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What Drives Land Sales and Rentals in Rural Africa: Evidence from Western Burkina Faso

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Abstract

This paper examines the conditions of emergence of agricultural land markets in the cotton zone of Burkina Faso. I use census data obtained from 454 villages in the Hauts-Bassins region, to estimate the determinants of activity in land sales and rental markets, focusing on the effect of internal in-migration. After controlling for the endogeneity of in-migration using instrumental variables, the results show a significant and positive impact of in-migration on the probability of rentals of agricultural land at the village level. The results also show that the eradication of river blindness in the study area, and rainfall shocks in migrant origin provinces are important determinants of in-migration in this part of Burkina Faso. Furthermore, I find a positive impact of urban proximity on both land sales and rental market activity. These findings suggest that heterogeneity in land endowment and access to (input and output) markets play a crucial role in the emergence of land markets in Western Burkina Faso.

Key words: Agricultural Land Markets; Internal Migration; Urban Proximity; Rainfall Shocks; River Blindness; Burkina Faso.

Résumé:

Cet article examine les conditions d'émergence des marchés fonciers ruraux dans la région des Hauts-Bassins dans la zone cotonnière du Burkina Faso. J'utilise des données de recensement sur 454 villages de la région combinées avec des données géo-référencées pour estimer l'impact de la migration sur les ventes et locations de terres agricoles. La première contribution de ce papier est de corriger du biais d'endogénéité de la migration en utilisant des variables instrumentales, à savoir les chocs de précipitations dans les régions d'origine des migrants, et la participation au programme de lutte contre l'onchocercose (PLO) lancé en 1974 par l'Organisation mondiale de la Santé. En recourant à cette approche par variables instrumentales, je trouve que l'augmentation de la part des migrants dans les villages a un impact positif sur la probabilité d'avoir un marché foncier actif à la location et à la vente. Ces résultats suggèrent que la rareté de la terre n'est pas le principal déterminant des ventes et locations de terres agricoles; les différences de dotations en terres jouent un rôle important dans l'émergence et le développement des marchés fonciers.

Mots-clés : Marchés fonciers agricoles; Migration interne; Proximité urbaine; Chocs de pluie ; Cécité des rivières ; Burkina Faso.

JEL Code : Q15; O15.

1 Introduction

As agricultural land is growing scarcer in Sub-Saharan Africa (SSA), researchers, governments as well as donors are increasingly focusing their attention on the issue of land markets (World Bank, 2007; Byamugisha, 2013). Land markets for agricultural land (hereafter 'land markets') are expected to ensure a better allocation of land, as land is transferred to more efficient producers, therefore impacting agricultural investment and productivity. However, in much of SSA land markets remain very localized and underdeveloped (Chauveau et al., 2006; Colin and Ayouz, 2006; Holden and Otsuka, 2014). In recent years, countries such as Benin and Burkina Faso have undertaken land tenure reforms in order to promote land security and the development of land markets. These reforms are intended to provide practical responses to the growing land scarcity and land conflicts, through efficient and equitable allocation of land[1].

The Evolutionary Theory of Land Rights (ETLR) (see Platteau, 1996) is the commonly used framework to analyze the emergence conditions of agricultural land markets and their effects in developing countries. This theory summarizes contributions by Boserup (1965), Ruthenberg (1971), Demsetz (1967), Alchian and Demsetz (1973), Ruttan and Hayami (1984) and others on the study of institutional and technical change (property rights and farming systems' evolution). According to the ETLR, customary land rights systems spontaneously evolve from systems of communal rights to land, towards individualized rights in response to increases in the commercialization of agriculture and population pressure. As this evolution leads to greater competition for land and increased conflicts, the state is expected to intervene in order to reduce the insecurity of landholders. Thus the state implements a formal land tenure system guaranteeing private property rights. This intervention is supposed to reduce tenure insecurity and to provide several economic benefits, such as the development of land and credit markets and an increase in land investment.

Empirical studies designed to explore the ETLR in the African context have obtained mixed results (e.g. Feder and Noronha, 1987; Barrows and Roth, 1990; Migot-Adholla et al., 1991; Bruce and Migot-Adholla, 1994; Tiffen et al., 1994; Place, 1995; Platteau, 1996; André and Platteau, 1998; Lund, 2001; Quisumbing and Otsuka, 2001; Lavigne Delville et al., 2002; Benjaminsen and

[1]Restrictions on land markets remained in force in several African countries in order to prevent land concentration for instance. Findings of studies on land rental markets in Ethiopia and Uganda, where land rentals are respectively restricted and controlled, suggest that the removal of the restrictions could enhance the efficient use of land (Deininger and Mpuga, 2003; Deininger et al., 2003).

Sjaastad, 2002; Chauveau et al., 2006; Chimhowu and Woodhouse, 2006; Colin and Ayouz, 2006 etc.). The central role of population pressure and land titling in the process of institutional change (especially the emergence of land markets) described above, has been questioned in the light of these empirical findings.

Studying land transactions in four African countries (Burundi, Malawi, Uganda and Zambia), Place (1995) finds a strong relationship between population pressure and land purchases[2]. The results of a study by Tiffen et al. (1994) in the Machakos district in Kenya also suggest that increasing population pressures (by a mechanism similar to that described by Boserup (1965)) have encouraged farmers to adopt new farming techniques including soil conservation techniques. Customary land rights systems have adapted to this change, resulting in an increasing individualization of land rights and increased transfers of land. The explanation for the changes in the Machakos' district has been, however, challenged by studies which attribute these changes to the proximity of the capital Nairobi (e.g. Nyangena and Sterner, 2008).

The development of land market transactions in connection with cash crops has been addressed in several studies, particularly in West African countries such as Benin, Burkina Faso, Ghana, or Cote d'Ivoire (see Chauveau et al., 2006; Berry, 1975; Edja, 2001; Colin and Ayouz, 2006; Colin and Woodhouse, 2010). Descriptive studies on land markets in these countries, mostly in the fields of anthropology and sociology, have also emphasized the role of migration (in- and out-migration). For instance, several studies describe the process of changes in land acquisition modes in West and Southern Africa, and how in-migration has led to an increase in population pressures on land and land commercialization (Lavigne Delville et al., 2002; Chauveau et al., 2006; Chimhowu and Woodhouse, 2006; Colin and Ayouz, 2006; Chauveau and Colin, 2010). Evidence also suggests that the expansion of urban centers and/or infrastructures development in rural areas may increase the competition for agricultural land especially in peri-urban zones (Cotula, 2007), allowing land to be transferred to more efficient farmers. On the contrary, Benjaminsen and Sjaastad (2002) describe the influence of 'urban elites' on land market transactions in the Malian cotton zone, around the urban centers of Koutialia and Sikasso that has led to an increase in inequality in this zone. According to the authors, there is a real "race" for agricultural land and for the capture of the rents derived from land transactions within 10 to 20 kilometers around Koutialia and Sikasso. Thus,

[2]The study does not find any impact of population pressure on land rental transactions.

the situation in these peri-urban areas is quite different from the situation in other areas of the Malian cotton zone, where the development of land markets is influenced primarily by population growth and agriculture commercialization, as stated by the ETLR [3]. Moreover, recent research on the determinants of participation in land markets particularly emphasizes the effects of differences in land and other production factors as well as imperfections in credit or labor markets to explain farmers' participation in land markets (see Holden and Otsuka, 2014).

