11.98 and 7.78 respectively for off-farm employment and its interaction with ln h. 5) Land Quality indicates controls for village and farm level land quality. 6) All specifications include controls for household demographic composition (as listed in table 2); 7) Sample size is 731; 8) * indicates the estimated coefficient is statistically significantly different from zero at the 5% level.

TABLE 4
LOG PRODUCTIVITY REGRESSIONS
(standard errors in parentheses)

	OLS	**OLS-FE**	**OLS**	**OLS-C**	**2SLS**
Ln Land (ln h)	.339*	.413*	.481*	.604*	.979*
	(.048)	(.039)	(.050)	(.077)	(.187)
Ln Family Size	-.334*	-.325*	-.526*	-.555*	-.522*
	(.122)	(.094)	(.097)	(.101)	(.148)
Re_all				.117	.935
				(.926)	(1.002)
Re_all × Ln Land				-.414	-.575*
				(.217)	(.245)
Off-farm employment				.406	3.515*
				(.281)	(1.277)
Off-farm employment × Ln Land				-.119	-.751*
				(.131)	(.370)
Cluster FE	No	Yes	No	No	No
Land quality	No	No	Yes	Yes	Yes
R-Squared	.33	.58	.53	.55	.42

Notes: 1) *Re_all* is the product of the fraction of village land reallocated within the past 3 years and the proportion of households receiving positive increases in allocated land. 2) Off-farm employment is a household level variable indicating the percentage of household members working off the farm. 3) The column headings refer to the estimator: OLS is ordinary least squares; OLS-FE adds village fixed effects; OLS-LQ adds village and farm-level measures of land quality; OLS-C corrects standard errors for village clustering; 2SLS is IV estimation, with off-farm employment (and its interaction with farm size) treated as an endogenous variable. The excluded instruments are: village measures of household labour market participation, age and education of the household head, as well as the fraction literate. These variables are also interacted with log farm size. The standard errors are corrected for village-level clustering. 4) The overid test is 6.14 ($?^2$(6) and the F-statistic (df=8,699) for the excluded instruments in the first stage regressions is 11.98 and 7.78 respectively for off-farm employment and its interaction with ln h. 5) Land Quality indicates controls for village and farm level land quality. 6) All specifications include controls for household demographic composition (as listed in table 2); 7) Sample size is 731; 8) * indicates the estimated coefficient is statistically significantly different from zero at the 5% level.

TABLE 5

IMPLIED DAYS OF WASTED LABOUR

Farm Size	Mean ln h	Mean ln L "Efficient" labour	Mean ln L "Actual" labour	Implied Wasted ln L (days)
Large	3.505 (33 mu)	5.203 (182 days)	5.203 (182 days)	0
Medium	2.512 (12 mu)	4.210 (67 days)	4.607 (100 days)	0.397 (33 days)
Small	1.393 (4 mu)	3.091 (22 days)	3.936 (51 days)	0.845 (29 days)

Notes: (1) Large farms are defined as those farms above the 90th percentile in size (i.e., ln h = 3.135); Medium farms are those above the median size (but below the 90th percentile; i.e., 2.079 = ln h < 3.135); and small farms are below the median size (i.e., ln h < 2.079). (2) "Efficient" labour is estimated as the predicted labour input, assuming no inverse relationship. (3) "Actual" labour is the implied days of labour, given the degree of the inverse relationship estimated in Table 4 (column 3)

TABLE 6

ALTERNATIVE MEASURES OF LABOUR

(standard errors in parentheses)

All Specifications Estimated by OLS

	Ln Household Labour Supply	Ln Labour Applied to Farm in Busy Season		Ln Labour Applied to Farm in Slack Season	
Ln Land (ln h)	-.038 (-.050)	.631* (.034)	.471* (.061)	.504* (.047)	.374* (.083)
Ln Family Size	1.032* (0.100)	.349* (.092)	.360* (.093)	.545* (.126)	.521* (.126)
Re_all			-1.775* (.595)		1.508 (.806)
Re_all × Ln Land			.563* (.223)		-.315 (.303)
Off-farm employment			-.668* (.237)		-1.105* (.321)
Off-farm employment × Ln Land			.211* (.010)		.367* (.135)
Cluster FE	No	No	No	No	No
Land quality	Yes	Yes	Yes	Yes	Yes
R-Squared	.30	.47	.49	.39	.41

