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Local Goverment Behavior and Property Rights Formation in Rural China

by

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Abstract

We examine the ongoing transition from centrally planned to market agriculture in rural China. In particular, we examine the devolution of land rights from village governments to villagers and the corresponding evolution of tenure security in agricultural land. We find econometric support for the statistical and economic importance of four explanations for local government behavior. Three of these explanations indicate a link between the incentives and constraints faced by village leaders and property rights in agricultural land, and hence suggest policy levers to encourage more secure property rights. J.E.L. : R52, Q13.

Local Government Behavior and Property Rights Formation in Rural China

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1. Introduction

The establishment of a system of well-defined property rights, often through privatization, is a cornerstone of the transition from a centrally planned to a market economy.[1] Privatization circumscribes bureaucratic authority and opens the door to market exchange. Property rights reform is not always easy or immediately effective however. Property rights are embedded in a host of economic, legal, and social institutions that may develop only slowly. Moreover, the devolution of secure property rights to individuals may run counter to the incentives facing government officials. Thus, privatization (or the establishment of secure property rights) may require a fundamental altering of bureaucratic incentives to complement the devolution of property rights to individuals. We examine the interaction between property rights reform, bureaucratic incentives, and the development of markets, in the context of land in rural China.

In the late 1970s and early 1980s, the Household Responsibility System (HRS) dismantled China's agricultural collectives. The HRS granted households use rights to the farmland in return for meeting certain tax and quota obligations. Land was not privatized however, and ownership remained vested with the village. State Council documents codifying HRS and subsequent national policies repeatedly called for giving households "secure" tenure rights for a period of fifteen years through land contracts. These policies have not been universally followed however. Before the original fifteen-year period expired, a majority of local (village) governments conducted village-wide land reallocations. In these reallocations, all or part of the land was taken back from households and reallocated among existing and newly formed households.

Across rural China we observe enormous heterogeneity in the extent to which households have enjoyed secure land tenure and an associated right to rent land. In some villages, tenure is very secure, and households enjoy most of the rights associated with private property short of being able to sell the land. In other villages, however, village leaders frequently reallocate land amongst households and appear to impose a variety of constraints on household land use.

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In this paper, we draw on a unique village level data set collected by the authors in order to examine the differences across localities with respect to one key property right, the security of tenure, as captured by village decisions with respect to the size and timing of reallocations. In our analysis, we consider four alternative explanations for the heterogeneity. First, village-wide reallocations are a substitute for missing land markets. Second, land is a common property resource and reallocations are carried out to ensure equal access. Third, reallocations are conducted to facilitate tax and quota collection by local governments. Finally, reallocations are a by-product of rent-seeking behavior on the part of local cadre. Since there are likely to be costs of carrying out reallocations, we also consider how reallocation behavior (regardless of the motivation) may be tempered by an assortment of transactions costs.

We find econometric support for the statistical and economic significance of each of our four factors, though the role of these explanations varies from village to village. Three of these factors (quotas, rent-seeking behavior, and missing markets) suggest a link between security of tenure and incentives facing local leaders. Overall, our results suggest that the heterogeneity in tenure security is related to the multiple objectives cadres are given by higher-level authorities and their own more narrow rent-seeking incentives. When land is "valuable" for either of these reasons, cadres have an incentive to retain control over its reallocations, thereby undermining secure tenure. Thus, from a policy perspective, the best avenue to providing secure tenure for households is by altering the incentives of local cadres.

Our findings also shed some light on the relationship between bureaucratic incentives and the advent of land rental markets. We find empirical support for the hypothesis that administrative reallocation is operating as a substitute for missing land markets. But this leads to the question: Why are land rental markets so thin?

We do not have the data to address this question in full. In particular, we cannot reject the hypothesis that land rental markets are missing because of the underdevelopment of legal and social institutions that support contracting between households. But we do find that a key set of variables, including the nature of local elections and cadre attributes, operate in the opposite direction on market (rental) and administrative allocations. Moreover, both market and administrative allocations are positively correlated with the growth of off-farm opportunities. An interpretation consistent with these results is that rental markets fail to develop because leaders discourage

them in order to preserve their role as intermediaries, in other words, rent-seeking behavior. This reinforces the need of altering local government incentives in order to strengthen individual property rights.

2. Institutional Background

In the late 1970s and early 1980s, the Household Responsibility System (HRS) dismantled agricultural collectives and allocated farmland to households. The HRS reforms effectively made households residual claimants to farm output. Land was not privatized however, since the collective (village hereafter) retained ownership.[2] HRS also gave village leaders authority over the allocation of land to households, as well as discretion over the assignment of other control rights, e.g. crop choice and the right to rent.

Village leadership is a body of several officials who derive authority from different sources. The main actors are the Party Secretary and the Village Head. The Party Secretary is selected by higher-level party organizations.[3] The Village Head may be appointed by township officials, elected by villagers, or selected by a village representative assembly. The division of administrative responsibility between the Party Secretary and the Village Head is not always clearly defined. However both are evaluated by higher levels of government on the basis of their success in meeting targets set by higher levels of government for family planning, quota fulfillment, tax collection and farm output. Performance contracts tie wages explicitly to meeting these targets and to other economic and social variables like village economic growth and equity (Ho (1994), O'Brien (1997), Rozelle (1994), Whiting (1996)). Promotion decisions are based on similar criteria. Village leaders also are accountable to villagers. Leaders are subject to lobbying by the villagers, or to pressure from above in response to villager lobbying. They are occasionally subject to some sort of election.

The State Council documents codifying HRS and subsequent national policies repeatedly called for secure tenure, initially for a period of fifteen years, and in 1999 for

[2] At the outset, fairly egalitarian, per capita, rules were used to allocate land in villages. (Putterman, 1989).

[3] A township consists of 12-15 villages. A county consists of 12-15 townships. Party Secretaries are typically appointed by township officials, occasionally by county officials.

thirty years.[4] These policies have not been followed. Across rural China, we observe enormous heterogeneity in the extent to which households enjoy secure tenure and exercise the right to rent land. Tenure security is largely determined by the frequency and magnitude of village-wide reallocations. In these reallocations, all or part of the land is taken back from the households and re-divided among existing and new households.

Table 1 reports the frequency of village-wide land reallocations. In more than two-thirds of all villages, land has been reallocated among households at least once. Conditional on reallocation, the average number of reallocations between 1982 and 1995 is 2.3. Table 1 also reports the percentage of land that has been reallocated since the introduction of HRS. This estimate implies that slightly more than half of all farmland has changed hands at least once since HRS was introduced. In addition, we report the percentage of land reallocated and the percentage of households affected by the most recent reallocation in those villages: A typical reallocation involves two-thirds of a village's land, and three-quarters of its households.

Although seventy percent of surveyed villages report that households enjoy unencumbered rights to rent land in 1995, the land rental market is thin. Table 2 offers estimates of the percentage of land rented out in 1988 and 1995. Although the amount of land rented increased from 1988 to 1995, in 1995 less than three percent of land was rented in.

The market for agricultural labor is equally thin. Only half of all villages report the use of hired on-farm labor in 1995, up from one quarter in 1988. Farmers in China hire less than 1 percent of their agricultural labor.[5]

While the markets for land rental and farm labor are poorly developed, the market

[4] There is currently considerable debate about how much latitude local officials should have over land. Current regulations prohibit larger reallocations and only allow leaders to make adjustments to benefit the community.

[5] Our survey records the number of individuals hired for agricultural labor, not the number of days. Most of the hiring in agriculture is seasonal and amounts to less than ten days per worker. An average village in 1995 had 300 households and a labor force of almost 600, a high percentage of which were involved at least part time in farming. In 1988, the number of individuals hired per village was less than 10, and in 1995 was only 25. Household level data suggest that individuals worked on average 75 days per year in farming, implying that only about one-half of one percent of farm labor was hired in 1995.

for non-agricultural labor has boomed. Our data record employment in local village and township-run enterprises, family businesses, and long-term employment outside the village. Between 1988 and 1995, the number of individuals employed off-farm doubled while the labor force grew only modestly. By 1995, nearly forty percent of the local labor force was employed outside of agriculture either full or part time, a level consistent with that reported at the national level (ZGTJNJ, 1996).