All these findings have important policy implications as they provide key information on the functioning of land markets and their effects in terms of equity and efficiency. They are particularly relevant for African countries given the threats to social peace and agricultural productivity posed by unequal and/or inefficient allocation of land (Deininger et al., 2003; André and Platteau, 1998). Although there is increasing evidence on the functioning of land markets[4], empirical studies in the African context are still rare, compared to Asia or Latin America. Moreover, the existing quantitative evidence on land markets in Africa comes from a few countries where land markets are already developed (see Holden et al., 2008).

Using village level data from the cotton zone in Western Burkina Faso, this paper contributes to the empirical literature studying the determinants of agricultural land market activity in rural Africa. Although the data used in this study do not enable the analysis of individual decisions to participate in land markets, the paper exploits the spatial heterogeneity of land market activity in the study area and key (historical and current) features of this zone to examine the determinants of land market activity. This paper aims to provide a better understanding of the development of land sales and rental markets in the study area by focusing on the effect of in-migration which is an important feature of this part of Burkina Faso. Previous studies have emphasized the fact that migration leads principally to an increase in population pressure. Instead, this study builds on the framework developed by Zimmerman and Carter (1996, 1999) and explores the channel of heterogeneity in land endowment through which in-migration can affect land market activity[5].

[3] See Adams et al. (1999); Kasanga et al. (1996); Kasanga and Kotey (2001) for other examples on the role of urban elites in the development of agricultural land markets in the peri-urban areas of cities in Western and Southern Africa.

[4] Early work on land transactions in the African context described the incidence of land sales in some localities in the pre-colonial period (e.g. Feder and Noronha, 1987; Shipton, 1989; Berry, 1993).

[5] To my knowledge, only a few quantitative studies in the African context have emphasized a direct effect of migration, i.e. independently of the effect of population growth, on land markets transactions and the formalization of property rights (e.g. Baland et al., 2000; Deininger and Mpuga, 2003; Grimm and Klasen, 2009).

This analysis is particularly relevant for Burkina Faso as migrants are considered as a marginalized group (like women and young people for instance) that lacks access to land in destination areas (CNSFMR, 2007).

The principal challenge with the identification of the impact of migration is the potential endogeneity of migration to land market activity. To account for a potential endogeneity bias, I rely on a control function approach, using rainfall shocks in migrant origin areas and exposure to the Onchocerciasis Control Program (OCP) launched in 1974 by the World Health Organization (WHO) as instruments for in-migration in the study villages. After controlling for the endogeneity of migration, I find a significant and positive impact of in-migration on land market activity in villages. This result has further important implications for the equity effect of land markets, as the results suggest that land markets enable the transfer of land to land-poor agents in the study area.

The organization of this paper is as follows. In the next section, I present the study area and the historical context of agricultural land markets emergence and development in this zone. Section III discusses the determinants of land market activity and the empirical evidence in the African context. Section IV describes the data and the methodology used in this paper. Section V presents the main results of the analysis, and section VI concludes.

2 Background

The study area, the Hauts-Bassins region, is located in two agro-climatic zones, the North-Sudanese zone (700 to 900 mm of rain per year) and the South-Sudanese zone (900 to 1200 mm of rain per year) making it one of the wettest regions of Burkina Faso. Agriculture is the main activity of the region (68.1% of the region's active population in 2006 is involved in this sector) which is also the second most urbanized region of Burkina Faso. However, the region remains moderately populated with a population density of 58p/sq.km compared to other regions of the country, e.g. the Central zone of the country where the mean population density is higher than 80 p/sq.km (around 602 p/sq.km in the Kadiogo province where the capital Ouagadougou is located). These conditions make the Hauts-Bassins region very attractive for farmers coming principally from other regions of the country. Two of the three administrative provinces of the region (provinces of Houet and Tuy) are situated in the so-called *old established farming area*, in reference to the period of time

during which in-migration has initially occurred. The third province (province of Kenedougou) is situated in the *pioneer area*, which is a newly opened up farming area, where in-migration is more recent (for more details, see Paré, 2001).