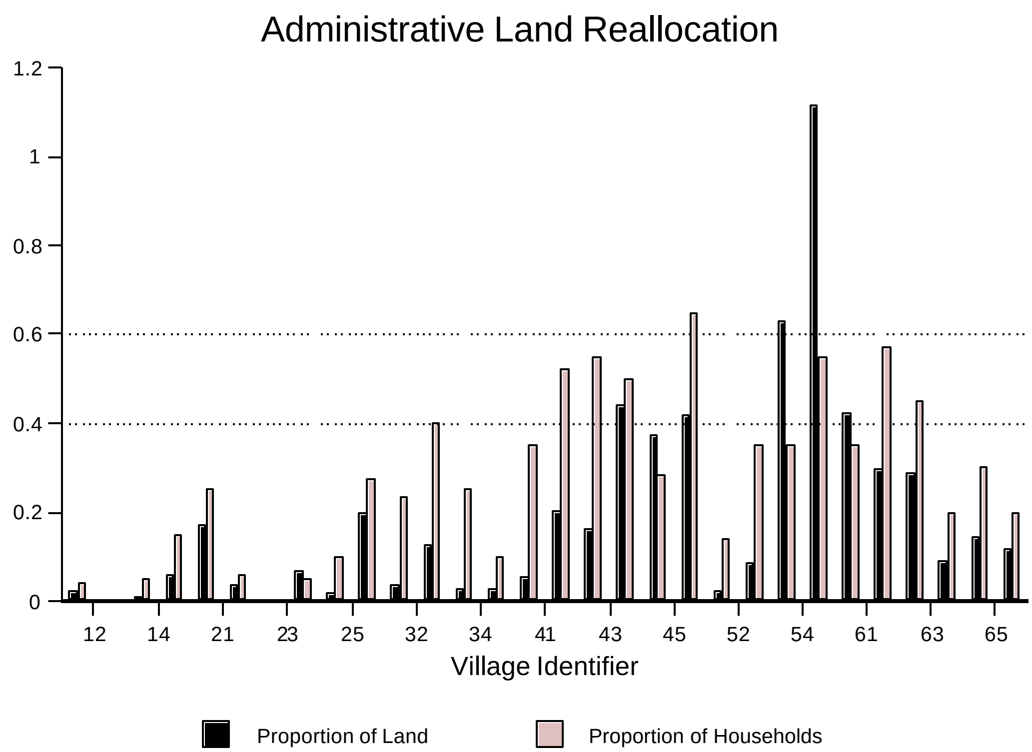
Notes: 1) *Re_all* is the product of the fraction of village land reallocated within the past 3 years and the proportion of households receiving positive increases in allocated land. 2) Off-farm employment is a household level variable indicating the percentage of household members working off the farm. 3) All specifications correct standard errors for village clustering. 4) Land Quality indicates controls for village and farm level land quality. 5) Cluster FE refers to village fixed effects. 6) All specifications also include controls for the age-gender mix of the household, as presented in Table2. 7) Household Labour Supply is the total number of days worked in ALL activities by household members; Labour Applied in the Busy Season is the number of days of family labour supplied to the farm in the self-reported busy season, while labour applied in the slack season is the analogous measure for the self-reported slack season; 8) Sample size is 731 for the household labour supply equation, and 717 for the busy and slack season equations (permitting a balanced sample of positive observations across the two equations); 9) * indicates the estimated coefficient is statistically significantly different from zero at the 5% level.

TABLE 7
LAND REALLOCATION TREATED AS ENDOGENOUS
2SLS Estimates
(standard errors in parentheses)

	Extended Instrument Set			**Limited Instrument Set**		
	1st Stage F-stat (36 Excl.)	**ln Output**	**ln Labour**	**1st Stage F-Stat (12 Excl.)**	**ln Output**	**ln Labour**
Ln Land (ln h)		1.087*	.154		1.176*	.225
		(.064)	(.108)		(.088)	(.123)
Ln Family Size		-.177*	.328*		-.188*	.310*
		(.061)	(.102)		(.072)	(.100)
Re_all	7.77	.757	-.885	3.18	1.151	-.292
	(0.00)	(.899)	(.814)	(0.00)	(1.313)	(1.099)
Re_all × Ln Land	15.56	-.098	.471*	2.15	-.303	.124
	(0.00)	(.177)	(.212)	(0.05)	(.401)	(.445)
Off-farm employment	46.20	.029	-2.783*	9.95	.773	-2.699*
	(0.00)	(.377)	(.711)	(0.00)	(.522)	(.885)
Off-farm employment ×	37.07	-.048	.806*	7.17	-.069	.726*
Ln Land	(0.00)	(.118)	(.218)	(0.00)	(.150)	(.246)
Over-id test		100.88	36.6		13.16	19.8
R-Squared		.82	.46		.79	.45