In return for use-rights to the land, in much of China village leaders assign quotas to farming households. These quotas are a vestige of the pre-reform period, and entail the delivery of grain, cotton, and/or oil crops to the state at predetermined prices that can be as low as 50 percent of free-market prices (Sicular, 1995). With HRS, responsibility for quota delivery shifted to households, although upper level officials hold village leaders responsible for ensuring that households fulfill quotas. Villages typically allocate quotas to households on the basis of family size, allocated land, or some combination of the two.

In absolute terms, village quotas remained fairly constant from the early 1980s until the mid 1990's. On average, they run slightly less than 10 percent of village crop output. We can also calculate the monetary value of the quota. The cash obligation associated with a 1 unit output quota is equal to the difference between the market and the quota prices for the unit of output. If we subtract non-labor input expenditure, the implicit value of the quota in 1995 was fifteen percent of net income from agriculture.

Quotas are usually fulfilled in kind, however, a growing number of villages allow farmers to fulfill their quota by making a cash payment. In 1995, 58.7 percent of all villages allowed cash to be used to fulfill grain quotas. In these villages, 26.9 percent of all households used cash to fulfill their grain quota. By comparison, only 30 percent of all villages allowed cash to be used when the HRS was introduced, and only 11.7 percent of all households exercised this option.

3. Explanations for Reallocation Behavior

There are a number of alternative explanations for the observed differences in village land reallocation behavior. First, administrative reallocations are a substitute for missing land rental and farm labor markets. Second, land is a common property

resource and reallocations are designed to ensure equal access to land among members of these villages. Third, reallocations are carried out to facilitate tax and quota fulfillment. And finally, reallocations are a by-product of rent-seeking behavior on the part of local leaders. These explanations are not mutually exclusive and their role may differ across villages. We examine each explanation to assess its potential implications for the timing and size of village-wide land reallocations.

3.1. Missing Markets Hypothesis

With the introduction of the HRS, land was usually allocated to village households on the basis of household size, possibly adjusting for the demographic composition of a household. In the early 1980s, few households had members working off the farm in non-agriculture and most family labor was directed to agriculture. Hence these "per capita" allocation rules were efficient in that they allowed only small differences across households in labor supply per unit of land.

During the two decades since the HRS was introduced, household farm labor supplies have changed because of demographic changes within the household, household division, and access to off-farm opportunities. Given unchanging land allocations this causes substantial heterogeneity in household labor to land ratios in agriculture, and hence differences across households in the marginal productivity of land. Well-developed land rental and farm labor markets would help eliminate these differences and ensure that the land was efficiently allocated across households. However, markets for farm labor and land rental are thin. Village-wide reallocations may help to reduce marginal differences in land productivity across households, and hence serve as an administrative substitute for the missing land and labor markets. More formally the "missing market" hypothesis is that administrative land reallocation serves to maximize agricultural profits in the absence of agricultural land and labor markets.

There are two reasons why this hypothesis may have explanatory power. First, it is probably easier for village leaders to collect taxes and ensure agricultural quota fulfillment as farm profits are higher. Since collecting quotas along with promoting farm output growth are important parts of a leader's responsibilities, a leader probably has an incentive to improve the efficiency of land allocation through periodic reallocations. Second, we expect households that value land more highly to lobby more

effectively for favorable reallocations.[6] This will also tend to move land to higher valued uses.

Reallocating land is not a costless process however. By all indications, conducting a reallocation requires considerable amounts of villager leaders' time.[7] These transactions costs imply that, even if the only motivation for reallocations is to maximize profits, it will not be optimal to reallocate land every period. Rather, villages periodically reallocate land when the inefficiency arising from the existing allocation is sufficiently high.

In an appendix, we provide a dynamic model of the reallocation path that maximizes the discounted present value of village farm profits. This model establishes that the reallocation path that maximizes the discounted present value of agricultural profits requires discrete periodic reallocations rather than continuous reallocations. It also establishes that the time since the last reallocation or, the *duration of a reallocation period* depends upon: 1) fixed and variable costs of reallocation; 2) rates of change of household agricultural labor supply; 3) agricultural technology; and 4) the interaction between the rate of change of agricultural labor supply and agricultural farm technology. Finally, the formal analysis establishes that the *amount of land reallocated* at any given reallocation depends upon all of the same factors as the duration of the reallocation period, except for two. First, fixed costs of reallocation affect duration of a reallocation period, but not the amount of land reallocated. Second, the duration of the reallocation period affects the amount reallocated.

Note that the missing market hypothesis does not imply that administrative reallocations are as good as or better than markets at allocating land efficiently. On the contrary, our expectation is that there will typically be less unexploited benefit from trade when land markets operate than when land exchange is conducted administratively.[8]

[6] This may occur informally, or more formally through the process of nominating and selecting village leaders.

[7] Reallocations typically occur in the off-season and involve several months of administrative work. Much of the work revolves around : 1) gathering and updating information on household demographics and labor supply; 2) talking and arguing with villagers about the nature of the prospective reallocation; and 3) redefining plot boundaries and reallocating land.

[8] Using household level data, Benjamin and Brandt (2000), find that, although reallocations help to improve efficiency, there remains significant inefficiency in the allocation of land across households.

3.2. Common Property Resource and Equal Access to Land

By law, land ownership in rural China resides with the village. Villagers and leaders sometimes interpret this as meaning that every individual in the village is entitled to equal access to the land. One way to achieve equal access is to use simple demographic rules that distribute land on the basis of household size, possibly adjusting amounts to reflect differences in household demographic composition. These kinds of rules were prominent with the introduction of the HRS. Burgess (1997) finds that land allocation in the provinces of Sichuan and Jiangsu continues to be well explained by simple demographic rules of this sort. Equal access would also require villages to periodically reallocate land in light of household demographic changes.

If demographic rules are a determinant of land reallocation, then we expect to find a strong statistical relationship between household size and land allocations, and a positive relationship between total land reallocated in a village and the mean absolute change in household size. Of course, reallocations to improve conformance with an equal access ideal would also be inhibited by transactions costs. Reallocations would occur only when the deviation from the equal access ideal was large enough that villagers' distaste for this inequality justified the cost of conducting a reallocation.

3.3. Quota Fulfillment

Ensuring tax and quota fulfillment is one of a village leaders' primary responsibilities. Kelliher (1996) and Li and Rozelle (1998) argue that leaders use their discretion over land allocation to expropriate land from villagers who do not fulfill quota obligations, and that village reallocations are driven by such expropriation.

Two facts weigh against this story. First, our data indicate that in a typical year the rate of default on quotas is probably near one percent. Given such a low rate of default it is difficult to imagine sixty percent of the land being reallocated every six years as a response to non-payment of quotas. Second, if reallocation behavior is motivated by the need to punish acts of default, we expect to see reallocations occurring fairly continuously and to involve a small number of households. In fact, we observe large and infrequent reallocations.

There is an alternative explanation for the role of quotas. As the quota obligation increases it becomes increasingly likely that the value of the quota exceeds agricultural

rents, i.e. net agricultural revenues less the opportunity cost of the household's labor. Such negative agricultural profits are likely the better are the off-farm opportunities, and thus, the higher the household's opportunity cost of labor. If a household's agricultural profits are negative, we expect it to lobby the village to reduce its land holdings. This could in principle, lead to more land reallocation.

There are alternatives to reallocating land to help promote quota fulfillment. The most important is for the village (with permission of higher levels of government) to convert the quota obligation to a cash obligation. This eliminates distortionary effects of the quota on farm labor supply, and thus eliminates deadweight loss. In 58 percent of the sampled villages, farmers can fulfill their quotas in cash. We expect the effect of quotas on reallocation behavior to be reduced in villages where quotas are convertible into cash.

3.4. Rent-seeking Behavior

In a majority of villages, the "rent" associated with the allocation of use rights to land is positive. In principal, village leaders could use their discretionary power over land to reallocate land as a way of extracting some of these rents from households. Rent extraction could come in the form of side payments or cooperation in other aspects of village political and economic life. Attributes of the village leader and the village in which they live will both affect the propensity of rent-seeking behavior. We expect older leaders whose careers are almost at an end to face the fewest constraints on this type of behavior. Leaders who are subject to contested elections might also be restrained in their behavior by the threat of losing office. More educated leaders for whom there are other opportunities to earn income or rents, e.g. manage a village enterprise, may also be less likely to use land reallocations as a way of extracting rent from villagers.