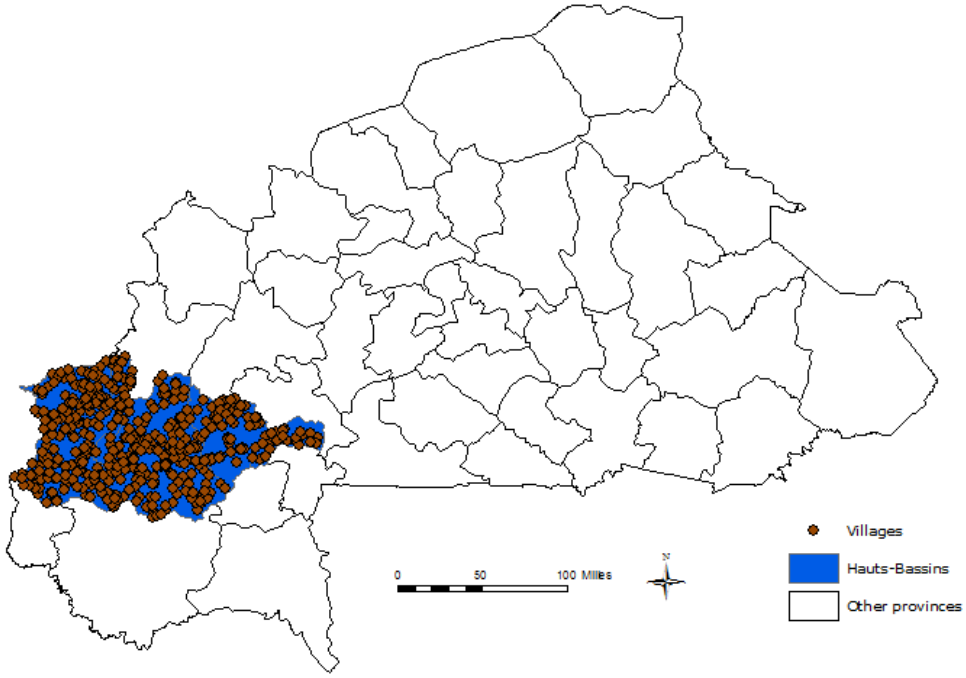

Figure 1: The Hauts-Bassins region in Western Burkina Faso

According to Burkina's Permanent Survey of Agriculture (EPA) of 2010-2011, the region is the first producer of cotton in Burkina Faso (about 39% of the country's entire cotton production in 2010), the country's leading export crop. It produces also an important part of the country's cereal production (almost 14% of the cereal production in 2010 according to the EPA 2010-2011). Presented as a "success story" (see World Bank, 1989), the cultivation of cotton in western Burkina Faso has spread rapidly since the beginning of the 1970s. This is principally due to government policies that promoted the adoption of cotton by farmers in this zone (through the supervision of the producers, granting of credits to producers, purchase price guarantee, etc.) (for more details, see World Bank, 1970; Lecaillon and Morrisson, 1985; Schwartz, 1991). Moreover, at the same period, government policies encouraged population movements from the densely populated central and northern areas to the western areas of the country. Population movements were particularly oriented towards the fertile river valleys, which had been deserted in the past because of the

presence of onchocerciasis (*river blindness*)[6]. The number of people infected with onchocerciasis in Burkina Faso was estimated to around 1 million (out of a population of 6.5 million) (World Health Organization, 1985). The control of the disease has been achieved under the Onchocerciasis Control Program in West Africa (OCP) launched by the World Health Organization (WHO) in 1974. Since the beginning of the OCP operations in Burkina in 1975, the control of the disease has led to important migration flows into the newly freed areas (see World Health Organization, 1985; Drabo et al., 2003).

In 1974 already, the government created the Volta Valley Development Agency (AVV by its French acronym), which was in charge of the coordination of settlements into the river valleys. For instance in AVV assisted settlements, migrants benefited from various infrastructures and services such as extension services (see Ahiadeke, 1989; Zoungrana, 1995; McMillan et al., 1993). However, as emphasized by McMillan et al. (1993), despite efforts of the government to control migration into the river valleys, migration was essentially unassisted. This was particularly the case in the Mouhoun and Comoe valleys, which covered the Western part of the country. First encouraged by the government, migration into the cotton zone (the *old established farming area*) increased rapidly after the drought periods of 1973/1974 and 1983/1984, which particularly affected the central and northern regions of the country. Since the 1990s, migration flows are essentially directed to the "pioneer area", which is relatively land abundant (see Drabo et al., 2003; Dabiré and Zongo, 2005). According to Burkina's population census of 2006, migrants accounted for around 22% of the Hauts-Bassins population[7]. Around 73% of these migrants were internal migrants.

2.1 Land markets in Western Burkina Faso

According to sociological and anthropological studies, the emergence of land markets for agricultural land in Burkina's cotton zone dates back to the 1970s with the promotion of cotton cultivation and migration from the other regions of Burkina Faso by the government (Drabo et al., 2003; Zongo and Mathieu, 2000; Paré, 2001; Tallet, 2003; Mathieu et al., 2003; Zongo, 2008). These findings are supported by fieldwork data I collected in five villages of the Hauts-Bassins region that sug-

[6]Onchocerciasis (*river blindness*) is a parasitic disease caused by worms, *Onchocerca volvulus*. It is transmitted by repeated bites of infected black flies that breed in rapidly flowing rivers and streams.

[7]Migrants are defined as people who do not live at their birth place that is another place within the country (internal migrants) or abroad (international migrants).

gest a positive influence of cotton cultivation on land market activity. Furthermore, focus group discussions and semi-structured interviews in the study area reveal that land transactions occur exclusively (i) between natives and migrants, (ii) between natives and urban dwellers, and (iii) among migrants. However, note that qualitative evidence suggests that land transactions in the study area bear a great potential for conflicts (see for example Zongo, 2009).

Since the first revision of the 1984 Agrarian Reform Act (RAF by its French acronym) in 1991, in a context of structural adjustment, the government of Burkina Faso has made further steps into the recognition of private property rights over land and customary land rights, as well as the formalization of land rights. Regarding rural land, the formalization of land rights principles have been particularly enshrined by the 2009 Rural land Law, which is currently in force. While the "original" 1984 RAF suppressed both private property rights and customary rights and introduced State property of land, the 2009 rural land law, result of a long process that began officially in 2002 with the creation of the National Committee for Rural Land Security (CNSFMR), definitively abandoned State property of land. Indeed the 2009 Rural Land Law is based on the 2007 Rural Land Policy (PNSFMR) which provides a framework for land management in a context of decentralization (see CNSFMR, 2007). The PNSFMR builds on a land tenure security diagnostic produced in 2005 that takes into account the results of (previous and ongoing) development projects and experiences aiming to promote land tenure security in Burkina's rural areas, e.g. the Ganzourgou Rural Land Plan. As a result of this process, the 2009 Rural Land Law particularly emphasizes the formalization of land rights and local management of land to meet its objectives that are: (i) the achievement of equitable access to land for all rural actors; (ii) the increase in agricultural investment and production and the reduction of rural poverty; (iii) productive investment; (iv) the promotion of sustainable resource management; (v) the consolidation of social peace. Access to land of so-called marginalized categories of farmers, i.e. women, youth, migrants and herders, is also an important part of the land policy in Burkina Faso. However, though land market transactions are recognized, even encouraged by the formal land law, they remain often prohibited (land sales in particular) by the customary land law, which is still the reference for land management in Burkina's rural areas. According to the 2009 rural land law, the approval of customary chiefs and/or family members or other people enjoying use and/or property rights over land is necessary for land transactions to be legal. As this is rarely the case (see Mathieu et al., 2003; Chauveau et al., 2006), most

land transactions in the study area may be considered as illegal (see Zongo and Mathieu, 2000; Ouédraogo, 2002).

3 Conceptual framework: factors driving the emergence of land markets

In this section, I develop the conceptual framework for understanding the factors driving the activity in land markets, i.e. why markets emerge and develop in some settings and not in others. This discussion is then used to motivate the estimation strategy followed in this paper.

