Do Limitations in Land Rights Transferability Influence Low Mobility Rates in Ethiopia?

Alan de Brauw[a*] Valerie Mueller [b]

December 9, 2009

Abstract

Migration is considered a pathway out of poverty for many rural households in developing countries. National policies can discourage households from exploiting external employment opportunities through the distortion of capital markets. Studies in China show that the presence of state and collectively owned land creates inefficiencies in the labor market. We examine the extent restrictions on land rights impede mobility in Ethiopia, having the lowest urbanization rate in sub-Saharan Africa. The empirical estimates support a robust positive effect from increasing the transferability of land rights on migration. Our findings are suggestive that the nascent land certification and registration programs in regions of Ethiopia may potentially promote poverty reduction by increasing incentives to migrate.

JEL Classification: O15, Q15, R23
Key words: migration, property rights, land security, Ethiopia

[a] Poverty, Health, and Nutrition Division, International Food Policy Research Institute, 2033 K Street, NW, Washington, DC 20006, US. Email: a.debrauw@cgiar.org.

[b] Development Strategy and Governance Division, International Food Policy Research Institute, 2033 K Street, NW, Washington, DC 20006, US. Email: v.mueller@cgiar.org.

*Corresponding author. Email: v.mueller@cgiar.org. Phone: +1 202-862-4649. Fax:+1 202-467-4439.

We thank Stefan Dercon, John Hoddinott, Neha Kumar, Yisehac Yohannes, and participants of the ERHS Lalibela workshop for their helpful input.

1 Introduction

The migration of household members is an attractive potential pathway out of poverty for many rural households in developing countries. Such households face the challenge of maintaining or improving their livelihoods in the presence of capital market imperfections, vulnerability to climate and macroeconomic shocks, and inaccessibility to credit. For many such households, labor is their main productive asset. Access to opportunities in distant labor markets through migration can increase the earning potential of members of such households (Harris and Todaro, 1970). Furthermore, if migration takes place as part of a household decision making strategy, it can help the source household reduce income risk (Azam and Gubert, 2006; Stark, 1991) at the very least, and potentially improve the well-being of the entire household (e.g., de Brauw and Harigaya, 2007). From the former perspective, households can diversify income risk preemptively by allocating labor spatially to areas where risks to income is not correlated with rural income shocks (Rosenzweig and Stark, 1989).

Despite the potential benefits of migration to reducing income risk or in improving overall well being, in most settings the majority of households in rural areas of developing countries do not send out migrants. There are several reasons that households might not send out migrants. Households might not have members in appropriate demographic categories; migrants tend to be younger individuals who have not yet spent significant time farming. Households might also lack information about the potential returns to labor in distant markets. Several authors have pointed out that as information flows increase through migrant networks, migration increases (e.g., Carrington, Detragiache, and Vishnawath, 1996).

An alternative reason that households might not send out migrants is that they lack complete control over their landholdings. Specifically, households

might fear that if one or more members of the household were absent for a period of time, then other claimants of the land, such as the local government, might expropriate it. If land expropriation can occur without compensation, households might be dissuaded from sending out migrants for fear of signalling that they do not need all of their landholdings (e.g. Yang, 1997). In several settings around the world, and particularly in transition countries, farmers do not enjoy complete rights of transferability over their land and may fear that the government might take land that is not being used or that officials might perceive is not being used adequately.

Low urbanization rates combined with incomplete land transferability rights make Ethiopia a compelling place to study whether migration is impeded by restrictions on land rights. Ethiopia has one of the lowest urbanization rates in sub-Sarahan Africa; whereas 36 percent of the population lives in cities in the remainder of Sub-Sarahan Africa, only 16 percent of Ethiopia's population lives in cities (World Bank, 2008). Increased internal migration to cities in Ethiopia could therefore improve overall living standards. Yet in the past, the government has explicitly discouraged migration through population policy (see National Population Policy, 1993). Ethiopia's poor infrastructure may further hinder migration by making movement costly as well as hindering the flow of information. Land transferability rights may also play a role in inhibiting population movement, giving households a further reason not to send away migrants. Unlike national policy, both infrastructure and transferability rights may vary by locality, which implies that their potential impacts on migration can be identified in an econometric model.

The objective of this paper is to analyze the potential impacts of land transferability rights on migration behavior in rural Ethiopia. To meet this objective, we present both theoretical and empirical results. The theoretical model

capitalizes this fear of expropriation through the impact migration has on the probability of continuing to farm the same land in the future and its associated future stream of returns, following similar studies on China (Lohmar, 1999; Yang, 1997).[1] We find that the impact of land security on migration is indeterminate, and depends on the interaction between the level of land tenure security and the amount of on-farm labor actually applied on the land in the present.

To test the theoretical predictions empirically, we use a unique panel data set that has been collected by Addis Ababa University, the University of Oxford, and the International Food Policy Research Institute over the past fifteen years, the Ethiopia Rural Household Survey (ERHS). The ERHS has followed the same set of households in 15 villages over 15 years. The last three rounds in 1999, 2004, and 2009 include a rich set of questions about land rights. We estimate a model that explains household migration flows in the 2004 and 2009 survey rounds, using first-differencing to control for household unobserved effects. In addition to changes in land transferability, we account for demographic characteristics, wealth, spatial amenities, and shocks the household may have experienced (such as serious illness, which can inhibit migration (Giles and Mu, 2007)). Finally, we also address the familiar simultaneity issue that arises from having the explanatory variables, e.g., household composition, being jointly determined with our dependent variable, migration, by replacing the explanatory change variables with lagged change variables. Our empirical results provide robust support that improvements in land security are positively associated with migration behavior.

The paper proceeds as follows. The next section briefly introduces the data set we will use for analysis, and defines the way we will study both migration and

[1] Studies have noted other components comprising the opportunity cost of migrating, such as its insurance value (e.g., Binswanger and Rosenzweig, 1986) or access to other benefits from land which we do not explicitly. Although we do not focus on these factors explicitly we essentially control for these effects in our empirical model.

land transferability rights. The third section provides some background on migration, land rights, and potential interactions between the two in Ethiopia. The following section presents our theoretical model, and the fifth section presents an empirical model consistent with the theory, including a discussion of identification. The sixth section describes the data set in more detail and presents results from the empirical model. The sixth section concludes with policy messages arising from the discussion of the results.

2 Data

We use a unique panel data set that was collected between 1994 and 2009 by Addis Ababa University, the University of Oxford, and the International Food Policy Research Institute, the Ethiopia Rural Household Survey (ERHS). The ERHS has followed the same set of households in 15 rural Ethiopian villages over seven survey rounds, the latest three rounds occurring in 1999, 2004, and 2009. The survey is not geographically concentrated and includes villages in all of Ethiopia's major regions. As a result, the ERHS has been used to study many aspects of the rural Ethiopian economy, including poverty dynamics and shocks (Dercon, 2004) and intrahousehold resource allocation (Dercon and Krishnan, 2000). We primarily draw on the past three rounds, as they include rich sets of questions about land holdings and land transferability rights. We focus on explaining the change in migration behavior in the latest two rounds, 2004 and 2009, using the 1999 and 1994 rounds to construct lagged household and land variables. This sample includes approximately 1,100 households.