4. Description of data

Our data are the product of a collaborative survey effort undertaken in 1996 and 1997. The survey covers 8 provinces: Zhejiang, Sichuan, Shanxi, Hubei, Hunan, Hebei, Liaoning, and Yunnan. Thirty two villages were sampled in the first five provinces, twenty four villages were sampled in Yunnan, and fifteen and sixteen villages were

surveyed in Hebei and Liaoning. Altogether enumerators interviewed the Village Head, Party Secretary, and Village Accountant in 215 villages in 50 counties. The sample of villages was constructed to provide a representative cross-section of villages in each province, while the eight provinces represent every major region of China.

The survey collected information on property rights in land, agricultural and off-farm labor markets, agricultural production, village governance structures, and other village characteristics. Data were collected for 1995, 1988, and for the year when the HRS was introduced, about 1980.

Below, we describe variables used in our empirical work. The variables are organized into groups: Reallocation behavior, demographics and labor supply, technology, transactions costs, village governance, and other markets. Means and variances of all variables are reported in Table 8.

Reallocation behavior: For all villages, we know the total number of reallocations conducted since the inception of the HRS. We also know the year, the number of households, and the amount of land involved in each village's most recent, first, and largest reallocation. We also know, as of 1996, the amount of land that had not been reallocated since HRS was introduced. Table 1 reports these data.

Demographics and labor supply: Several of the hypotheses under consideration predict that reallocation behavior depends upon the rates at which households' demographic or labor supply characteristics change. Let N be the number of households in a village, and let l_i^t denote the level of a demographic or off-farm labor supply variable for household i in time t. One measure of the rate of change of l^t in an average household is:

$$\frac{1}{\sum_{i=1}^{N} l_i^t}\left[\sum_{i=1}^{N}\left|l_i^t - l_i^{t+1}\right|\right], \tag{4.1}$$

that is, the factor by which an average household's value of l changes in period t.

Since we only observe village level data, it is not possible to construct this type of measure. However, we can construct something similar using aggregate data. Since we observe $\sum_{i=1}^{N} l_i^t$, and $\sum_{i=1}^{N} l_i^{t+1}$, the aggregate levels of l at t and $t+1$, we can

calculate,

$$\frac{\left|\sum_{i=1}^{N} l_i^t - \sum_{i=1}^{N} l_i^{t+1}\right|}{\sum_{i=1}^{N} l_i^t} = \frac{\left|\sum_{i=1}^{N} \left(l_i^t - l_i^{t+1}\right)\right|}{\sum_{i=1}^{N} l_i^t}. \tag{4.2}$$

This expression is a lower bound for 4.1 and is used as a proxy for 4.1. Annual rates of change, r_l, that correspond to 4.2 are constructed using the formula

$$\left(\frac{1}{1+r_l}\right)^7 = \left(1 + \frac{\left|\sum_{i=1}^{N} \left(l_i^{88} - l_i^{95}\right)\right|}{\sum_{i=1}^{N} l_i^{88}}\right). \tag{4.3}$$

We construct the measure corresponding to 4.3 for three variables:

- Rate of change of village population: The annual rate of change in the number of people officially registered as village residents, and therefore entitled to consideration in the land allocation process.
- Rate of change of off-farm non-migrant labor: The annual rate of change in the numbers of villagers who are employed off-farm, but live in the village.
- Rate of change of off–farm migrant labor: The annual rate of change in the numbers of villagers who are employed off-farm and work and live most of the year outside the village. We will sometimes aggregate the off-farm labor of migrants and non-migrants.

Technology: If villages conduct land reallocations to improve the efficiency of land allocation then, as detailed in the appendix, reallocation behavior depends on characteristics of the agricultural production function. We use two measures to control for village heterogeneity in the village agricultural technology, the land-labor ratio and the output-land ratio.

We calculate output per mu (1 mu $\approx$ 1/6 acre) by dividing the total grain output by sown area in grain.[9] To reduce the possibility that this quantity is affected by reallocation behavior, we use 1988 values for sown area and output. These values pre-date most of the reallocations with which we are concerned. We calculate the land-labor ratio by dividing the total land in cultivation by the village population. As with output per mu, we use 1988 estimates of the population and land in cultivation.

[9] We use grain yields because we lack local price data to aggregate grain and non-grain crops. On average, nearly 80 percent of cultivated area is in grain.

Transactions costs: The following variables capture the costs associated with reallocation. Because of difficulty in assigning them to either a "fixed" or "variable" costs category, we allow for the possibility that they contribute to both fixed and variable costs of reallocating a unit of land:

- Multiple Cropping Index: The multiple cropping index indicates the average number of crops planted in a year and reflects the intensity with which land is farmed. Administrative reallocations are more likely to disrupt farming as the land is farmed more intensively.

- Number of households: All else equal, as the number of households increases we expect the cost of conducting a reallocation to rise.

- Number of production teams: Prior to the HRS, households were organized into production teams. Their current counterpart is the small group (*xiao zu*). These teams frequently are responsible for reallocating land among members during reallocations. In most villages, land is fixed within these groups, though some reallocation may occur between teams. Heterogeneity in administrative structures probably results in heterogeneity of reallocation costs.

- Number of plots: All else equal, we expect the costs of reallocations to rise as the village land is divided into more plots.

Since land reallocations decrease the private incentives for investment in agriculture, this disincentive may also be interpreted as a cost of reallocation. If this sort of investment cost is important, we expect it to be larger when agricultural investment is more important.[10] Our data record the proportion of village land that is rice paddy. Since paddy land is relatively investment intensive, if investment and tenure security are positively related, then fewer and smaller reallocations will occur in villages where paddy land is more common.

Quotas: Quotas were applied to grain, cotton and oil-crops, and represented the amount of each crop that had to be sold to the government at state-set prices that

[10] We note that, as Besley (1995) points out, investment in land may serve to increase tenure security.

were typically below market-clearing levels. Lacking complete data on cotton and oil crops, we limit ourselves to grain quotas, which were the most important. For each village, we know the grain quota in 1988, and normalize this by total grain output in 1988. We also know for each village if the quotas could be fulfilled in cash, and the percentage of households in each village that did so.

Village Governance: Our survey describes village governance in some detail. Variables that we make use of are:

- The number of village bureaucrats ("cadres") employed by the village government.
- Age and education of the village leader and party secretary.
- Tenure of the party secretary and village leader.
- Whether the last election for village leader was contested.
- Distance from county seat.
- Whether village or township governments make decisions about reallocations.

Other markets: Our survey describes the state of land rental markets in 1988 and 1995, as well as the state of the market for agricultural labor market.

5. Econometric model

Our econometric inquiry is in two parts. We first analyze the number of village reallocations since HRS. Since tenure security depends upon both the frequency of reallocations and their size, we then analyze the duration of the most recent reallocation cycle and the amount of land reallocated at the most recent reallocation. Table 3 provides a summary of the predictions made by the various hypotheses and highlights those of our results consistent with each of them.

5.1. Number of reallocations

In any given year, we know the time since each village last reallocated its land. In principle, these data on reallocation periods in progress could generate a great deal of insight into reallocation behavior. Unfortunately these data are subject to two sampling problems: Interruption bias and length-based oversampling.[11]

Salant (1977) proposes a method for dealing with these two problems. This method makes the following identifying assumptions: (1) For any given village, the probability of reallocating land is the same in any given year, and each village draws its constant hazard rate from a gamma distribution. (2) The birth process for reallocation periods is stationary over the entire period of the sample. (3) The cross-section of periods in progress is far enough away from time zero that the distribution of spells in progress is stationary.

About one-third of the villages in our sample have not reallocated since the advent of the HRS. This means, unlike our 1995 cross-section, a cross-section taken 50 years from now would not contain the spike of villages with a spell length of about 15 years. Thus, the distribution of spells in progress is certainly not stationary. In addition, given the evolution of land policy in China since the inception of the HRS, it is implausible that the birth process of reallocation spells is stationary. Consequently, we cannot use Salant's method, or any obvious variant, to deal with the combination of length-based over-sampling and interruption bias that occurs in reallocation periods in progress data.

While we cannot use Salant's method to examine our periods in progress data, we can use a simpler method that has much the same spirit. If the number of times that a village reallocates during our 15-year window provides us with information about the distribution from which villages draw hazard rates, then an attempt to explain the number of reallocations will provide some insight into the distribution of village hazard rates.