3.1 Factors driving land market activity

Economists often explain that land scarcity is the main determinant of the development of land market transactions (following e.g. population growth and technological change, as hypothesized by the ETLR). Scarcity confers to land its market value and favors the development of market transactions. Although the way land markets emerge (and develop) may be studied by looking at the effect of *generalized land scarcity* as termed by Zimmerman and Carter (1999), an alternative but complementary approach consists to consider the emergence of land markets as a function of a *specific asset scarcity*. Zimmerman and Carter (1996, 1999) have shown that endowment heterogeneity among agents guarantees the existence of a supply and a demand for land, which gives to the market its economic meaning. Sources of heterogeneity among agents that can foster land transactions encompass differences in physical and human capital and risk management capacity. Moreover, these differences are intrinsically linked to the functioning of the other markets, e.g. the credit market and the labor market (see Deininger and Feder, 2009 for a discussion of the links between the land markets and other factor markets). Thus, land market activity, as driven by differences among agents, has further implications in terms of efficiency and equity.

In their highly cited work on land rights and land markets in the West African Sahel, Zimmerman and Carter (1996, 1999) rely on simulations using parameters from Burkina Faso to show that the demand for land markets is related to the imperfection of credit and insurance markets and the inability of informal social mechanisms to cover risks faced by households (decrease income or consumption due to shocks). As the authors point out, these findings have further implications in

terms of equity and efficiency as "low-wealth" agents facing income shocks are vulnerable to distress land sales. Moreover, land transfers from poorer to wealthier agents may lead to land concentration and reduce agricultural production as land is transferred to "lower productivity, large-scale producers". Zimmerman and Carter's findings are supported by a study by André and Platteau (1998) in Rwanda, which emphasizes the role of risk and differences in income opportunities in distress land sales. Analyzing a sample of 247 sales transactions, the authors find that approximately 65% of sales of agricultural parcels (160 out of a total of 247) were motivated by urgent financial needs. Land is mainly sold to people who have regular non-farm income, to meet current food spending, health spending, social spending (baptisms, funerals, weddings) etc. However, regarding land rentals transactions, André and Platteau (1998) find a decrease in households' participation in rental markets that the authors attribute to the increasing incidence of *inter-vivo* transfers from father to sons as well as increasing generalized land scarcity and social tensions.

Thus, I assume land sales and rental market activity at the village level to be linked to the existence of a supply and demand of land which depend, for both types of land markets, on land scarcity (generalized and specific scarcity), production risks (e.g. droughts), commercialization of agriculture, access to non-farm activities and other factors such as tenure security in the village. A general model of land market activity could be written as:

$$LM_i = F(S_i, X_i) \tag{1}$$

where LM_i is land market activity in village i, S_i is land scarcity in village i, and X_i is a vector of the other factors affecting land market activity such as risk, commercialization of agriculture, etc. Under the assumption that in-migration is a source of heterogeneity in land holdings at the village level, which is a credible assumption as migrants, from other provinces and other ethnic groups in particular, are less likely to have an initial land endowment in their destination villages[8], land market activity at the village level could directly be modeled as a function of in-migration.

$$LM_i = G(M_i, S_{gi}, X_i) \tag{2}$$

[8]See Baland et al. (2000) and Quisumbing and Otsuka (2001) for a discussion of this assumption in the case of Uganda and Ghana respectively.

where M_i refers to the share of migrants in village i and S_{gi} is generalized land scarcity in village i. In-migration can affect land market activity through two main channels. For instance, in-migration is associated with an increase in population pressure that could affect land market activity as predicted by the ETLR. A second channel through which in-migration could affect land market activity is through its dis-equalizing effect on land distribution, what I call the direct effect of migration.

While the effect of population pressure on land markets transactions in the African context has been studied in the economic literature, the direct effect of in-migration remains under-explored. Several facts could explain this gap in the literature. First, descriptive findings from studies in the West African setting cast a doubt regarding the effects of migration on land market activity. Sjaastad (2003) has emphasized the difficulty to distinguish between reciprocal transfers (traditional modes of rights transfers on land such as gifts and loans) and market transfers. According to the author, this difficulty can be accentuated by the fact that market transactions, sales in particular, are disguised as customary transactions such as loans for example. Anthropological studies have also pointed out the social and political relationships between migrants and natives (autochthons) to suggest that all the monetized land transactions cannot be considered as free market transactions (Colin and Woodhouse, 2010). Indeed, these studies show that in some context monetized transactions are not considered as land sales by the suppliers, which situation may lead to the contest of purchasers' rights (see Chauveau et al., 2006)[9].

Second, estimates of the relationship between land market activity and in-migration are complicated by the fact that: (i) migrants can choose to locate in areas where they can buy or rent agricultural land, or at the contrary where they can receive land "freely" through gifts or borrowing[10][11]; (ii) unobserved characteristics of the destination villages may also simultaneously influence land market activity and in-migration. Thus, treating migration as an exogenous variable in the land market equation could yield biases.

To my knowledge, very few studies on the determinants of land market activity try to address

[9] These findings show the importance of clarifying the nature of land transactions with participants on both sides of the land markets, when estimating the impact of migration on land market activity.

[10] Despite the development of land market transactions, gifts and borrowing remain the main modes of access to land for migrants in Burkina Faso and particularly in the study area (GRAF, 2012; Chauveau et al., 2006).

[11] If migrants choose to settle in villages where traditional land tenure institutions are strong or where they can have access to land through non-market modes of access to land (e.g. gifts or borrowing), estimates of the effect of migration on land market activity are likely to be biased downward.

this identification problem. One notable exception is the study by Baland et al. (2000), which explores the distribution of land and the redistributive impact of land markets in 36 villages of eastern and central Uganda. The authors highlight a strong and positive impact of migration on land purchases and attribute the development of agricultural land market transactions to rural-rural migration.

Endogeneity concerns have led me to treat in-migration as an endogenous variable and use instrumental variables to estimate its impact on land market activity. I expect in-migration to have a positive impact on land market activity at the village level through its dis-equalizing effect on land allocation. Thus, I control for generalized land scarcity, proxied by the overall population pressure and availability of fallow land, to ensure that the estimate of the impact of migration measures the effect of differences in land endowment between migrants and natives.

3.2 Determinants of migration

The theoretical and empirical literature on the determinants of (internal and international) migration has placed great emphasis on the costs and (expected) returns to migration (see Lucas, 1997; Taylor and Martin, 2001; De Haas, 2010 for reviews). These costs and (expected) returns to migration, which play a crucial role in determining migration destination choice, are influenced by migrant individual (observable and unobserved) characteristics such as education and ability, characteristics of destination and origin areas including social norms and migrant access to networks (e.g. McKenzie et al., 2010; Munshi, 2003; Fafchamps and Shilpi, 2008).