A primary advantage of the ERHS is it is a panel and therefore there are numerous observations for certain variables on each household over time. Of course, each round of the survey has also undergone improvements and has

been designed to ask about pertinent topics. One such recent topic is land registration, and as such there are a number of questions in the most recent survey round that pertain to land rights and registration. From a descriptive perspective, this information is quite useful. However, it is not as useful from an econometric perspective, as we would ideally be able to show that changes in land transferability rights affect the ability of households to provide labor to the migrant market. Instead, we must use a measure available in more than either the most recent survey round or the two most recent survey rounds. We use the share of land held by the household that the household reports as being transferable as our primary measure of transferability rights, as a question has been asked about whether each plot held by the household is transferable in most survey rounds, including the ones important to this study.[2]

The focus of our study is to understand whether long-term labor migration patterns change in response to land availability and tenure security. We identify a migrant household based on the following three conditions. First, migrants are individuals who were present in the household in the previous round of the survey (five years prior to the survey) but not present in the current round. Second, we further limit migrants to only include individuals who were at least fifteen years of age when they moved (to rule out children leaving for school). Third, we also only include migrants where the respondent noted that he/she left the household to seek employment, rather than for other reasons. In regressions, we use two measures for migration– the number of migrants who have left since the previous survey round, and the share of migrants in the household who have left, using the initial household size as a denominator.

Since the survey does have wide geographical coverage, there is a great deal of heterogeneity in the experience with migration, land under cultivation, land

[2] This variable is also used by Dercon and Alayew (2007) to study the relationship between land rights and investment in one region of Ethiopia.

rights, and even development across regions. The latter is actually important for our study, as one of the sites, Debre Berhan, has traditionally had both larger plot sizes and a longer history of marketization than the other sites. Furthermore, many of the households in the sample have been subsumed by Debre Berhan town since the survey began. As a result, we might expect the relationship between migration and land tenure security to differ in Debre Berhan versus other ERHS villages. To deal with this difference, we estimate models both with and without the households in Debre Berhan included.

3 Background

In this section, we provide further background about the Ethiopian context. We describe land rights in some detail, and some evidence describing the effects of land rights on other outcomes that have been found in the literature. Next, we provide additional description of migration in the ERHS households, and third, we describe some patterns in the data relating migration to landholdings and land transferability rights.

3.1 Land Rights in Ethiopia

Land in Ethiopia is property of the state. Committees within the peasant association, a local administrative unit having one or few villages, appropriate use rights to households for a given amount of land. The conditions for continued use of the land vary, yet there are commonalities across regions. For example, farmers must cultivate the land without interruption, remain a resident of the kebele (the weight placed on being a resident and duration of residency required for land varies), and take "proper care" of the land (Rahmato, 2008). The amount of land allocated to a household is often based on historical agreements determined in most cases by household size. For example, in Adele Keke

(an ERHS village in the Oromia region), two hectares of land was granted per each head upon receipt of a small fee (20 Birr) (Gashaw, Bekele, and Tibebe, 1996).

In the past, fear of land expropriation was a real concern. During the Derg, land redistributions were frequent with some locales experiencing as many as three rounds over ten to twelve years (Rahmato, 2008). Redistributions have not been as common under the present government. In 1991, households were granted households permanent use rights over land (Benin and Pender, 2009). Yet redistributions still occur, although they are less common. Benin and Pender (2009) find numerous cases of redistributions occurring in the late 90s. In their survey, 73% of the villages in Amhara experienced on average three land redistributions since 1991. Ultimately, there are key players in local governments that can decide to expropriate land for a variety of reasons, including expansion of government offices, environmental degradation, and urban development, offering a predetermined compensation to the households in exchange.

Since the Derg regime, increased security in the use right of the land has manifested in the form of land transfers mainly to family members. In most cases, those that inherit the land must be residents of the kebele. There are limited options to rent out the land, however, often regional conditions are imposed in terms of to whom the land may be rented to, what portion of the land can be rented, what the land may be used for, and the duration of the rental contract. For example, Rahmato (2008) notes Oromia law prohibits households from renting out over half of their allocated land. Despite these available mechanisms, it is still forbidden by national law to sell, mortgage, or exchange land in Ethiopia.

The government recently has attempted to improve land security more formally through various land registration and certification programs. According

to Rahmato (2008), over half of rural households have their land registered and possess user certificates. Land certificates serve two purposes: 1) secure the right to compensation if land is reallocated, and 2) secure the right to the land during disputes (Rahmato, 2008). In their survey of Ethiopia's land certification program, Deininger, Ayalew Ali, Holden, and Zevenbergen (2008) study the extent that the registration process is equitable (in terms of existing biases against the women and the poor), and beneficial (using various measures of benefits and documenting the costs of first-time registration). Their preliminary evidence finds a lack of wealth and gender bias. In addition, land certification yields net benefits in the form of high demand for certification, reduced unsettled disputes,and increased investments in the short term.

3.1.1 Links Between Land Rights and Investment

A broader literature reflects on the relationship between land insecurity and investment. Besley (1995) summarizes three channels in which improvements in property rights can positively affect investment. First, the probability of securing land in the future declines particularly in areas where expropriation is common, thereby reducing household's expected return to investment and their incentives to invest. Second, the value of property rights may be capitalized in the type of credit portfolios available to the household. In some areas, the ability to use land as collateral can leverage packages with lower interest rates which increases the marginal return of investment on the land. Third, property rights can promote investment by virtue of the gains from trading good quality land. Well-defined property rights reduce the transfer costs inherent in land exchanges. Increasing investments on the land improves the chances of a sale and increases the sales price which improves the landowner's return to investing. This final channel hinges on the ability to sell or rent the land, which differs from the previous two in its focus on land sales and prices.

Besley (1995) finds that improvements in property rights, measured by land transfer rights, increased tree planting investments in some areas of Ghana. He further attempts to test which channel is affecting investment, finding support against the land collateral hypothesis due to field-specific rights weighing more importance than household rights for investments. Jacoby, Li, and Rozelle (2002) also discover evidence of property rights quantified by expropriation risk reduces investment (in the form of reduced organic fertilizer) in rural China.

A recent body of the literature examines the link between property rights and investment in Ethiopia. Deininger and Jin (2006) empirically estimate the relationship between transferability and security of land rights on investment in Ethiopia using a nationally representative dataset collected in 1999-2001. Tenure security is measured by village-level and individual experience of a land reallocation in 1990-1998 and households' expectations about future village-level reallocations. Transferability is proxied by respondents' assessment of whether they will be able to transfer their land through mortgage or sale. They find that tenure security and transferability provide incentives for investment. However, land transferability has a large impact on productivity-enhancing investment, such as terracing.