Column 1 of Table 4 reports the results of an OLS regression to explain the

[11] Interruption bias occurs because we observe interrupted reallocation periods, which are shorter than completed periods. To understand length-based oversampling, imagine that all villages are identical, and that each draws reallocation periods from a Bernoulli density which takes the values one day or 20 years with equal probability. Despite the fact that reallocation periods of one day and twenty years are equally likely, a cross-section of periods in progress over-samples long periods.

number of village-wide reallocations as a function of demographics and labor supply, technology, transactions costs, and village governance. The regression also includes village income and quota level as explanatory variables. We report heteroskedasticity corrected standard errors in parentheses. In order to check the robustness of these results, we conduct two related estimations. Column 2 of Table 4 reports the coefficients of a Probit explaining a dummy variable that is 1 if a village reallocated at least once since HRS was introduced. Column 3 of Table 4 reports coefficients of the corresponding OLS regression. The results of the Probit and OLS regressions are similar to the number regression, though levels of significance are generally lower. Given that the second two specifications "throw away" observed variance in the LHS variable, the following discussion focuses primarily on the number regression.

Transactions Costs: Villages reallocate fewer times as the number of plots per household and the number of households in the village rise. Villages allocate more frequently as the number of "small groups" and cadres in the village increase, though the effect of the number of cadres is statistically insignificant. These results indicate that reallocation behavior is sensitive to transactions costs. If the opportunity costs of a reallocation drops as the number of village cadres (officials) rises, and the cost of a reallocation rises with the number of plots and households, then these results indicate that villages reallocate fewer times as the costs of reallocations rise.

As the percentage of cultivated area in paddy in the village increases, the number of reallocations decreases. Since paddy land requires more ongoing investment for maintenance, this may indicate that reallocation behavior is sensitive to the importance of investment. The intensity of cultivation as measured by the multiple cropping index, however, does not affect the number of reallocations, but does have a negative and statistically significant effect on the likelihood of reallocation since HRS.

Demographic and Labor Supply Variables: As predicted by the simple rules and missing market hypotheses, the number of reallocations changes with the rate of change of population. As predicted by the missing market hypothesis, reallocation is sensitive to both the rate of change of population and the rate of change of off-farm opportunities. Specifically, all of the demographic and labor supply variables are statistically significant at least at the 10 percent level: Villages experiencing greater changes in population or off-farm non-local employment reallocate more times.

Villages reallocate less as local off-farm opportunities change faster.

The opposite effects of the two types of off-farm labor, however, are difficult to explain as a consequence of the missing market hypothesis. From the point of view of a profit maximizing household, the only difference between local and non-local off-farm labor is that one must be supplied in much larger blocks than the other. It is not obvious why the "lumpiness" of non-local employment should be important. On the other hand, the opposite effects of the two types of off-farm labor may be evidence in favor of interest group politics.[12] We note that the opposite signs of the two labor variables do not persist in later regressions (see section 5.2).

Technology: We include the land-labor ratio and yields to capture differences in technology. We find that yields are significant when the land-labor ratio is not in the regressions and only the land-labor ratio is significant when both are included. Consequently, we report regressions that include only the land-labor ratio.

We find that reallocations are more frequent as the land-labor ratio increases, and that the coefficient is statistically significant.

Quotas: As the level of agricultural quota increases, the number of reallocations increases. This effect is statistically significant at the five percent level.

Village Governance: There are fewer reallocations in villages where decisions about reallocations are made by the township. This result, which is especially pronounced in the Probit and linear probability model, suggests that townships are helping to enforce the fifteen year tenure security provision of the HRS law.

Other effects: Village income is irrelevant, while the distance from the county seat reduces the number of reallocations. An interpretation of this finding is that distance to the county seat is picking up some of the heterogeneity in local off-farm opportunities not fully captured by our labor variables: Villages located nearer to the county seat have access to better local off-farm opportunities. Alternatively, villages that are more distant from the county seat are less influenced by central government policies that discourage reallocation.

In summary, the number regressions reported in Table 4 show that village real-

[12] Villagers who work outside the village leave land behind unfarmed (or under-farmed), and are not present to lobby for their continued tenure. Consequently, higher rates of reallocation associated with high rates of emigration may reflect redistribution to those who live in the village from those who leave.

location behavior is responsive to the costs of reallocation, to quota levels, and to demographic and labor supply variables.

5.2. Duration and amounts

5.2.1. Econometric issues

In 1994 and 1995 we observe 51 of the 215 villages reallocate land. For villages that reallocate, we observe the proportion of land that changes hands and the time since the preceding reallocation. That is, we observe 51 pairs of amounts and durations $(S_j, \tau_j) > 0$, and 164 villages with reallocation periods in progress for which $S = 0$. We describe these data with a three equation model: 5.1 explains the amount reallocated; 5.2 explains the time since the last reallocation; and 5.3 explains whether or not we observe a reallocation in 1994 or 1995:

$$
\begin{aligned}
S_j &= A_0 x_j + A_1 \tau_j + \mu_j, && (5.1)\\
\tau_j &= B_0 x_j + B_1 z_j + \varepsilon_j, && (5.2)\\
I_j &= \begin{cases} 1 & \text{if} \quad I_j^* > 0 \\ 0 & \text{else} \end{cases}, && (5.3)\\
I_j^* &= C_0 x_j + C_1 z_j + \delta_j,
\end{aligned}
$$

where we observe S_j and τ_j only if $I_j = 1$ and I_j^* is a latent variable. The third equation allows us to account for selection into the sample of villages which reallocate, but does not make use of the biased length data for periods in progress. This model provides an accurate description of the data, and since it does not use information on the length of spells in progress, avoids the intractable problem of correcting for length biased oversampling and interruption bias.

To estimate the system we must deal with two econometric problems: (1) Error terms in the amount and duration equations may be correlated; and (2) there may be selection bias: Unobservables may differ between villages that reallocate and those that don't. We begin by estimating the model for a basic set of explanatory variables in order to assess the importance of the two econometric problems.

We first estimate the amount and duration equation with OLS. Provided that selection and endogeneity are not problems, these estimations generate consistent coefficient estimates. We next use predicted values of τ instead of actual values in

the OLS amount regression to correct for possible correlation of ε and μ. Provided that $E(z\mu) = 0$ and there is no selection effect, the second stage OLS regression (or TSLS) provides consistent estimates of all coefficients.

We also conduct two exercises to check if our results are influenced by selection, i.e., $E(\mu|I = 1) \neq 0$, or, $E(\varepsilon|I = 1) \neq 0$. First, we calculate the Heckman correction based on a Probit estimation of 5.3. We then include this correction in the naive OLS regressions for duration and amount.[13] Second, we test whether our results are sensitive to selection bias using the procedure described in Baker and Benjamin (1997).[14]

Tables 5 and 6 report the regression results for the Duration and Amount regressions. In column 1 of Tables 5 and 6, we report the OLS results for the basic version of the time and size regressions. Column 6 of Table 6 reports TSLS estimates for the size regression.[15] The coefficient on Time in the TSLS estimation is about twice as large as that obtained using OLS. This suggests that the OLS coefficient of time since the last reallocation may be biased downward. However, the other parameter estimates are similar in the OLS and the TSLS. Consequently, in several auxiliary versions of the Amount regression, we only report OLS estimations.

Inclusion of the Heckman correction in the basic model generates results indistinguishable from those obtained by OLS. This test, along with results obtained using the Baker and Benjamin procedure suggest that selection bias is not important.

[13] Since all variables in the *duration* regression are present in the switching equation, we are able to identify parameters in the corrected duration regression only because of non-linearities in our estimate of $E(\varepsilon|I = 1)$.

[14] To conduct this sensitivity test, we first use the naive OLS regressions to impute amounts and durations to the 164 villages for which we do not observe a reallocation in 1994-1995. By scaling all of the imputed estimates by a constant, we are able to adjust implicitly the mean of the unobserved component. Reestimating the naive regression on the full sample, and using the scaled, imputed values for villages which do not reallocate, allows us to check whether our results are sensitive to selection bias. We conduct these robustness tests by scaling imputed values up and down by 15 percent. If our results are not sensitive to this sort of manipulation, then we can conclude that our results are not sensitive to selection bias, even if such a bias exists.