Munshi (2003) uses rainfall shocks in the 'origin community' as an instrument for the size of Mexican migrants networks in the United States to study the role of the network in labor market outcomes of network members. The study reveals that the size of the network has a positive impact on the probability of being employed and holding a non-agricultural job in destination areas. Studies using a similar strategy, i.e. relying on weather conditions in the migrant origin areas to predict migration, include Pugatch and Yang (2011) in the case of Mexican migrants in the United States and Beegle et al. (2011) in the case of internal migrants in Tanzania (Kagera region)[12].

[12]There is a large body of the empirical literature on shocks and informal insurance in developing countries studying the effects of rainfall shocks on household (agricultural) income and consumption (e.g. Rosenzweig and Stark, 1989; Dercon et al., 2005; Kazianga and Udry, 2006; Rose, 1999).

The empirical literature also identifies various pull factors that could attract migrants in specific destination areas. In their analysis of the choice of migration destinations in Nepal, Fafchamps and Shilpi (2008) find that population density in potential destination areas, social proximity between the origin area and the destination area, and access to amenities have a strong and positive influence on the choice of the migration destination.

In this paper, I rely on both pull and push factors to address the endogeneity of migration to my final outcomes, land sales and rental market activity. Because contemporaneous characteristics of the destination areas may influence land market activity, I use historical features of the destination areas to instrument for migration in the destination areas[13].

4 Data and descriptive statistics

The empirical analysis relies on data from various sources. The main data come from a survey conducted by Burkina's National Institute of Statistics and Demography (INSD) between March and April 2007 in the Hauts-Bassins region, *Enquête Fichier des Localités*[14]. This survey provides information on all 476 rural localities of the region about the availability of farm land in the village (1 if fallow land is available in the village, 0 otherwise), occurrence of land sales transactions (1 if land is sold in the village, 0 otherwise), occurrence of land rental transactions (1 if land is rented in the village, 0 otherwise).

The *Enquête Fichier des Localités* also provides information about access to public services and economic infrastructure: primary school (1 if there is a primary school in the village, 0 otherwise); health center (1 if there is a health center in the village, 0 otherwise); road type to access the nearest town (paved road, laterite road, other); distance to the paved road (at less than 5 km, between 5 and 10 km, at more than 10 km), etc. Information on environmental and water facilities is also available; as well as information on agricultural activities and access to non-agricultural activities. These data were collected with the help of local councilors, heads of Village Development Councils (CVD) and officials in charge of specific services such as health and education services. Data

[13]Push factors, such as shocks in migrant origin areas are relatively more used in the literature as they are less likely to be correlated with outcomes at destination. Tables B.1 and B.2 in the appendix report results using only the pull factor. Results are very similar to those using the two instruments.

[14]Despite earlier plans to extend the survey to other regions of Burkina Faso, as of today only the Hauts Bassins region has been surveyed.

collection instruments included focus group discussions, which enabled to clear ambiguities about the nature of land transactions as data collection requires an agreement of various groups on the given information [15].

Data from the *Enquête Fichier des Localités* are matched with Burkina's latest population census of 2006 that provides information on village population size and the number of migrants (internal and international migrants) and with georeferenced data from various sources. I use rainfall data from the Climatic Research Unit (CRU) (University of East Anglia) and data on the location of hydrometric stations from the SIEREM database (Boyer et al., 2006) to construct the instrumental variables used in the analysis (see below). Furthermore, I use data on the location of the villages from the Directorate of Water Resources (Burkina Faso) to estimate village areas and population density in each village. Village areas are estimated using a SIG software to create Thiessen polygons (see figure A.4 in the appendix)[16].

The final sample consists of 454 successfully matched villages out of the Hauts-Bassins region's 476 villages. Table 1 gives descriptive statistics of the key variables used in the regressions. I focus on two outcome variables: land sales market activity and land rental market activity. These dependent variables of interest are measured by dummy variables equal to 1 if the village has an active land sales market, respectively an active land rental market. The independent variable of interest is the share of internal in-migrants in each village, i.e. the number of internal migrants divided by the village total population.

Land sales and land rental markets are both very localized (see figure 2). Land sales markets are active in only 6% of villages (27 villages) of the study area, and land rental markets are active in 19% of the villages (84 villages). Both types of land transactions coexist in approximately 5% of the villages. Furthermore, regarding land pressure, approximately half of the villages still have fallow land available for agricultural use. The mean population density in the study area is 44 p/sq.km and varies from a minimum of 1 p/sq.km to a maximum of 702 p/sq.km in the village of Bama in the Houet province. Migration statistics show a strong presence of internal migrants (i.e. people whose birth place is another place within Burkina Faso) in the study area. Internal migrants represent on average 18% of the village population. The proportion of migrants in the study area varies from less

[15] Although I would have ideally observed the intensity of land market activity, this feature of the data collection make me confident about the reliability of these data.

[16] For two villages, population density correspond to the average density calculated at the *commune* level.

Table 1: Descriptive statistics of variables used in regressions

Variable	N	Mean	SD
Land markets outcome and land availability			
Land sale market dummy	454	0.06	0.24
Land rentals market dummy	454	0.19	0.39
Land availability dummy	454	0.42	0.49
Population-migration			
Number of migrants	454	393.59	545.81
Share of migrants	454	0.18	0.14
Population density	454	44.37	52.98
Total population	454	1983.9	1897.34
Access to markets and Infrastructure dummies			
Distance to the major urban center	454	69.96	32.08
Access to an all-season road	454	0.47	0.5
Public transportation= Bus	454	0.2	0.4
Public transportation= Truck	454	0.28	0.45
Public transportation= Bush-taxi	454	0.2	0.4
No public transportation	454	0.33	0.47
Primary school	454	0.85	0.36
Health center	454	0.29	0.45
Access to Electricity	454	0.5	0.5
Revenue sources dummies			
Temporary labor migration	454	0.15	0.36
Commercial Agriculture	454	0.47	0.5
Rainfall Standard -deviation at destination	454	608.25	16.83
Instrumental variables			
RAIN (Rainfall shocks at origin)	454	27.26	4.74
DIST (Weighted distance from the nearest river)	454	0.009	0.004

than 1% to 96% of the population in the village of Fignana (Kenedougou province). Regarding the infrastructures present in the study area, 85% of the villages have a functioning school, while only 29% have a functioning health center. In addition, about half of the villages have access to electricity through various services (multifunctional platforms, generators, the national electricity company, etc.). Inhabitants have no access to public transportation in about 33% of the villages. In the villages where public transportation is available, inhabitants have principally access to trucks (41% of the villages where populations have access to public transportation). Regarding the distance (calculated using gps coordinates) to the major urban center of the region (Bobo-Dioulasso), the mean distance is about 70 km; and the distance varies from 5.5 km to 160.5 km. It could be that distance to the city also conditions the village's access to infrastructures. When I split the distance variable into quartiles and look at the relationship between city proximity and infrastructures, I find no evidence of systematic infrastructure concentration according to city proximity (figure A.1 in the appendix).