Dercon and Ayalew (2007) explore similar issues with investment using a panel household survey in Ethiopia focusing on the SNNP region. They exploit a policy-induced source of variation in land rights on the sample; an unexpected large-scale land reform in a non-adjacent region, Amhara Region, between late 1997 and the first few months of 1998, where politically important people were given land taken away from households. Their survey data show that in this period, farmers changed considerably in their perceived tenure security in the sample villages in SNNP. They use variation in political power to instrument changes in perceptions of land rights, controlling for household fixed effects,

and village-specific time effects. They find a strong, significant, and robust link between land rights on the allocation of land to perennial crops such as coffee.

Holden, Deininger, and Ghebru (2009) perform one of the first evaluations of tenure security on investment in Ethiopia as measured by household participation in the land certification program. They use plot-level data of households over 1998, 2001, and 2006 in the Tigray region. They apply several forms of sensitivity analysis in terms of the analysis of outcomes, specifications, and instrumental variable approaches, and find robust evidence that improving land security through the certification program robustly encourages investment in trees, superior soil conservation practices, and enhances land productivity.

3.2 Migration

As previously mentioned, internal migration is thought to be relatively rare in Ethiopia. By the definition of migrant households provided in the data section, we find that 37 percent of households can be considered migrant households in the ERHS. In other words, between 1999 and 2009 at least one individual left 37 percent of households in the sample for work and were not found in a subsequent round of the survey as a result. This number might seem like a significant proportion of the sample, but households in Ethiopia tend to be large (the average household size was 6 in 2009), and the period of study is relatively long. Therefore, the figure is consistent with fairly low migration rates. Just under two thirds of the individuals identified as migrants are male, and about half go to urban destinations, with the remainder going to other rural destinations.

Although the average incidence of migrant households is 37 percent in the ERHS, this average masks a great deal of heterogeneity by site (Figure 1). A few villages have very little migration; less than one quarter of households can

be labelled migrant households. On the other hand, more than 60 percent of households in Imdibir and Aze Deboa are migrant households, meaning that at least one household member left between 1999 and 2009. The general pattern shown here is consistent with earlier sociological evidence, which showed that those two villages have more migration historically, and that households are more prone to being landless (Dea, Desta, and Tafese, 1996; Molla and Feleke, 1996).

To investigate possible determinants of migration at the household level, we next compare household characteristics among migrant and non-migrant households in the 1999 and 2004 rounds (Table 1). Although we do not find much difference between the two groups with regards to the land variables of migrant households versus non-migrant households (rows 1 and 2), we may still find differences when we look at how these variables change over time. We do find that migrant households appear to both be richer in terms of livestock holdings (row 3) and their holdings appear to have grown more over time between 1999 and 2004. Finally, demographic characteristics appear to be important in determining which households are migrant households and which are not (rows 4 and 5). In both survey rounds, migrant households have more male and more female members of prime working age, or between the ages of 16 and 40. The difference is larger for male than female members, consistent with the fact that migrants tend to be male more often than female. These descriptive statistics suggest that wealth and household demographics may be key determinants of migration.

3.3 Land Rights and Migration

While some authors have linked land rights and investments in the literature on Africa's economies, no study we are aware of has attempted to study a

potential relationship between land transferability rights and migration in the African context. In fact, there are very few studies in general that have looked at the relationship between migration and land transferability. Existing studies have focused on China, which has or had a similar property rights regime over land after its economic transition began. In China, as in Ethiopia, the state is the nominal owner of all land, but since HRS reforms households have held use rights and rights to the residual but not transfer rights.[3]

The few studies that have considered the potential relationship between migration and land transferability rights suggest that improved land rights facilitate migration. Yang (1997) develops an economic model that describes the explicit trade-offs a household without permanent rights to the land must make upon deciding to send a migrant elsewhere. Due to the lack of formal land markets, the household ultimately foregoes a future stream of land earnings in farming in its decision to leave the village. The conditions of the land market discourage investment on the land, but also produce a disincentive for farmers to migrate (Yang, 1997). In a recent empirical study, Mullen, Grosjean, and Kontoleon (2008) suggest that improvements in tenure security on both agricultural and forest land increase migration in China.

We initially look at whether or not migrant household status is correlated with a number of variables that measure land transferability rights in the 2009 survey (Table 2). Among these questions, many of the differences are not significant. However, we do find two differences that suggest a relationship between migration and land rights. The survey specifically asked about whether households lose land if the household migrates to the *woreda* (district capital) for 3 years. Households with no change in migrant flows more often answer that the village will take the land (rows 1 and 2). Furthermore, we find that households

[3] See Brandt, Rozelle, and Turner (2004), for a detailed description of land rights in China up to the late 1990s.

with no change in migrant flows also report, on average, that rental contracts with a slightly shorter duration must be registered. These differences begin to suggest that differences in regulations affecting land transferability rights may affect the decision over whether or not to send away migrants.

Although Table 2 might suggest that there is a positive relationship between migration and land transferability rights, we have not yet provided a theoretical justification for a potential relationship, nor have we begun to demonstrate that other factors, such as household demographics, do not explain these differences in descriptive statistics. In the next section, we develop a conceptual framework to understand how land security may affect labor allocation decisions on and off of the farm, and under what conditions may land security have a positive or negative effect on migration. We then control for a number of potential confounding factors in the empirical section.

4 Land Constraints and Migration Decisions

To demonstrate how the role of land may influence migration decisions in Ethiopia, we model the problem from the perspective of the head of household. His or her primary objective is to maximize household income by choosing the amount of farm land to cultivate A, family labor employed on the farm L, and labor sent to migrate for employment elsewhere M. We assume that household income has three components. First, households produce a single output where Q is the amount produced, $f(\cdot)$ is a well behaved production function, and the output price is normalized to one. Income from the output can therefore be written as $Q = f(L, A)$. Land sales and land rentals are both rare in most of rural Ethiopia, as are sharecropping arrangements. Therefore it is reasonable to further assume that land area is fixed in the short term, which can be reflected in the production function as $Q = f(L, \overline{A})$. The choice faced by households is

therefore reduced to the amount of labor put into farming. Second, the household can send out migrant labor to earn income wM, where w is the market wage. Migrants cannot work on the farm, so the household labor endowment must be split between migration and off-farm labor. The third source of income represents the value of future agricultural production to the household. It can be written as the discounted future return from the land $\delta p(L,S)\left[f(L,\overline{A})\right]$, where δ is the discount rate, and S measures tenure security. Important here is the function $p(L,S)\ \epsilon[0,1]$, which represents the probability that the household will continue to hold the land in the future. We assume that the function $p(\cdot)$ depends on the number of people cultivating the land and tenure security, increases in both arguments $\left(\frac{\partial p}{\partial L}>0, \frac{\partial p}{\partial S}>0\right)$, and that it is concave.