[15] The instruments that we use to predict time since the last reallocation are: All explanatory variables as in column 1 of Table 4, plus interaction terms involving the transactions cost variables that appear in the duration, but not the amount regression. This instrument set passes the Hausman over-id test at the 5% level.

5.2.2. Duration and Amount results

Table 5 reports estimates of regressions explaining the duration of the most recent reallocation period. The regressions are similar to the number of reallocations regressions, although the level of significance is considerably lower for some variables. This result is unsurprising given the much smaller sample size. The size of the village and the average number of plots per household remain significant, and increases in either leads to increases in the expected duration of a reallocation period. An increase in cropping intensity also leads to an increase in expected duration. The signs of the demographic and labor supply coefficients are unchanged, although only the rate of change of village population is statistically significant. Finally, the duration of the reallocation period is shorter in villages facing higher output quotas.

The remainder of this section discusses the results of a number of different regressions explaining the amount of land reallocated in the most recent reallocation.

Duration: The amount of land reallocated depends significantly on the length of time since the last reallocation. The OLS (TSLS) coefficient suggests that for each additional year since the last reallocation, the amount of land reallocated increases by 3% (6%). This is consistent with the simple rules hypothesis and the missing market hypothesis.

Transaction costs: We find that two of the transactions costs variables affect the amount of land reallocated: Amounts reallocated decrease with the number of plots and the percentage of paddy land. Apart from the possibility that reallocating paddy land reduces investment, the well-defined perimeter of a paddy field increases the cost of sub-division relative to that on non-paddy. All other transaction costs variables affect amounts reallocated only through their effects on durations. Note that this is a prediction of the missing market hypothesis: Some transaction costs variables only affect duration while others affect duration and amount.

Demographics and Labor Supply: We find that both off-farm opportunity variables have nearly identical, positive coefficients: Changes in different types of off-farm employment have about the same effect on the percentage of land reallocated. This finding provides evidence for the missing market hypothesis. In Table 6, we aggregate off-farm opportunities into a single variable. This economizes on degrees of freedom and facilitates exposition of interaction effects. We also find that villages experiencing more rapid change in population reallocate a larger percentage of land.

Quotas: The discussion of quota fulfillment effects in section 3.3 suggests that the land reallocation will increase with quota levels. In Table 6 we observe that the percentage of land reallocated increases in areas with higher quotas.

The discussion of quota fulfillment in section 3.3 also suggests that the effect of quotas should be greater in areas where returns to off-farm labor are greater. In areas with higher off-farm wages, a higher percentage of households will find the returns to farming (conditional on the quotas) negative. Thus, we anticipate that a higher percentage of land will be reallocated. In column 2 of Table 6, we include an interaction term between quotas and the off-farm wage in the basic amount regression. Quotas alone becomes insignificant, while the interaction term is positive and highly significant. As predicted, the effects of quotas are larger as agriculture is less profitable.

The discussion of quota fulfillment in section 3.3 also predicts that villages will look for ways to eliminate the deadweight loss associated with binding agricultural quotas. One way to do this is to allow quotas to be fulfilled in cash. In column 4, we include an interaction term involving quotas and the percentage of households paying their quotas in cash. Quotas continue to have an independent effect, but the interaction term is negative, and highly significant. For every ten percentage point increase in the number of households paying their quota in cash, the amount of land reallocated falls by six percent.

Finally, in column 5 we include both of the interaction terms involving quotas. The coefficients and the t-statistics on the interaction terms are slightly smaller than when the interaction terms are included separately, but both effects remain important. These regressions provide strong support for the importance of quota fulfillment effects on reallocation behavior.

Technology: The missing market hypothesis predicts that the size of the reallocation depends on the production technology as proxied by the land-labor ratio and yield. In our estimation, yield was consistently insignificant. On the other hand, the amount of land reallocated is positively related to the land-labor ratio: Areas with higher land-labor ratios reallocate more land. We also interacted the land-labor ratio with the change in off-farm opportunities, and find that the coefficient is significant at the 1% level. Both of the results are consistent with the missing market hypothesis. None of the other hypotheses make such a prediction.

Rent Seeking: To assess the importance of rent seeking by village leaders, we include attributes of Party Secretaries and Village Heads in the basic regression. Leader attributes included: Age, education, and tenure. The effect of leader education on reallocation behavior was ambiguous, however, the time since the last reallocation was negatively correlated with the age of both leaders, while the size of the reallocation was positively and statistically significantly related to age.

We also included a dummy that was coded 1 if the village experienced a contested election (more than one candidate) in the year of the reallocation, or the year before. A contested election in the year of the reallocation or the year prior to a reallocation significantly reduced the time since the last reallocation and the size of the reallocation.

To sum up, older leaders reallocate more, and leaders elected in competitive elections reallocate less. Since leaders elected in contested elections are younger than the mean, this suggests the following conjecture. Reallocating land is a way for leaders to collect rents. Old leaders are prone to collect more rents since they are closer to the ends of their careers and are less interested in their reputations or advancement. Contested elections tend to shift power to the villagers. The villagers exercise this power to select leaders who are young, and therefore have an incentive to restrict their rent seeking behavior in order to remain in office or otherwise advance their careers. A more rigorous examination of this conjecture is a subject of future research.

Market activity: Column 2 of Table 6 includes two measures of market activity as explanatory variables in the amount regression. The percentage of land rented is highly significant and negative: A one percent increase in the amount of land rented is associated with a 1.4 percent decrease in the amount reallocated. A dummy variable indicating whether the market for agricultural labor market was active[16] is not significant, though this is not surprising given the crudeness with which this variable measures labor market activity. In Column 2 of Table 5 we include both measures of market activity as explanatory variables in the duration regression, and find that neither is statistically significant.

[16]The market is defined to be active if one or more people were hired as agricultural laborers during the year in which the reallocation occurred.

5.2.3. Assessing economic significance

Thus far we have concentrated on determining the statistical significance of relationships between reallocation behavior and various explanatory variables. Table 7 provides a basis for assessing the economic significance of these variables.

The first column of Table 7 indicates the percentage change in the duration of the most recent reallocation period that results from a one standard deviation change in an independent variable. This is calculated by multiplying the regression coefficients of the duration regression in column 1 of Table 5 by the standard deviation of the variable and then dividing by the mean duration of a reallocation cycle. Thus, for example, a one standard deviation change in the rate of change of population results in a 16 percent decrease in the duration of a reallocation cycle.[17] The second column indicates the percentage change in the amount reallocated due to a one standard deviation change in each of the same independent variables. We find that changes in population, quotas and transactions costs have the largest effects on the duration, while changes in off-farm opportunities and village income have the most pronounced effects on the size of the reallocations.

Our estimates of the effect of the independent variables on the amount reallocated ignore the indirect effect of these variables on the amount reallocated that operates through their effect on the duration of the reallocation. Column 3 of Table 7 incorporates this effect into our calculation. Column 3 gives the total effect of a one standard deviation change in an explanatory variable on the annual percentage of land reallocated. Quotas and income are especially important, followed by the demographic changes, changes in off-farm opportunities, and finally the transactions costs. These results are consistent with the view that reallocations are heavily motivated by quota fulfillment, followed by inefficiency in land allocation and the desire to maintain equal access. High transactions costs, on the other hand, inhibit reallocation.

[17] To facilitate comparison of results on duration and amount, the change in duration due to the change in off-farm labor that we report is the sum of the individual values for off-farm migrant and non-migrant labor.

5.3. Administrative vs. Market reallocations

Our data also show that in 1995 about 3 times as much land changed hands in administrative reallocations as changed hands in rental transactions.[18] If administrative reallocations and land rental are substitutes, why do villages select centralized over decentralized organization of their agricultural production? One explanation might be that rental markets fail because of problems with contract enforcement under a weak legal system. The appeal of this explanation is undermined by the wide use of markets for other transactions despite a similar lack of legal infrastructure.

Our data do not allow a complete examination of the interaction between the market and administrative reallocations. However, to investigate this choice of market versus administrative exchange, we carried out regressions on the percentage of land rented using the same independent variables as we used in Tables 5 and 6. Using the full sample of 215 villages in the rental regressions, we observe that leader attributes, elections and quotas usually operate in opposite directions on market and administrative transactions. Specifically, administrative reallocations are more important in villages with higher quotas, older leaders and non-contested elections; rental, on the other hand, is more prominent in villages with smaller quotas and younger and better-educated leaders. Both administrative reallocations and rental are positively correlated with the growth in off-farm opportunities.