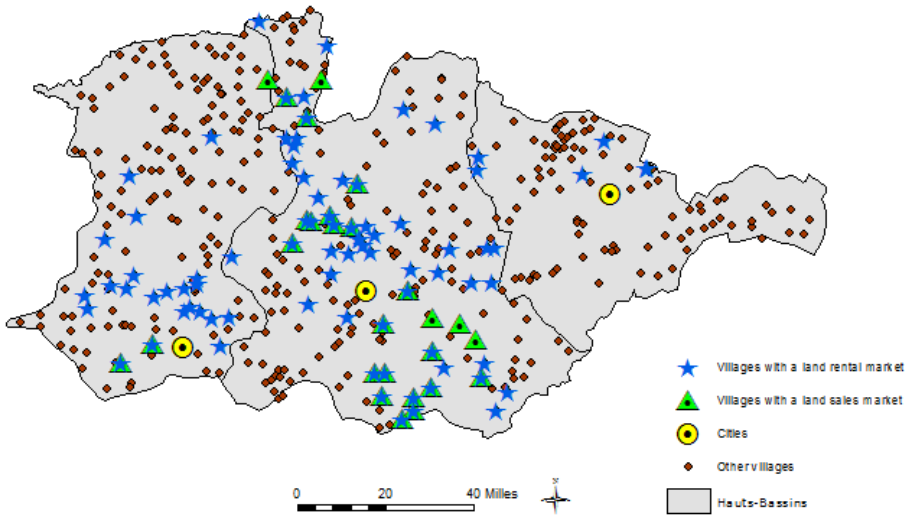

Figure 2: Land markets in the study area

5 Estimation strategy

The paper studies the determinants of land sales and rental market activity, and the role of heterogeneity in land endowments in particular. While our village level data do not allow us to directly assess whether land market activity is driven by differences in factors endowment, we use differences in the stock of in-migrants across villages in the study area and the fact that migrants are likely to have no initial land endowment in the destination villages to estimate the effect of differences in land endowments on land sales and rental and activity. Indeed, under the assumption that in-migration is a source of heterogeneity in land endowment, an increase in the stock of migrants[17] is expected to lead to an increase in the probability that an active land market exists in the destination villages.

5.1 Estimating the effect of migration

Conventional estimations of the effect of migration are potentially biased due to the already mentioned endogeneity issue. To overcome this issue, this paper uses rainfall shocks in migrant

[17] I focus on internal migrants, excluding *inter alia* migrants from other countries and return-migrants from Côte d'Ivoire, as internal migrants may constitute a more homogeneous group in terms of land and capital endowment.

origin provinces and exposure to the Onchocerciasis Control Program (OCP) as instrumental variables for the share of migrants in the village. Irrigated land represents a marginal amount of total land being exploited in Burkina Faso. According to the EPA, irrigated areas for cereals production represented less than 1% of the total land under cereals production in 2010. As the population is largely dependent on rain-fed agriculture in Burkina Faso and ex-ante self-insurance mechanisms are largely ineffective (see Reardon et al., 1988; Kazianga and Udry, 2006), I expect that a negative rainfall shock in migrant origin provinces will increase the number of migrants outside the affected provinces.

Rainfall shocks measures

Rainfall data are obtained from the global gridded monthly precipitation dataset (for 1901-2009) produced by the Climatic Research Unit (CRU) of the University of East Anglia. I use the high resolution (0.5°X 0.5°- latitude longitude) CRU data (CRU TS 3.1) to construct a precipitation dataset at the province level for Burkina's total territory. Rainfall variables are constructed for the wet season from May to September and for the entire year by calculating the average monthly rainfall during these periods. However, as rain-fed agriculture is the dominant system in Burkina Faso, I rely on the (agricultural) wet season (from May through September) rainfall data to construct the instrumental variable for internal migration. The rainfall variable is constructed at the province level as the number of rainfall shocks, i.e. the count of the normalized deviation (z-score)[18] from the long run mean rainfall (1960-2005) when the z-score value for a specific wet season is negative[19]. Since a rainfall shock in a given year should explain the number of migrants flowing from the affected province this given year, the number of shocks in the province during the period 1960-2005 is expected to determine the total number of migrants from the province during the period.

Destination villages are assigned the rainfall data for the origin province of the biggest migrant community. Migrant community is defined as the number of migrants coming from the same

[18] Z-scores are obtained by subtracting the long-run (1960-2005) mean in each province from the province level rainfall and dividing by the province rainfall standard deviation (for 1960-2005).

[19]
$$R_o = \sum_{t=1}^{T} Z_{ot} \text{ if } Z_{ot} < 0$$
were R_o is the number of rainfall shocks in origin province o and Z_{ot} is the z-score in origin province o for the wet season t.

province[20]. In addition, I use a second instrument as a pull factor for migration, which is the exposure to OCP.

Exposure to the Onchocerciasis Control Program (OCP)

The OCP covered 11 West African countries (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Guinea-Bissau, Mali, Niger, Senegal, Sierra Leone and Togo). By the end of 2002, the program enabled to stop the transmission of the disease in most parts of the participating countries. In Burkina Faso, where OCP operations began in early 1975, research has showed that in 1977-1978 the program had already positive effects, e.g. the reduction of annual biting rates of flies from more than 8000 bites per man per year to less than 500 bites in most treated areas (Walsh et al., 1979) (see figure A.2 in the appendix). Moreover, around 41,000 sq.km of uninhabited and uncultivated fertile river basin land have been freed from onchocerciasis (McMillan, 1995). Theses results were obtained by relying exclusively on aerial application of insecticides on infested, fast-flowing rivers to destroy blackfly larvae (see Hougard et al., 2001)[21].

Following McMillan et al. (2012, 2013) who use distance to rivers to explain village population growth in the program area in Burkina Faso, I use features of the OCP to explain variation in the share of migrants across destination villages. However, as the exogeneity of distance to rivers to land market activity may be disputable[22], I rather rely on the 'weighted' distance to historical functioning hydrometric stations, which provided information about river level and flow, to instrument the share of migrants in the village. Indeed, access to hydrometric data has been a crucial aspect of the success of aerial treatments (Pouyaud and Le Barbé, 1987; Hougard et al., 1994). Hydrometric data, water level data in particular, were used by OCP teams to calculate insecticides doses for weekly aerial treatments of rivers. Although the insecticide used during the first years of the program (until 1985) did not require exact hydrometric data, failure to have access to reliable water level data did considerably reduce the effectiveness of the treatment (Servat et al., 1990). Indeed over and under-dosages of insecticides could have both adverse consequences on population and the environment, i.e. insecticide resistance, disturbances of the aquatic fauna (Hougard et al., 1994).