The household's objective is to choose L and M in order to maximize the total income from these three components:

$$\max_{L,M}(1+\delta p(L,S))\left[f(L,\overline{A})\right]+wM \text{ s.t. } \overline{L}\geq L+M \tag{1}$$

Essentially, the third part of income illustrates the trade off faced by the household. The household can send household members elsewhere to generate income off the farm, at the expense of both agricultural production in the present and through a decrease in tenure security for future agricultural production. Equation (1) can be further simplified by assuming that able-bodied workers are employed at all times, reducing the constrained optimization problem to:

$$\max_{M}\left(1+\delta p(\overline{L}-M,S)\right)\left[f(\overline{L}-M,\overline{A})\right]+wM \tag{2}$$

The solution to M must satisfy the following first order condition:

$$(1+\delta p)f_1+\delta p_1 f=w \tag{3}$$

Thus, the household allocates labor efforts outside of the farm such that the discounted stream of the marginal product of migrant labor on the farm over time is equal to the wages generated off of the farm.[4]

Our interest is to explain whether low mobility in Ethiopia is attributable to land constraints. We will empirically test whether land shortages and/or tenure insecurity affect migration decisions. To test these hypotheses, it is informative to develop priors based on our theoretical model of how these aspects of land constraints may influence migration. First, we totally differentiate (3) with respect to M and $\overline{A}$ to determine the sign of $\frac{dM}{d\overline{A}}$:

$$\frac{dM}{d\overline{A}} = \frac{(1+\delta p)f_{12} + \delta p_1 f_2}{(1+\delta p)f_{11} + 2\delta p_1 f_1 + \delta f p_{11}} < 0, \tag{4}$$

If we assume that the objective function is well-behaved and there is an interior solution, then the denominator in (4) must be less than zero due to the concavity. If we make the additional assumption that $f_{12} > 0$, then it must be that $\frac{dM}{d\overline{A}} < 0$. This framework therefore suggests that an increase in the land available to farmers will marginally reduce migration efforts. In other words, if land is short then households will be more likely to send out migrants.

Next, we totally differentiate (3) with respect to M and S to determine the sign of $\frac{dM}{dS}$:

$$\frac{dM}{dS} = \frac{\delta\left[p_2 f_1 + p_{12} f\right]}{(1+\delta p)f_{11} + 2\delta p_1 f_1 + \delta f p_{11}}. \tag{5}$$

The numerator in equation (5) represents the expected increase in the future marginal product of labor given an increase in land security plus an increase in the marginal probability of farm labor caused by an increase in tenure security. The sign of $\frac{dM}{dS}$will depend on the cross derivative of the probability function p_{12}.

[4] Clearly, a "corner solution" is also possible in which the household does not send out any migrant labor; this solution occurs if the marginal product of labor in agriculture plus the discounted marginal product of labor in agriculture, including the marginal probability of losing land, exceed the wage rate in migration. The existence of this corner solution does not affect our primary analysis, so we do not point it out explicitly above.

If $p_{12} > 0$, then $\frac{dM}{dS} < 0$. If $p_{12} < 0$, then the sign of $\frac{dM}{dS}$ may be indeterminate. Consider the case where p_{12} is very negative, this implies that at some level increasing tenure security will imply that having additional labor allocated to the farm will not benefit income. For these extreme cases, it may be possible that $\frac{dM}{dS} > 0$. Since the sign is theoretically indeterminate, we must estimate an empirical model to learn about the relationship between land tenure rights and migration in Ethiopia, and how important that relationship is relative to the relationship between land shortages and migration.

5 Empirical Model and Identification

To investigate the relationships between migration and land suggested by equations 4 and 5, we want to understand how existing household land and land transferability rights affect the migration decision, while controlling for the household labor endowment and potentially other observables that will affect the returns to labor within the household. We can write down a simple linear model consistent with these observations as follows:

$$M_{ijt} = \alpha_j + \beta_1 A_{ijt-1} + \beta_2 S_{ijt-1} + \beta_3 H_{ijt-1} + \beta_4 W_{ijt-1} + \gamma_{ij} + \varepsilon_{ijt} \qquad (6)$$

where M represents the migration decision of household i in village j at time t, A represents the household land holdings, S represents the household's tenure security, H its human capital endowment, and W its wealth. We lag the variables A, S, H, and W to ensure that migration occurs as a result of each of its potential determinants. The variable γ_{ij} represents fixed unobservables about the household that cannot be measured, and ε is a mean zero error term. In the context of our theoretical model, our interest is to measure β_1 and β_2.

Unfortunately, if we were simply to estimate equation (6) using ordinary least squares, the coefficient estimates $\hat{\beta}_1$ and $\hat{\beta}_2$ would almost certainly be biased, because we cannot measure γ_{ij} and it is likely correlated with A_{ijt-1} and S_{ijt-1}. If a set of instruments were available that clearly only affected migration through land holdings and land rights, we could potentially estimate equation (6) with an instrumental variables estimator. However, in the absence of strong instruments, we can take advantage of the panel nature of the data set to eliminate some potential sources of bias, and we can analyze how further sources of bias might affect the coefficient estimates.

To take advantage of the panel nature of the ERHS, we can first difference equation (6), which removes the fixed unobservables at the household level. The resulting equation can be written as:

$$\Delta M_{ijt} = \beta_0 + \beta_1 \Delta A_{it-1} + \beta_2 \Delta S_{it-1} + \beta_3 \Delta H_{it-1} + \beta_4 \Delta W_{it-1} + \sum_{j=1}^{J} V_j + \Delta \varepsilon_{it}. \quad (7)$$

where V_j represents differences in the growth of migration over time at the village level. By differencing equation (6), we control for any fixed factors at the household level that might affect migration behavior.

We measure A as the total household land holdings that were either allocated by the government or inherited, under the assumption that these landholdings cannot be affected by household behavior. We measure S as the share of allocated and inherited land over which the household reports that it has transfer rights. Wealth is proxied by the value of household livestock assets, and we measure the labor endowment using the number of females and males aged 16 to 40 years old who are household members.

Finally, in some specifications we also add the age of the household head in the initial survey and its square. We do so because life cycle effects may be

particularly important in determining migration. In every regression, standard errors are clustered at the neighborhood level to account for arbitrary within neighborhood correlation between outcomes.

5.1 Identification

The coefficients of interest in equation (7) are β_1 and β_2. Our theoretical model predicts that an increase in land would deter households from sending migrants, $\beta_1 < 0$. The second coefficient β_2 measures the extent land security affects migration, and the theoretical model is indeterminate about its sign.

A major concern with measuring either the amount of land held by the household or the tenure security is that unobservables at the household level might affect both the explanatory variable and migration, rendering the estimated coefficients on both variables biased. Taking tenure security as an example, the best way to measure the effects of tenure security on migration would be to randomly allocate levels of tenure security across households, which would allow us to learn whether better or worse tenure security affected migration. Such a random experiment, however, is totally infeasible in this or arguably any context. An alternative would be to find an instrument that only affects migration through its effects on either cultivated land area or land tenure security. However, there are at least two potential drawbacks to using instrumental variables in this context. First, the instrument has to be a good one; bad instruments can actually bias coefficient estimates more than simply using ordinary least squares and acknowledging the bias (McKenzie, Gibson, and Stillman, 2006). Second, instrumental variables estimators are higher variance than linear regression estimators (Wooldridge, 2002). This problem is particularly acute with weak instruments (Stock and Yogo, 2005). Therefore, using bad or weak instruments can actually cause worse problems than using an OLS approach to

estimation.