An interpretation consistent with these results is that markets fail because leaders discourage them in order to preserve their role as intermediaries in land exchange.[19] This provides them an opportunity to influence village behavior and extract rents both directly and indirectly, for example, through ensuring that quotas are fulfilled. Thus, in villages where these rents are more important to the leader, either because the quotas are larger, the direct rents are larger (because villagers put a higher value on land), or because of the leader's attributes, we observe more administrative reallocation. This, in turn, crowds out market exchange in these villages. This interpretation suggests that a reduction of quotas, a reduction in agricultural land rents, and in-

[18] In 1995, every seventh village reallocated land, and an average reallocation involved 60 percent of a village's land. Thus, on the order of 9 percent of all land was reallocated administratively. On the other hand, about 3 percent of land was rented in 1995.

[19] In the course of conducting a new survey in the fall of 2000, older village cadres revealed that there were often village restrictions on rental in the 1980's.

creases in the extent to which leaders are accountable to villagers, will promote more secure tenure and cause a shift from administrative to market exchange.

6. Conclusion

Since the introduction of the HRS in the early 1980s, much of the farm land in rural China has been reallocated by local governments. This has occurred despite government policy guaranteeing farm households the right of secure tenure for 15 years.

We consider four different explanations for the land reallocation behavior of village governments, which determines tenure security. First, administrative reallocations are a substitute for missing land rental markets. Second, land is a common property resource and reallocations are designed to ensure equal access to land by members of these villages. Third, reallocations are carried out to facilitate tax and quota fulfillment. Finally, reallocations are a by-product of rent-seeking behavior on the part of local leaders. These explanations are not mutually exclusive and their role may differ across villages. We examine each explanation to assess its potential implications for the timing and size of village-wide land reallocations.

Analyzing data on the frequency as well as the timing and size of recent reallocations, we find solid empirical support for the role of each of the four explanations. The economic and statistical importance of three of our explanations, quota fulfillment, rent-seeking, and missing markets, are of particular interest to policy makers because they indicate a link between the incentives and constraints faced by village leaders and household property rights in agricultural land. Understanding this linkage between leader incentives and property rights opens the door to informed central government policies to improve tenure security.

Our results also suggest a link between leader incentives and the degree of market exchange in land. In particular, our analysis suggests that rental markets and decentralized exchange will be allowed to play a larger role only as leader incentives change.

Interestingly, predictions made by this analysis appear to explain current behavior. Over the last several years grain quotas have been virtually eliminated while grain prices have fallen sharply. Both of these changes tend to reduce the benefits that

leaders can derive from control over land. Our observations during a revisit (in the summer of 2000) to areas surveyed in 1996 suggest that, in fact, the expected reduction in reallocation frequency and increase in land rental activity has occurred. Associated with this decline has been a marked increase in land rental activity.

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8. Technical appendix: Missing Market hypothesis

We consider the hypothesis that, given the absence of land and farm labor markets, land reallocations serve to maximize village agricultural profits. In other words, they are an administrative substitute for missing markets, and thus increase the efficiency with which land is allocated among households.

Formally, our hypothesis is that administrative land reallocations maximize the discounted present value of agricultural profits, net of costs to conduct reallocations. Over time households change their labor supply to agriculture in response to changes in their off-farm opportunities or changes in household labor endowment. Since households cannot adjust land holdings and hiring of agricultural labor is limited, agricul-

tural land and labor gradually become "less well matched" and a village's agricultural profits decline. Reallocations correct this deterioration, but entail substantial transactions costs. As such, they occur only when the land-labor match deteriorates sufficiently to warrant the cost.[20]

Consider a village with one unit of farm land divided between two households. Village agricultural profit in a given year is the sum of agricultural profits in the two households. Land and labor are *perfectly matched*, and village agricultural profits are maximized when the marginal productivity of land is equal for both households. For a given initial allocation of land and labor, define the *quality of the land-labor match* to be the amount of land that must be reallocated to achieve this optimum.

Let F denote the household farming technology and let x_i, and l_i, denote land and labor for household i. Suppose that in Year One land and labor are perfectly matched, but that in Year Two each household experiences a change in its agricultural labor supply. Since agricultural labor and land markets do not function, these labor supply changes affect the marginal productivity of land and open the door to gains from land reallocation. For a given change in labor supplies, the amount of land that must be reallocated to maximize village profits depends directly on F_{xl}, the sensitivity of the marginal product of land to changes in labor supplies, and inversely on F_{xx}, the sensitivity of the marginal product of land to changes in household land allocation. From this discussion we conclude that the missing markets hypothesis implies that reallocation behavior depends on the technology, changes in the labor supply, and the interaction of these two quantities.

If the motivation for reallocations is to maximize agricultural profits, when there are fixed costs of reallocating land, it is not optimal to maintain at all times a perfect land-labor match. Instead, villages periodically reallocate land when the existing allocation is "far enough" from the optimum. In order to analyze this behavior we require a dynamic model of optimal land reallocation.

Let Π^* denote the maximal agricultural profits that can be obtained in any given year and let S denote the quality of the land-labor match. Since the quality of the land-labor match is defined to be the amount of land that must be reallocated to

[20] We expect reallocation behavior will affect investment behavior, and perhaps that investments in land affect tenure security. Since our data set contains very little information about household investments in agriculture, we ignore investment decisions in the formal model.

return the village to an instantaneous optimum, increases in S should be associated with decreases in agricultural profits. That is,

$$\Pi(S) = \Pi^* - \alpha S, \tag{8.1}$$

where $\alpha = |\Pi_S|$ measures the sensitivity of profits to changes in the land-labor match. Earlier discussions suggest that this parameter will depend on characteristics of the agricultural technology. Let ν denote the rate at which the land-labor match deteriorates. Our earlier discussion suggests that this deterioration is closely related to changes in households' labor supply behavior. We can now write the land-labor match as a linear function of time, $S(t_0 + t) = S(t_0) + \nu t$. Substituting into 8.1 we have $\Pi\left(S(t_0 + t)\right) = \Pi^* - \alpha\left(S(t_0) + \nu t\right)$.

This expression reflects the following intuition. Village agricultural profits decrease in the time since the last reallocation and in the rate at which the land-labor match deteriorates. The rate at which the land-labor match deteriorates increases with the rate at which labor supplies to agriculture change. The sensitivity of profits to a given change in the land-labor match depends on the shape of the underlying agricultural production function.

Even if the only motivation for reallocations is to maximize agricultural profits, as long as there are fixed costs of reallocating land, it does not maximize village profits to maintain a perfect land-labor match ($S = 0$) at all times. Instead, villages periodically reallocate land when the existing allocation is "far enough" from the optimum. To analyze this behavior requires a dynamic model of optimal land reallocation. Introduce the following notation:

$$\begin{aligned} c_f &= \text{fixed cost of conducting a land reallocation,} \\ c_v &= \text{marginal cost of reallocating a unit of land,} \\ r &= \text{discount rate,} \\ \tau &= \text{time between reallocations,} \\ t &= \text{time since a reallocation.} \end{aligned}$$

The problem of maximizing the discounted present value of agricultural profits generates the following value functional:

$$V(x) = \max_{\substack{\tau \geq 0 \\ y \geq 0}} \left\{ \int_0^\tau e^{-rt} \left(\Pi^* - \alpha(x + \nu t)\right) dt - e^{-r\tau} \left(c_f + c_v(x + \nu\tau - y) + V(y)\right) \right\}. \tag{8.2}$$

For any given initial state of the land-labor match, x, the village chooses the time until the next reallocation, τ, and the amount of land reallocated at the next reallocation, $(x + \nu\tau - y)$. Optimal reallocation behavior maximizes the discounted present value of the present cycle's profits, conditional on optimizing behavior thereafter.

This statement of the problem makes the following implicit assumptions. (1) Villages never make the choice "never reallocate". While our sample contains some villages that have not reallocated, we cannot distinguish the decision "never reallocate" from the decision "reallocate less often than every 15 years".[21] Given this we opt for the simpler statement of the problem. (2) Equation 8.2 restricts attention to discontinuous reallocation behavior. In the presence of a discrete cost of reallocation, continuous reallocation cannot be optimal if the response to reallocations is continuous. (3) Equation 8.2 does not consider the case when the village's initial need to reallocate land is larger than the threshold. This is a simple extension of the analysis but is not indicated by the data, which suggest that first reallocations are like subsequent reallocations.[22] (4) If the leader can anticipate changes in households' labor supplies, he might choose to reallocate more land than is required to get to the optimum. Equation 8.2 does not allow this. This is a simplifying assumption consistent with the leader having limited ability to predict the direction of change in any given household's labor supply.