[20]For some villages where the size of the second biggest migrant community was not significantly different at the 5% level of the size of the biggest migrant community, I assigned the mean rainfall value for both origin provinces.

[21]The OCP operations were based on weekly insecticide spraying until 1989, date on which Ivermectin treatment was added to the control operations.

[22]As mentioned by McMillan et al. (2013), distance to rivers could directly influence the probability of selling and renting land, for example through a better access to irrigation or exposure to other diseases.

However, although a problem of resistance to insecticide has led to changes in the insecticides used by OCP teams, studies assessing the impact of OCP operations do not find significant impacts on the environment (see Calamari et al., 1998). I expect migrant flows from areas affected by the severe droughts of the early 1970s and 1980s to be directed to newly freed lands from onchocerciasis because of the availability of fertile lands. Moreover, I expect the share of migrants in the study villages to be an increasing function of the effectiveness of the aerial treatments measured by the 'weighted' distance to historical functioning hydrometric stations.

In practice, the instrument is constructed as the great circle distance to the nearest hydrometric station that was active and accessible during OCP operations in the river valleys (i.e. Mouhoun, Comoe and Niger basins that covers the study area) divided by the basin area controlled by the station. Data on the locations of hydrometric stations within the river valleys come from the SIEREM database (Boyer et al., 2006) and information on historical hydrometric stations status (accessibility and reliability of the data) comes from the hydrological yearbooks of 1974-1975 and 1976 as well as reports on hydrometric stations maintenance for the years 1974, 1977 and 1979 (H.A.E.R - ORSTOM, 1975, 1977; Séchet et al., 1974; Claude et al., 1978; Chevallier et al., 1980)[23]. Furthermore, to account for differences between AVV assisted settlements and unassisted settlements, I include in the estimated models controls for access to a wide range of infrastructures, e.g. school and health facilities and electricity.

5.2 Econometric specification

I start by analyzing whether internal migration influences land sales and rental market activity, relying on a "naive" probit approach. I estimate the following equation:

$$y^*_{ji} = \alpha + \beta M_i + \delta X_i + e_{ij} \tag{3}$$

$$y_{ji} = \begin{cases} 1 & \text{if } y^*_{ji} > 0 \\ 0 & \text{if } y^*_{ji} \leq 0 \end{cases}$$

where y_{ji} is a dummy variable denoting whether land market j (land sale market or land rental market) is active in the village i ; M_i is the share of internal migrants in the village i; and X_i are a

[23] See figure A.3 in the appendix for the location of the stations used in the analysis.

set of village characteristics: population density[24]; distance between village i and the major urban center of the region; indicators of access to transport facilities and road quality (i.e. access to an all-season road); indicators of village inhabitants income sources, i.e. the type of agriculture being practiced -subsistence or commercial- and an indicator of access to non-farm activities (a dummy equal to 1 if temporary labor migration to the city exists in the village); an indicator of income variability (rainfall variability in the study area, measured by the standard deviation from the long term mean (1960-2005) at the province level); indicators for access to rural infrastructures (access to school, health center, electricity).

I test different specifications (see tables 2 and 3) and, given the endogeneity issue, I estimate the full model using a control function approach The model is written as:

$$y^*_{ji} = \alpha + \beta M_i + \delta X_i + e_{ij} \tag{4}$$

$$M_i = \sigma + \gamma_1 R_{oi} + \gamma_2 D_i + \theta X_i + \epsilon_i \tag{5}$$

$$y_{ji} = \begin{cases} 1 & \text{if } y^*_{ji} > 0 \\ 0 & \text{if } y^*_{ji} \leq 0 \end{cases}$$

where R_{oi} is the number of rainfall shocks in the origin province o assigned to village i under the rule described above; D_i is an indicator of exposure to OCP, which is the weighted distance between village i and the nearest (historical and functioning) hydrometric station.

I also estimate a linear probability model with instrumental variables (linear 2SLS) as a robustness check. Results are mainly similar to those of the above estimated model, which I prefer given the binary nature of the dependent variables.

6 Probit estimates of land sales and rental market activities

Tables 2 and 3 present the results of the naive Probit model (marginal effects of Probit models), i.e. the estimation of equation (3) respectively for land sales market activity and land rental market activity.

Column (1) in table 2 and table 3 presents the results of the base specification. Column (2)

[24] I expect migration to be significant despite the control of population density. I also include in the regressions an indicator for availability of fallow land in the village.

controls for the density of the population, the availability of fallow land and access to basic services (education, school and electricity); and column (3) adds further controls for the distance to the major urban center, access to transport facilities and the quality of roads. Then in my preferred specification (column (4)), I control for rainfall variability (measured at the province level) and add the indicators of income sources. The effect of the variable of interest (the share of migrants) has the expected sign and remains significant at the 1% level (except in table 3, column (1)) where it is significant at the 5% level) across specifications.

Table 2: Probit estimates of the effects of internal migration on land sales market activity

	Probit marginal effects (1)	Probit marginal effects (2)	Probit marginal effects (3)	Probit marginal effects (4)
Share of migrants	0.279***	0.260***	0.212***	0.209***
	(0.071)	(0.070)	(0.069)	(0.066)
Population density		0.000383**	0.000323**	0.000343**
		(0.000178)	(0.000157)	(0.000145)
Land availability dummy		0.008	-0.001	0.001
		(0.021)	(0.021)	(0.021)
Distance to the major urban center			-0.001271***	-0.001312***
			(0.000429)	(0.000446)
Access to an all-season road			0.036*	0.042**
			(0.022)	(0.021)
Public transportation= Bus			0.045	0.034
			(0.045)	(0.042)
Public transportation= Truck			0.104***	0.102***
			(0.040)	(0.037)
Public transportation= Bush-taxi			0.096**	0.097**
			(0.041)	(0.038)
Primary school		-0.049*	-0.038	-0.030
		(0.028)	(0.027)	(0.027)
Health center		0.002	-0.005	-0.001
		(0.026)	(0.024)	(0.023)
Access to Electricity		0.059**	0.052**	0.045**
		(0.024)	(0.023)	(0.022)
Temporary emigration				-0.074**
				(0.034)
Commercial Agriculture				-0.052**
				(0.022)
Rainfall Standard -deviation at destination				0.001
				(0.001)
Observations	454	454	454	454
Pseudo R2	0.0838	0.160	0.326	0.388
% correct prediction overall				95.15
% correct prediction positive outcome				33.33
% correct prediction negative outcome				99.06

Note: Standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted category is *No public transportation.*

The results suggest that both land sales market activity and land rental market activity are positively correlated with in-migration in the study villages. The results also suggest that the probability that land sales and rental markets are active is higher in villages situated near the major urban center and in densely populated villages. These findings also support the hypothesis that in-migration creates the conditions for the emergence of land-markets independently from the effect of 'generalized' population pressure.