Because we could not find strong instruments for either land allocation or land tenure security, we go forward using OLS, and attempt to control for as many sources of potential bias as possible. We do so as follows. Household fixed effects are used through differencing to control for any factors that might affect both migration behavior and land transferability rights but do not change over time. We lag all of the explanatory variables, so that we can be sure that they are influencing migration, and not the other way around. We further include village fixed effects in all regressions, which act as controls to pick up changes in time trends across villages. We therefore must only be concerned about shocks that occur between survey rounds that might affect the way households make decisions about migration and/or land. We further measure land area as the total amount of land that was either allocated to the household or inherited by the household, leaving out land that was transferred in or out by the household. We therefore are able to remove any decisions made by the household that might affect their land allocation that might be influenced by the same unobservables as migration might be. Finally, we test whether or not the most interesting results are robust to the inclusion of interactions between a variable measuring the largest shock in the past ten years, the drought in 2002, and household characteristics.

6 Results

We first present the basic results from the estimation of equation (7) (Table 3). We use both the number of migrants who are household members and the share of household members who are migrants as dependent variables. We find that regardless of the specification or sample, the estimated coefficient on the land variable is never significant, even at the 10 percent level. Although the

theoretical model would suggest that additional land holdings should have a negative effect on migration, the point estimates on the land variable are not significant and are often positive. There are two potential explanations for this finding. First, as it is defined the land area variable does not adjust much over time, and since there are few adjustments it might not be surprising not to find a significant coefficient. Second, land also proxies for wealth, which is left out of the theoretical model, and if a major barrier to migration is the initial fixed cost of migrating, households with more land might have an advantage in sending out migrants, cancelling out the predicted negative effect.[5]

We find a reasonably robust relationship between migration and the variable measuring tenure security, the share of household land reported to be transferable, and the relationship is typically positive (row 2). Although the coefficient estimate is consistently positive, it is only significant at the 10 percent level when we use the share of household migrating variable to measure migration. The consistently positive coefficients suggest that as households feel that they have better transferability rights over their land, they may feel more free to send out migrants. However, we must be cautious in our interpretation as the estimates are not consistently statistically significant.[6]

We next remove Debre Berhan from our sample, since as argued above Debre Berhan is a bit different from the remainder of the sample in terms of land holdings, market development, and the encroachment of the town on the village sites in the sample. When Debre Berhan is removed, the coefficients on the share of land that is transferable do not change markedly, but they do become significant at the 10 percent level for the number of migrants dependent variable

[5] The lack of significance of the land coefficient is also not caused by collinearity between the lagged change in the amount of land and the lagged change in the share of land that is considered transferable variables. The partial correlation coefficient of the two variables is 0.08.

[6] We also estimated models that include variables that interact land availability and security, and land security with household characteristic variables. However, the coefficients were both insignificant and did not improve the explanatory power of our chosen model.

and the 5 percent level for the share of migrants dependent variable (rows 5-8). These results suggest that for the remaining villages in our sample, improved transferability rights do seem to be positively related to additional migration. As households feel that their rights are more secure, they can send out migrants without worrying about sending the signal to local government officials that they do not need all of the land allocated to them.

As mentioned in the previous section, we cannot simply conclude that improved land transferability rights have a positive effect on migration, because confounding effects may still affect the estimated migration coefficient. One potentially confounding factor would be shocks that affected the household that were not observed at the household level, and affected both migration and land tenure security. If shocks occurred that both strengthen land tenure security and drove out migrants, we might estimate a positive relationship between migration and land tenure security even if one did not exist.[7]. We might expect that the households facing worse shocks might send additional migrants to seek employment if, for example, the marginal productivity of labor declines on the farm in response to the shock or the shock causes a labor surplus. In contrast, areas prone to shocks may have social protection programs in place, which could have a countervailing effect. For example, the direct support component of Ethiopia's PSNP program targets food insecure areas (Gilligan, Hoddinott, and Taffesse, 2008; Negatu, 2008), which may reduce the pressure to send household members to migrate for employment. Of particular relevance to our sample is the major drought experienced in 2002, in which approximately 12.6 million people were affected (U.S Agency for International Development, 2003).

In order to evaluate whether omitting shock variables do not affect our main estimates, we consider the largest shock that occurred over the period between

[7] Furthermore, there is evidence in the literature that migration is used as an *ex post* insurance strategy by households (e.g., Yang and Choi, 2007; Halliday, 2006)

the surveys, which was the 2002 drought. We can measure the impact of the drought at the village level through the deviation of 2002 rainfall from the historical mean.[8] To create variables that vary at the household level, we then interact the rainfall shock with the two demographic variables and the livestock variable. The results in Tables 4 and 5 show that the estimated coefficient on the transferable land variable are robust to the inclusion of the shock interactions. Since the worst common shock that occurred over the study period did not confound the relationship, it is unlikely that other shocks confound the estimated relationship.

It is further possible that migrant households have a greater tolerance for risk than other households. For example, households who are risk averse not only shy away from sending household members elsewhere, but might also feel less confident in the security of their land. Since we do not observe risk tolerance, one might be concerned that our empirical model yields a positively biased estimate on the land transferability coefficient. However, recall that it must be changes in household risk aversion that would affect our coefficient estimate, because we difference out household fixed effects. Second, recall that we also proxy for household wealth using the value of livestock. To the extent that changes in risk aversion might be correlated with changes in wealth levels, we control for them.

Our final concern is the overall ability to identify the causal effect of land security on migration due to the potential for changes in unidentifiable preferences or events that may influence the changes in perceptions of land transferability. If mismeasurement of household perceptions of land transferability is correlated with unobserved characteristics, our coefficient of interest will be biased. As in the case of risk aversion, controlling for household fixed

[8] Rainfall data were taken from the LEAP project http://www.hoefsloot.com/index.php?title=LEAP_Development.

effects using the first-differencing, should essentially condition upon household heterogeneity in perceptions. However, it is still possible that our estimates are subject to bias. Consider the example where the true parameter estimate is positive, and those who have perceptions of greater transferability rights also generally have access to ways of securing land. For example, these households can signal that they are more productive to the village official through political influence. Further, consider that these same influential types also tend to have fewer migrants because the marginal benefit of their family staying on the land is greater than sending them abroad. Under these circumstances, it is possible that our estimate on the land security coefficient is underestimating the true effect.[9]

7 Conclusion

Land in Ethiopia is nationally owned, where local governments reallocate the land periodically. It is common for households to maintain the use right of their land allotment by continuing to farm, providing adequate care to the land, and remaining a resident in the kebele (Rahmato, 2008). Recent policies have promoted household land security by permitting land transfers to family members, and in fewer cases to anyone. Earlier work in Ethiopia demonstrates that such improvements in land security through increases in the households' rights to transfer land has a positive impact on productivity-enhancing investment (Deininger and Jin, 2006; Dercon and Ayalew, 2007). Similar impacts on the household allocation of labor off of the farm are anticipated, as individuals can secure the land by transferring it to other family members and explore alterna-

[9] Facing a similar econometric issue, Dercon and Ayalew (2007) use the household's historical level of power within a village to instrument land security. Although the instrument was strong for the case of the SNNP in Ethiopia, such variables proved to be relatively weak instruments in our own analysis of all four regions. We instead have relegated to including household (through differencing) and village fixed effects to reduce the impact of idiosyncratic and spatial heterogeneity on our coefficient estimates.

tive employment opportunities outside of the region.