To find the value function V define

$$Y^* = \max_{\tau \geq 0} \frac{1}{1 - e^{-rt}} \left[\int_0^\tau e^{-rt} \left(\Pi - \alpha(x + \nu t)\right) dt - e^{-r\tau} \left(c_f + c_v(x + \nu t - y)\right) \right]. \tag{8.3}$$

That is, if we constrain all reallocation cycles to be of the same length, require each reallocation to exhaust completely gains from trade, and for the initial state of the village to be the instantaneous optimum, then Y^* is the best we can do. Let

[21] The HRS was introduced in the early 1980's, about 15 years before our 1996-7 surveys.

[22] We cannot reject the hypothesis that the average amount of land changing hands in a village's first reallocation is the same as the average amount of land changing hands in subsequent reallocations.

$\tau^* = \tau^*(\Pi, \alpha, \nu, c_f, c_v, r)$ be the optimal time period in 8.3. Given Y^*, the value function for 8.2 is given by:

$$V(x) = \int_0^{\tau^* - \frac{x}{\nu}} e^{-rt} (\Pi - \alpha(x + \nu t))\, dt - e^{-r\left(\tau^* - \frac{x}{\nu}\right)} (c_f + c_v \nu \tau^*) + e^{-r\left(\tau^* - \frac{x}{\nu}\right)} Y^*, \quad (8.4)$$

where $\alpha - r c_v > 0$. That is, for any given starting value the optimal reallocation path involves waiting until the village needs to reallocate a certain optimal amount of land, $\tau^* \nu$, in order to return to the instantaneous optimum. When the village reaches this state, it reallocates until the instantaneous optimum is achieved.

To verify that 8.4 is a solution to 8.2, substitute 8.4 into 8.2. Since this expression is an identity when $y = 0$, and $\tau = \tau^* - x/\nu$, it is sufficient to show that these two values are optimizing. To do this take derivatives with respect to y, and τ. To verify that the τ derivative is zero, differentiate 8.3 and substitute. To verify that the constraint $y > 0$ binds, follow the same procedure. This analysis follows Lucas and Stokey (1989, p. 123).

Differentiating 8.4 with respect to τ gives:

$$-rY^* + [\Pi - \alpha \nu \tau] - c_v \nu + r(c_f + c_v \nu \tau) = 0. \quad (8.5)$$

This expression does not have an analytical solution for τ^*, however we can differentiate implicitly. This yields two unambiguous comparative statics: $\frac{d\tau^*}{d\Pi} = 0$, and $\frac{d\tau^*}{dc_v} > 0$.

The reallocation path that maximizes the discounted present value of agricultural profits has the following characteristics. For a given initial value of the land-labor match, the planner allows the land-labor match to deteriorate until a threshold, $S = \nu\tau^*(\Pi^*, \alpha, \nu, c_f, c_v, r)$, is reached and then reallocates land until $S = 0$. Thereafter, the planner reallocates until $S = 0$ every τ^* years. Hence a plot of the time path of village profits is a "sawtooth" pattern.

We note that if instantaneous profits were concave in the amount of land reallocated, e.g., $\Pi(S) = \Pi^* - \alpha S^2$, then the amount of land reallocated could depend on variable costs of reallocation, as could the upper and lower thresholds of the land-labor match. We assume that instantaneous profits are linear in the amount of land reallocated. Our data provide no basis for estimating second order terms of the instantaneous profit function. An artifact of this assumption is that variable costs of

reallocating do not affect the amount of land reallocated, except by affecting the time between reallocations.[23] In a more general model variable costs may impact the amount of land reallocated directly, not just through their impact on time between reallocations.

Although we cannot find an analytical solution for τ^*, we can generate comparative statics. Unexpectedly, the time between reallocations need not be decreasing in α, ν, and c_v. Two countervailing forces are at work here. First, the "continuation payoff", i.e., the maximum present value of profits, conditional on a reallocation having just occurred, declines as α increases. Since α measures the sensitivity of agricultural profits to changes in the land-labor match, as α increases, the village must reallocate more often to maintain the same average profits. Consequently, either the average profits decline or expenditure on reallocations increases. In either event the continuation payoff declines. Therefore, as α increases, it becomes less costly to delay reallocating because the village delays a less valuable future. On the other hand, as α increases, the marginal benefit from reallocating at any given time increases, since the village is further from the instantaneous optimum. Hence, as α increases, delay is less costly and the benefit of reallocation grows more quickly. Since these two effects work in opposite directions, the net effect of a change in α on τ^* is ambiguous. Similar arguments explain why the effect of changes in c_v and ν on τ^* are also ambiguous.

In summary, the missing market hypothesis has the following implication for the behavior of the observed time between reallocations: (1) The time between reallocations depends on the rate at which household agricultural labor supplies change, the sensitivity of agricultural productivity to land-labor mismatches, and the product of these two quantities. (2) The time between reallocations depends on the marginal and fixed costs of reallocation.

In addition, the missing market hypothesis has the following implication for the behavior of the observed size of village land reallocations: (1) The size of a given reallocation increases in the time since the last reallocation; (2) the size of a given reallocation increases with the rate at which household agricultural labor supplies change; (3) the size of a given reallocation depends on the sensitivity of agricultural profits to land-labor mismatches, and the product of this sensitivity with the rate of labor supply change; (4) the size of a given reallocation depends on fixed costs only

[23] Barring a corner solution where the village never reallocates.

indirectly, through their impact on the timing of reallocations. In practice, this leads us to expect that some transactions costs variables will influence time and size, while others will influence only time; and (5) the size of a given reallocation depends on variable costs of reallocation.

Table 1

Village Reallocation Behavior

Percentage of villages that have reallocated	71.6
Mean number of reallocations (all villages)	1.7 (1.8)
Mean number of reallocations (given reallocate at least once)	2.4 (1.7)
Percentage of land reallocated at least once since HRS	48.5 (43.4)
Size of most recent reallocation	
Percentage of land	57.6 (41.3)
Percentage of households	72.6 (31.2)

Note: Standard deviations are reported in parentheses.

Table 2

Agricultural Factor Markets

	1988	1995
Number of households renting-in	2.1 (5.7)	8.9 (14.1)
Percentage of land rented-in	0.6 (1.8)	2.9 (5.8)
Number of farm laborers hired	9.1 (27.1)	24.4 (49.8)
Number of individuals working off-farm	107.4 (137.0)	210.1 (186.5)

Note: Standard deviations are reported in parentheses.

Table 3
Predictions by Variable and Hypothesis

Variable Class	Variable Name	Common Property	Quota Fulfillment	Missing Market	Rent Seeking
Demographic	Rate of change of population	Direct effect on amounts and number	No effect	Direct effect on amounts. Unsigned effect on number.	No effect
	Rate of change in off-farm labor supply.	No effect.	No effect	Direct effect on amounts. Unsigned effect on number	No effect
Technology	Land/labor	No effect	No effect	Unsigned effect on amounts reallocated. Unsigned effect on number	No effect
Interaction of technology and off-farm labor supply change		No effect	No effect	Unsigned effect on amounts reallocated. Unsigned effect on number	No effect
Transactions costs	#Plots	Unsigned effect on number. Unsigned effect on amount. ``Fixed costs" affect number but not amount. ``Variable costs" affect amount and number.	Unsigned effect on number. Unsigned effect on amount. ``Fixed costs" affect number but not amount. ``Variable costs" affect amount and number.	Unsigned effect on number. Unsigned effect on amount. ``Fixed costs" affect number but not amount. ``Variable costs" affect amount and number.	Unsigned effect on number. Unsigned effect on amount. ``Fixed costs" affect number but not amount. ``Variable costs" affect amount and number.
	#Households	"	"	"	"
	#Production teams	"	"	"	"
	#Cadres	"	"	"	"
	%Paddy	"	"	"	"
	Multiple cropping index	"	"	"	"
Quota		No effect	Direct effect on amounts and number	Unsigned effect on amount and number.	No effect
Leader attributes	.	No effect	Unsigned effects on amounts and number	Unsigned effect on amount and number	Unsigned effect on amounts and number

Note: Shading indicates predictions consistent with regression results.