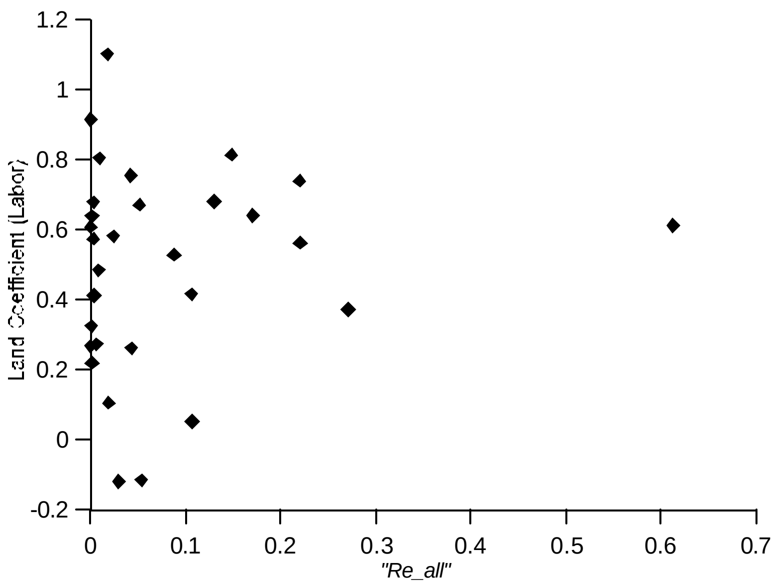
Notes: 1) *Re_all* is the product of the fraction of village land reallocated within the past 3 years and the proportion of households receiving positive increases in allocated land. 2) Off-farm employment is a household level variable indicating the percentage of household members working off the farm. 3) 2SLS is IV estimation, with off-farm employment (and its interaction with farm size) and Re_all (and its interaction with farm size) treated as endogenous variables. The excluded instruments are: (i) The same as in previous tables: village measures of household labour market participation, age and education of the household head, as well as the fraction literate; and (ii) Additional village-level political economy variables designed to help predict the nature of land reallocation. (a) For the extended set: number of plots, an indicator of whether the township reallocates, the number of households, the number of production teams, the number of cadres, whether the last election was contested, and the age, education, tenure, and farming-status of the village head and party secretary. (b) For the limited instrument set, only the township reallocates and number of households are used. These variables are also all interacted with log farm size. 4) The overidentification (overid) test is distributed as $?^2(32)$ and $?^2(8)$ in the extended and limited specifications. The 5% critical values would be 45 and 16, respectively, and at the 1% level, 55 and 20. The first stage F-statistic tests for the joint significance of the excluded instruments in the first stage regressions. 5) All specification include the demographic variables listed in table 2, as well as the Land Quality measures. The standard errors are corrected for village-level clustering. 6) Sample size is 731; 7) * indicates the estimated coefficient is statistically significantly different from zero at the 5% level.

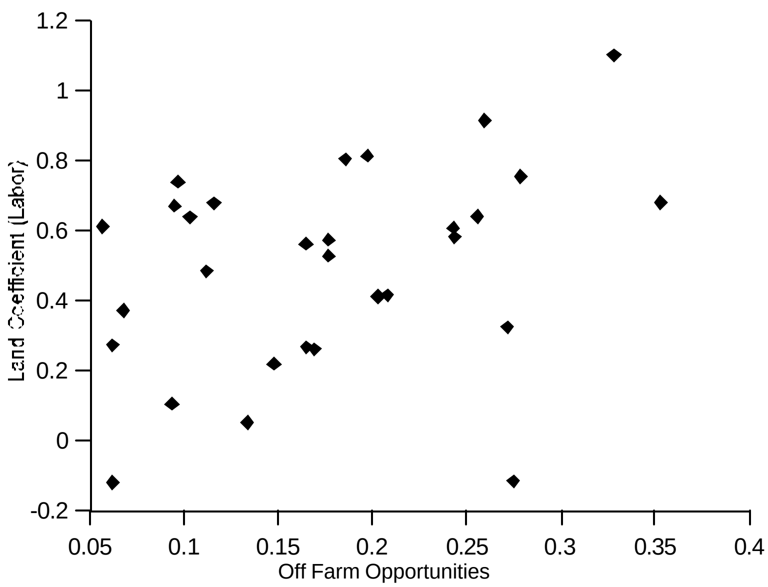
FIGURE 1 — VILLAGE LAND REALLOCATIONS



Notes: Numbers on the X-axis indicate the village identification numbers. Villages 11-33 are in Hebei Province, while villages 41-65 are in Liaoning Province.

FIGURE 2—THE INVERSE RELATIONSHIP ACROSS VILLAGES AND ITS CORRELATION WITH LOCAL "INSTITUTIONS"





Notes: The inverse relationship land coefficients are estimated from a regression identical to the specification in column two of Table 3 (with village fixed effects), but with interaction effects between village and (log) farm size. These interaction effects yield the village specific relationship between farm size and labor intensity. These coefficients are then plotted against the institutional variables ("*Re_all*" and off-farm opportunities) as described previously.

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