We offer the first study to examine how improving land transfer rights might affect household labor decisions. Specifically, we evaluate the impact of land transfer rights on migration. Predictions from our theoretical model where current and future household income relies on the allocation of labor off and on the farm, the latter being also important for securing future land and farm revenue, indicate that the impact of land transfer rights will depend on the extent increasing both land and transfer rights will affect the probability of securing land in the future. Our empirical estimates suggest improvements in land transfer rights will increase migration behavior. This is consistent with the notion that households are no longer able to increase the probability of securing land in the future by increasing the labor allocated to the farm as tenure security increases.

The relationship between migration and land transfer rights has implications for the future development of Ethiopia. The implementation of land certification programs and other government efforts to improve land security potentially has secondary benefits. We show securing land rights can encourage mobility in Ethiopia. In many developing country contexts, migration can reduce vulnerability to income risk, provide access to additional sources of income, and improve overall household well-being. It is also easier to serve more densely populated areas with health clinics and schools, if the government collects and analyzes data on changes in population. Finally, it is possible that providing households with more land security can lead to poverty reduction by increasing incentives to migrate. In the future, we plan to use further migration studies to measure the welfare impacts of migration, which will help provide further indirect measures of the benefits of securing land rights.

References

Azam, J.-P., and F. Gubert (2006): "Migrants' Remittances and the Household in Africa: A Review of the Evidence," *Journal of African Economies*, 15(2), 426–462.

Benin, S., and J. Pender (2009): *Land Rental and Land Management in the Highlands of Ethiopia*. Resources for the Future, Washington, DC, USA.

Besley, T. (1995): "Property Rights and Investment Incentives: Theory and Evidence from Ghana," *Journal of Political Economy*, 103(5), 903–937.

Binswanger, H., and M. R. Rosenzweig (1986): "Behavioral and Material Determinants of Production Relations in Agriculture," *Journal of Development Studies*, 22(3), 503–539.

Brandt, L., S. Rozelle, and M. Turner (2004): "Local Government Behavior and Property Right Formation in Rural China," *Journal of Institutional and Theoretical Economics*, 160(4), 627–.

Carrington, W., E. Detragiache, and T. Vishnawath (1996): "Migration with Endogenous Moving Costs," *American Economic Review*, 86(4), 909–930.

de Brauw, A., and T. Harigaya (2007): "Seasonal Migration and Living Standards in Vietnam," *American Journal of Agricultural Economics*, 89(2), 430–447.

Dea, D., B. Desta, and A. Tafese (1996): "Ethiopian Village Studies: Aze Debo'a," Department of Sociology, Addis Ababa University, Ethiopia and the Centre for the Study of African Economies, Oxford, UK.

Deininger, K., D. Ayalew Ali, S. Holden, and J. Zevenbergen (2008): "Rural Land Certification in Ethiopia: Process, Initial Impact, and Implications for Other African Countries," *World Development*, 36(10), 1786–1812.

Deininger, K., and S. Jin (2006): "Tenure Security and Land-Related Investment: Evidence from Ethiopia," *European Economic Review*, 50, 1245–1277.

Dercon, S. (2004): "Growth and Shocks: Evidence from Rural Ethiopia," *Journal of Development Economics*, 74(2), 304–329.

Dercon, S., and D. Ayalew (2007): "Land Rights, Power and Trees in Rural Ethiopia," Discussion Paper WPS/2007-07., CSAE.

Dercon, S., and P. Krishnan (2000): "In Sickness and in Health: Risk Sharing Within Households in Rural Ethiopia," *Journal of Political Economy*, 108(4), 688–727.

Gashaw, M., Z. Bekele, and M. Tibebe (1996): "Ethiopian Village Studies: Adele Keke," .

Giles, J., and R. Mu (2007): "Elder Parent Health and the Migration Decision of Adult Children: Evidence from Rural China," *Demography*, 44(2), 265–288.

Gilligan, D., J. Hoddinott, and A. Taffesse (2008): "The Impact of Ethiopia's Productive Safety Net Programme and its Linkages," Discussion paper, International Food Policy Research Institute.

Halliday, T. (2006): "Migration, Risk, and Liquidity Constraints in El Salvador," *Economic Development and Cultural Change*, 54(4), 893–925.

Harris, J., and M. Todaro (1970): "Migration, Unemployment, and Development: A Two-Sector Analysis," *American Economic Review*, 60, 126–142.

Holden, S. T., K. Deininger, and H. Ghebru (2009): "Impacts of Low-Cost Land Certification on Investment and Productivity," *American Journal of Agricultural Economics*, 91(2), 359–373.

Jacoby, H. G., G. Li, and S. Rozelle (2002): "Hazards of Expropriation: Tenure Insecurity and Investment in Rural China," *American Economic Review*, 92(5), 1420–1447.

Lohmar, B. (1999): "Land Tenure Insecurity and Labour Allocation in Rural China," .

McKenzie, D., J. Gibson, and S. Stillman (2006): "How Important is Selection? Experimental versus Non-Experimental Measures of the Income Gains from Migration," Discussion Paper 3906, World Bank.

Molla, B., and D. Feleke (1996): "Ethiopian Village Studies: Imdibir Haya Gasha," Department of Sociology, Addis Ababa University, Ethiopia and the Centre for the Study of African Economies, Oxford, UK.

Mullen, K., P. Grosjean, and A. Kontoleon (2008): "Land Tenure Arrangements and Rural-Urban Migration in China," .

National Population Policy (1993): "National Population Policy of Ethiopia," .

Negatu, W. (2008): *Food Security Strategy and Productive Safety Net Program in Ethiopia*pp. 1–22. Forum for Social Studies.

Rahmato, D. (2008): *Ethiopia: Agriculture Policy Review*. Forum for Social Studies.

Rosenzweig, M., and O. Stark (1989): "Consumption Smoothing, Migration, and Marriage: Evidence from Rural India," *Journal of Political Economy*, 97(4), 905–926.

Stark, O. (1991): *The Migration of Labor*. Basil Blackwell, Boston.

Stock, J. H., and M. Yogo (2005): *Testing for Weak Instruments in Linear IV Regression*. Cambridge University Press, Cambridge.