Table 4
Number of Reallocations Regressions

		(1) OLS	(2) Probit	(3) Linear Probability
Demographic Variables	Population	40.938*** (22.626)	34.374** (17.430)	5.237 (3.285)
	Off-farm local	-38.143* (16.163)	-28.660** (18.13)	-7.766** (4.693)
	Off farm non-local	28.131** (13.747)	25.752 (14.261)	5.593 (3.731)
Technology	Land/Labor	0.365 (0.225)	0.278 (0.234)	0.049 (0.054)
Transactions costs	# Plots	-0.051* (0.015)	-0.059** (0.024)	-0.0173* (0.006)
	# Households	-0.002** (0.001)	-0.001 (0.001)	-0.0003 (0.0002)
	# Productions teams	0.112* (0.027)	0.117* (0.044)	0.023* (0.009)
	# Cadres	0.058 (0.063)	0.039 (0.072)	0.010 (0.018)
	% Paddy	-0.689 (0.437)	-0.718*** (0.377)	-0.183*** (0.099)
	Multiple Cropping Index	-.008 (0.315)	-.551** (0.255)	-.168** (.076)
Quota		3.713** (1.688)	1.573 (1.277)	0.373 (0.301)
Township Decides		-0.575 (0.415)	-0.883* (0.316)	-0.262 (0.877)
Income		-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
County seat		-0.020* (0.007)	-0.233* (0.009)	-0.005** (0.002)
N		177	177	177
R-squared		0.26		0.27
Log(L)			-79.42	

Note: Standard errors are reported in parenthesis. *=1% significance, **=5% significance, ***=10% significance. Errors in columns 1 and 3 are corrected for heteroskedasticity. In Columns 2 and 3 the dependent variable is a dummy that is 1 if a village reallocates at least once, zero otherwise. In column 1 the dependent variable is the number of village reallocations.

Table 5
Duration of most recent reallocation period

		(1) OLS	(2) OLS
Demographic Variables	Population	-70.278** (33.815)	-91.114* (32.777)
	Off-farm	67.517 (63.421)	58.545 (65.054)
	Off farm non-local	-18.097 (66.124)	-34.592 (74.041)
Technology	Land/Labor	-0.295 (0.747)	0.166 (0.712)
Transactions cost	# Plots	0.287* (0.070)	0.399* (0.069)
	# Households	0.007 (.004)	0.007 (0.004)
	# Productions teams	-0.126 (0.100)	0.097 (0.112)
	# Cadres	0.382 (0.437)	0.680 (0.519)
	% Paddy	2.743 (1.965)	2.910 (1.932)
	Multiple Cropping Index	-1.864*** (1.004)	-1.314 (1.077)
Quota		-7.756** (3.531)	-6.257** (2.881)
Township Decides		1.237 (1.849)	1.319 (2.139)
Income		-0.0015* (0.001)	-0.002* (0.0013)
Distance from County seat		0.031 (0.040)	0.024 (0.044)
Farm Factor Markets:	Land Rentals (%)		-6.618 (5.578)
	Hired Farm Labour		-0.826 (1.458)
Sample Size		48	46
R^2		0.43	0.51

Note: Standard errors are reported in parenthesis. *=1% significance, **=5% significance, ***=10% significance. Errors are corrected for heteroskedasticity.

Table 6
Amount Reallocated

		(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) TSLS
Duration	Years since Last Reallocation	0.029*** (0.016)	0.039* (0.014)	0.031** (0.013)	0.025*** (0.016)	0.028 (0.131)	0.062** (0.028)
Rates of demographic and labor supply change	Population	4.994 (3.354)	7.138** (2.899)	5.980** (3.043)	6.200** (3.554)	7.202** (3.246)	6.579** (2.690)
	Off-farm labor	28.415* (7.666)	29.635* (9.915)	31.132* (9.337)	21.705** (10.205)	20.758* (10.523)	27.960* (8.025)
	Land/Labour	0.187** (0.080)	0.168*** (0.089)	0.168** (0.078)	0.185** (0.075)	0.149** (0.068)	0.163** (0.077)
Technology	Land/Labour*Off-farm	-8.458** (3.823)	-8.106** (4.252)	-9.630** (4.297)	-7.642*** (4.851)	-7.136 (4.684)	-8.273** (3.894)
	# Plots	-0.017*** (0.009)	-.0266* (0.007)	-0.016** (0.008)	-.0011 (0.009)	-0.011 (0.008)	-0.026** (0.011)
Transactions cost	% Paddy	-0.192 (0.121)	-0.205*** (0.124)	-0.401* (0.157)	-0.259** (0.124)	-0.446* (0.156)	-0.258** (0.123)
	Quota	0.604** (0.254)	0.467** (0.222)	-0.521 (0.560)	0.806* (0.254)	-0.187 (0.568)	0.796* (0.286)
Quota	Quota*Off-farm Wage			0.058** (0.026)		0.048*** (0.026)	
	Quota*Cash				-0.067* (0.010)	-0.058* (0.010)	
		0.0004* (0.0001)	0.0005* (0.0001)	0.0004* (0.0001)	0.0004* (0.0001)	0.0039* (0.0001)	0.0004* (0.0001)
Income	Land Rental		-1.349* (0.443)				
Farm Factor Markets	Hired Farm Labour		-.104 (0.094)				
		48	46	48	48	48	48
Sample Size		0.50	0.63	0.56	0.57	0.61	0.53
R^2							

Note: Standard errors are reported in parenthesis. *=1% significance, **=5% significance, ***=10% significance. Errors are heteroskedasticity corrected. In column 6 we use predicted values for the duration of the most recent reallocation period.

Table 7

Economic importance of explanatory variables

		(1) % Change of duration of most recent reallocation period	(2) % Change in amount reallocated	(3) % Change in annual percentage reallocated
Time	Years since Last Reallocation	n.a.	15.44	n.a.
Demographic	Population	-16.13	9.52	25.89
	Off-farm	8.76	40.30	31.00
Technology	Land/Labor	4.93	3.76	2.03
Transactions cost	# Plots	22.15	-11.31	-22.88
	% Paddy	18.37	-10.99	-20.95
Quota	Quota	-21.78	14.90	39.98
Income		-12.78	29.14	44.40

Note: Column 1 records the percentage change that results to the duration of the most recent reallocation period in response to a one standard deviation change in a given explanatory variable. These numbers are calculated by multiplying coefficients from regression 1 In table 5 by the standard deviation of the independent variable and dividing by mean duration of the reallocation period (5.4 years). Column 2 records the percentage change in the amount reallocated in response to a one standard deviation change in a given explanatory variable. These numbers are calculated using coefficients from regression 1 in Table 6 and multiplying by the standard deviation of the independent variable and dividing by the mean amount reallocated (62.8%). Changes to amount reallocated do not include indirect changes due to change in duration. Column 3 records the percentage change in the average annual reallocation of land in response to a one standard deviation change in a given explanatory variable. These values are calculated using the same regression coefficients as are used in columns 1 and 2 of this table.

Table 8

Descriptive Statistics

Demographics and labor supply:	
Annual rate of change of population	1.08%
	(1.00)
Annual rate of change of off-farm non-migrant labor	0.85
	(0.85)
Annual rate of change of off-farm migrant labor	0.71
	(0.80)
Transactions costs:	
Number of households	295.1
	(168.6)
Number of production teams/small groups	7.1
	(4.7)
Number of plots	6.4
	(5.5)
Cropping intensity (multiple cropping index)	1.7
	(0.5)
% Paddy	43.8
	(37.1)
Village governance:	
Number of Cadres	5.1
	(1.8)
Reallocation decision made by township (Coded 1 if township decides)	0.14
Attributes of Party Secretary:	
Age	45.5
	(7.9)
Education	7.7
	(2.6)
Tenure	6.5
	(6.8)
Attributes of Village Head:	
Age	42.6
	(7.1)
Education	7.3
	(2.7)
Tenure	4.8
	(5.2)
Distance from county seat	19.8
	(14.8)
Technology:	
Land-labor ratio (1988) (mu per capita)	1.53
Yields (1988)	533.6
	(285.9)
Quota (Required gross sales/total output)	11.2
	(11.6)
Village income (1988 Yuan)	654.7