U.S Agency for International Development (2003): "Office of U.S. Foreign Disaster Fact Sheet 5, Ethiopia-Drought," Discussion paper.

Wooldridge, J. M. (2002): *Econometric Analysis of Cross Section and Panel Data*. Massachusetts Institute of Technology.

World Bank (2008): *World Development Indicators*.

Yang, D., and H. Choi (2007): "Are Remittances Insurance? Evidence from Rainfall Shocks in the Philippines," *World Bank Economic Review*, 21(2), 219–248.

Yang, D. T. (1997): "China's Land Arrangements and Rural Labour Mobility," *China Economic Review*, 8(2), 101–115.

8 APPENDIX

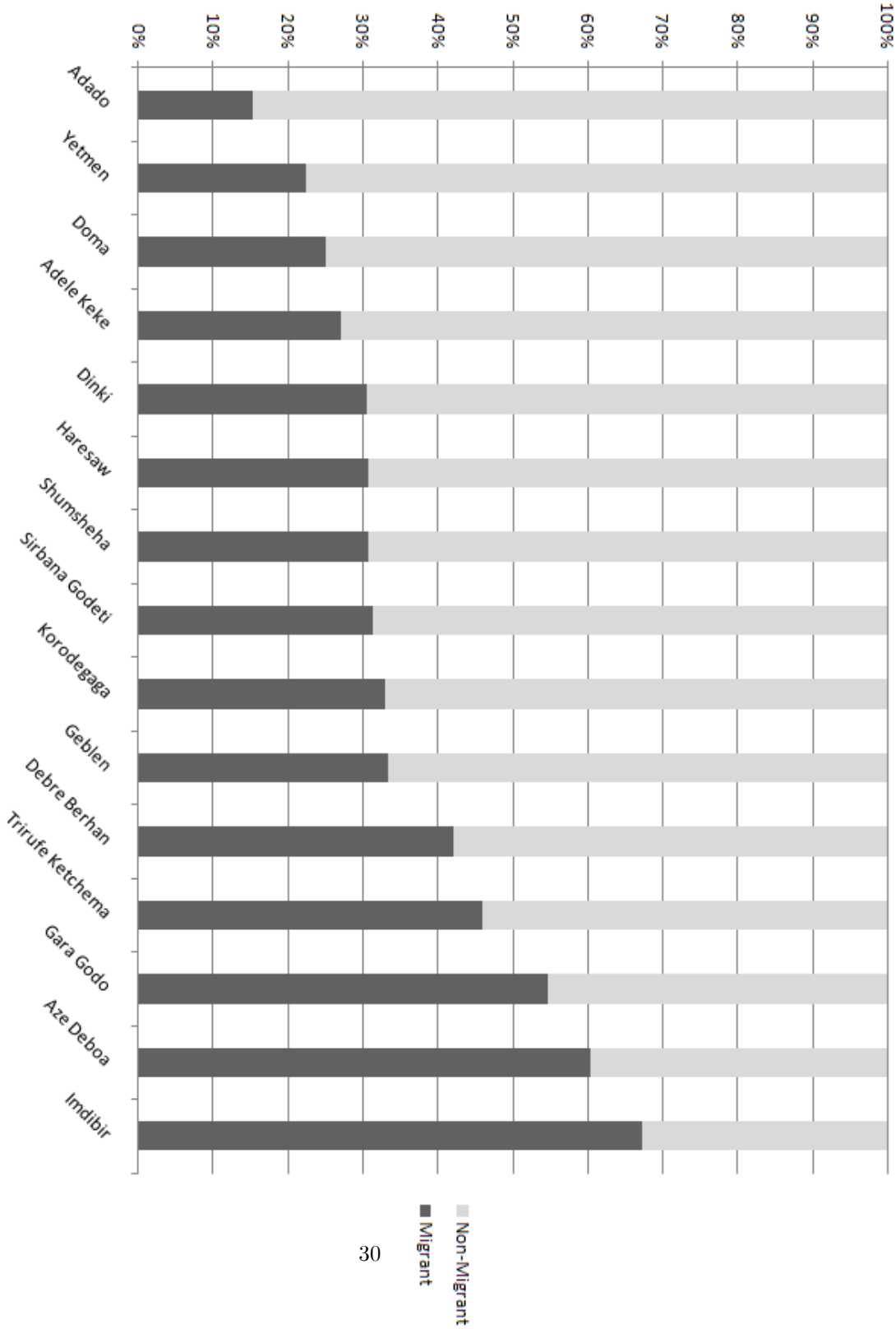

Figure 1: Migration by Village

Table 1: Characteristics of Households by Year and Migration Status

	Non-migrant households		**Migrant households**	
	Mean	Mean	Mean	Mean
	(Std. Dev.)	(Std. Dev.)	(Std. Dev.)	(Std. Dev.)
	2004	1999	2004	1999
Land variables				
Allocated and inherited land	1.45	0.98	1.44	0.97
	(1.55)	(1.06)	(1.85)	(1.02)
Share of transferable allocated	0.90	0.86	0.87	0.85
and inherited land	(0.22)	(0.27)	(0.24)	(0.28)
Household characteristics				
Real livestock value (100s 1994 Birr)	22.72	16.96	27.61	18.86
	(26.28)	(18.89)	(32.47)	(18.62)
Number of males ages 16-40	0.86	0.91	1.13	1.15
	(0.83)	(0.84)	(0.98)	(1.07)
Number of females ages 16-40	0.97	0.98	1.09	1.17
	(0.75)	(0.79)	(0.92)	(1.01)
Number of households	686		412	

Table 2: Perception of Land Security (2009) by Change in Migrant Flows

	No change			Positive change		
	Mean	SD	N	Mean	SD	N
What happens to the land if household migrates to the woreda capital for 3 years but no job?						
Village takes the land under any conditions	0.14	0.35	734	0.10	0.30	217
Village takes the land only if has not transferred it to others	0.11	0.31	734	0.09	0.29	217
Can person bequeath land through inheritance to individuals who are not his children?	0.56	0.50	736	0.55	0.50	220
Don't know if rental contracts for any period have to be registered?	0.18	0.38	832	0.19	0.39	248
Rental contracts for a period longer than x years have to be registered?	3.55	3.02	603	3.81	3.47	176
It is not possible to increase rent if two years ago a hh rented out land under 10 year contract.	0.74	0.44	720	0.73	0.45	201
It is legal for a household to mortgage the use right for its land?	0.64	0.48	722	0.67	0.47	211
Use right of land is affected if head of household left kebele where land located for 10 years?	0.24	0.43	720	0.23	0.42	220

Table 3: OLS Estimation of Migration and Land Relationship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Change in migrants	Change in migrant share	Change in migrants	Change in migrant share	Change in migrants	Change in migrant share	Change in migrants	Change in migrant share
	All	All	No DB	No DB	All	All	No DB	No DB
Lagged change in allocated and	0.00848	-0.000294	0.00129	-0.00133	0.00999	-8.53e-05	0.00198	-0.00113
inherited land	0.0125	0.00197	0.0118	0.00218	(0.0127)	(0.00202)	(0.0122)	(0.00228)
Lagged change in share of transferable	0.0422	0.0154**	0.0550*	0.0178***	0.0358	0.0140**	0.0499*	0.0163**
allocated and inherited land	0.0294	0.00615	0.0297	0.00659	(0.0293)	(0.00634)	(0.0296)	(0.00674)
Lagged change in real livestock value	0.00303***	0.000111	0.00261*	6.70e-05	0.00299**	0.000108	0.00273*	6.29e-05
	0.00113	0.000165	0.00147	0.000231	(0.00118)	(0.000166)	(0.00158)	(0.000236)
Lagged change in number of males	0.0637***	0.00768**	0.0493**	0.00588	0.0673***	0.00875**	0.0525**	0.00705*
(ages 16-40)	0.0211	0.00364	0.0196	0.00385	(0.0219)	(0.00373)	(0.0210)	(0.00402)
Lagged change in number of females	0.0411**	0.00560	0.0372*	0.00259	0.0449**	0.00570	0.0402*	0.00251
(ages 16-40)	0.0188	0.00402	0.0208	0.00454	(0.0191)	(0.00396)	(0.0214)	(0.00447)
Head of household's age (1994)					0.0233***	0.00297**	0.0186***	0.00230
					(0.00580)	(0.00141)	(0.00601)	(0.00158)
Head of household's age squared (1994)					-0.000231***	-2.42e-05	-0.000188***	-1.76e-05
					(5.86e-05)	(1.52e-05)	(6.22e-05)	(1.74e-05)
Observations	1138	1138	981	981	1098	1098	941	941
Pseudo R-squared	0.030	0.010	0.021	0.009	0.042	0.017	0.029	0.014

Neighborhood-clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Village dummy variables included.

Table 4: Migration and Land Relationship Controlling for 2002 Drought Interacted with Livestock Value

	(1)	(2)	(3)	(4)
	Change in migrants	Change in migrant share	Change in migrants	Change in migrant share
	All	All	No DB	No DB
Lagged change in allocated and inherited land	0.0100	-8.40e-05	0.00176	-0.00112
	(0.0128)	(0.00203)	(0.0122)	(0.00228)
Lagged change in share of transferable allocated and inherited land	0.0366	0.0140**	0.0497*	0.0163**
	(0.0293)	(0.00636)	(0.0295)	(0.00673)
Lagged change in real livestock value	0.000680	2.42e-05	-0.000313	0.000306
	(0.00282)	(0.000401)	(0.00355)	(0.000530)
Lagged change in number of males (ages 16-40)	0.0677***	0.00877**	0.0535**	0.00697*
	(0.0220)	(0.00373)	(0.0213)	(0.00401)
Lagged change in number of females (ages 16-40)	0.0453**	0.00571	0.0395*	0.00257
	(0.0191)	(0.00396)	(0.0214)	(0.00447)
Head of household's age (1994)	0.0230***	0.00295**	0.0184***	0.00232
	(0.00570)	(0.00142)	(0.00600)	(0.00158)
Head of household's age squared (1994)	-0.000227***	-2.40e-05	-0.000186***	-1.77e-05
	(5.77e-05)	(1.53e-05)	(6.24e-05)	(1.74e-05)
Deviation of 2002 rainfall from the historical mean*lagged change in share of transferable allocated and inherited land	1.52e-05	5.50e-07	2.73e-05	-2.18e-06
	(1.67e-05)	(2.32e-06)	(3.18e-05)	(5.03e-06)
Chi-squared test: transferable land and rainfall=0	7.49**	0.5	3.38	0.37
Observations	1098	1098	941	941
R-squared	0.043	0.017	0.030	0.014
Neighborhood-clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.				
Village dummy variables included.				

Table 5: Migration and Land Relationship Controlling for 2002 Drought Interacted with Human Capital

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Change in migrants	Change in migrant share	Change in migrants	Change in migrant share	Change in migrants	Change in migrant share	Change in migrants	Change in migrant share
	All	All	No DB	No DB	All	All	No DB	No DB
Lagged change in allocated and inherited land	0.00749	-0.000340	0.00135	-0.00117	0.00939	-0.000166	0.00178	-0.00106
	(0.0128)	(0.00211)	(0.0122)	(0.00230)	(0.0126)	(0.00199)	(0.0122)	(0.00225)
Lagged change in share of transferable allocated and inherited land	0.0347	0.0139**	0.0501*	0.0163**	0.0346	0.0138**	0.0495*	0.0164**
	(0.0291)	(0.00634)	(0.0295)	(0.00673)	(0.0294)	(0.00643)	(0.0297)	(0.00676)
Lagged change in real livestock value	0.00287**	9.49e-05	0.00274*	6.34e-05	0.00300**	0.000108	0.00269*	7.47e-05
	(0.00116)	(0.000165)	(0.00157)	(0.000236)	(0.00118)	(0.000165)	(0.00157)	(0.000241)
Lagged change in number of males (ages 16-40)	-0.0192	-4.84e-05	-0.0149	0.00292	0.0659***	0.00857**	0.0523**	0.00713*
	(0.0512)	(0.00809)	(0.0558)	(0.0111)	(0.0221)	(0.00378)	(0.0209)	(0.00404)
Lagged change in number of females (ages 16-40)	0.0420**	0.00540	0.0396*	0.00248	0.00510	0.000388	0.0118	0.0127
	(0.0191)	(0.00402)	(0.0212)	(0.00449)	(0.0404)	(0.00817)	(0.0461)	(0.0103)
Head of household's age (1994)	0.0232***	0.00296**	0.0186***	0.00230	0.0238***	0.00303**	0.0188***	0.00221
	(0.00570)	(0.00140)	(0.00597)	(0.00158)	(0.00586)	(0.00143)	(0.00606)	(0.00158)
Head of household's age squared (1994)	-0.000230***	-2.41e-05	-0.000187***	-1.75e-05	-0.000235***	-2.47e-05	-0.000190***	-1.68e-05
	(5.78e-05)	(1.52e-05)	(6.19e-05)	(1.74e-05)	(5.94e-05)	(1.54e-05)	(6.26e-05)	(1.74e-05)
Deviation of 2002 rainfall from the historical mean* lagged change in number of males	0.000737	7.50e-05	0.000687	4.21e-05				
	(0.000448)	(6.72e-05)	(0.000482)	(0.000115)				
Deviation of 2002 rainfall from the historical mean* lagged change in number of females					0.000347	4.62e-05	0.000300	-0.000108
					(0.000267)	(6.64e-05)	(0.000379)	(0.000110)
Chi-squared test: males(females) and rainfall=0	10.98***	6.18**	12.04***	3.17	9.52***	2.35	5.25*	1.65
Observations	1098	1098	941	941	1098	1098	941	941
R-squared	0.047	0.018	0.031	0.014	0.043	0.017	0.030	0.015

Neighborhood-clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Village dummy variables included.