Regarding the other control variables, the results suggest that land sales market activity is positively associated with access to transport facilities [25] and negatively associated with temporary labor migration and commercialization of agriculture. Furthermore, the results suggest that rainfall variability has a positive and significant (at the 5% level) impact on land rental market activity (table 3, column (4)) but not on land sales market activity.

However, because the Probit estimates may suffer from endogeneity bias, the next section provides further evidence on the causal effect of in-migration on land market activity.

[25] As multicollinearity may potentially be a concern, I performed multicollinearity tests that allow to rule out the possibility of multicollinearity problems.

Table 3: Probit estimates of the effects of internal migration on land rental market activity

	Probit marginal effects (1)	Probit marginal effects (2)	Probit marginal effects (3)	Probit marginal effects (4)
Share of migrants	0.303**	0.332***	0.312***	0.327***
	(0.125)	(0.123)	(0.121)	(0.113)
Population density	0.000606**	0.000627***	0.000683***	
	(0.000254)	(0.000243)	(0.000164)	
Land availability dummy		0.078**	0.061*	0.055
		(0.035)	(0.035)	(0.034)
Distance to the major urban center			-0.003053***	-0.002921***
			(0.000576)	(0.000602)
Access to an all-season road			0.017	0.028
			(0.036)	(0.037)
Public transportation= Bus			-0.012	-0.024
			(0.051)	(0.051)
Public transportation= Truck			0.015	0.015
			(0.046)	(0.045)
Public transportation= Bush-taxi			-0.014	-0.003
			(0.050)	(0.049)
Primary school		-0.033	-0.021	-0.020
		(0.052)	(0.050)	(0.047)
Health center		0.048	0.040	0.048
		(0.041)	(0.041)	(0.039)
Access to Electricity		0.090**	0.063*	0.048
		(0.037)	(0.036)	(0.037)
Temporary emigration				-0.007
				(0.047)
Commercial Agriculture				-0.052
				(0.035)
Rainfall Standard -deviation at destination				0.003**
				(0.001)
Observations	454	454	454	454
Pseudo R2	0.0129	0.0590	0.116	0.129
% correct prediction overall				81.50
% correct prediction positive outcome				5.95
% correct prediction negative outcome				98.92

Note: Standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted category is *No public transportation.*

7 Instrumental variables estimates of land sales market activity and land rental market activity

Tables 5 and 6 present the results of the instrumental variables probit model (IV-Probit) alongside with results of the Probit model and results of the linear probability model with instrumental variables. Before turning to these results, I first assess the validity of the instrumental variables used in the analysis and present the results of the first stage OLS estimation of the determinants of in-migration.

7.1 Effects of rainfall shocks and exposure to OCP on migration

Table 4 presents the results of the first stage, which explores the determinants of in-migration. First, the results show as expected a strongly significant impact (significant at the 1% level) of the instruments, rainfall shocks and exposure to OCP (distance to hydrometric stations), on the share of migrants in the destination village. The share of migrants in the village increases with the number of rainfall shocks (for the period 1960-2005) in the origin area and decreases as the destination village is distant to hydrometric stations. To assess the strength of the instruments, I report in tables 6 and 5 (column (3)) the Kleibergen-Paap rank Wald F statistic and the critical values provided by Stock and Yogo, 2005 obtained from the linear probability model. According to the StockYogo test of weak instruments, the weak instruments hypothesis is rejected if one is willing to tolerate a rejection rate of at most 10% as the F statistic (with a value of 41.56) exceeds largely the critical value of 19.93[26]. Furthermore, the F statistic is well above the threshold of 10 suggested by Staiger and Stock (1997) as a weak identification test.

Turning to the validity of the instruments, the p-values of the Hansen J test for overidentification statistics, respectively 0.95 for the land sales market regression and 0.54 for the land rental market regression, suggest that I should not reject the null hypothesis that the instruments are valid instruments.

I further test the endogeneity of the variable of interest by performing a Wald test of exogeneity (IV-Probit model) and a Durbin-Wu-Hausman (DWH) test (linear probability model). Both tests

[26]Similarly statistics reported in table B.2 for the model including only one instrument suggest that we can reject the null hypothesis of weak instruments if one is willing to tolerate a rejection rate of at most 10%.

Table 4: First stage

Dependent variable :	Share of migrants
DIST (Weighted distance from the nearest river)	-12.425***
	(1.705)
RAIN (Rainfall shocks at origin)	0.004***
	(0.001)
Population density	0.000001
	(0.000077)
Land availability dummy	-0.006
	(0.012)
Distance to the major urban center	0.000451**
	(0.000191)
Access to an all-season road	-0.011
	(0.012)
Public transportation= Bus	-0.004
	(0.017)
Public transportation= Truck	0.034**
	(0.016)
Public transportation= Bush-taxi	0.031*
	(0.017)
Primary school	-0.043**
	(0.020)
Health center	-0.033***
	(0.012)
Access to Electricity	0.039***
	(0.013)
Temporary emigration	-0.041***
	(0.013)
Commercial Agriculture	-0.010
	(0.012)
Rainfall Standard -deviation at destination	0.000
	(0.000)
Constant	-0.093
	(0.272)
Observations	454
R-squared	0.212

Note: OLS estimates. Robust standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted category is *No public transportation.*

suggest a strong rejection of the null hypothesis that the share of migrants may be treated as exogenous in the land rental market equation (the p-value of the DWB robust chi-square test is 0.0042 and the p-value of the Wald test is 0.0081). However, the tests are both non-significant in the land sales market equation (the p-value of the DWB robust chi-square test is 0.8313 and the p-value of the Wald test is 0.5688) suggesting that the share of migrants may be treated as exogenous. This result may be explained by the fact that land sales transactions remain prohibited under the customary land tenure system in most of the region. It may be more difficult for migrants living in

the villages to infringe this norm, compared to outsiders such as urban dwellers. Thus these test results further suggest that there are no differences between the instrumented and non-instrumented results.

7.2 Determinants of land sales market activity

Columns (1) to and (3) of table 5 reports the marginal effects of Probit, IV-Probit and linear probability model[27] estimations of the probability of the village having an active land sales market. As expected, Probit and IV-Probit estimations are very similar, though the positive effect of migration loses its statistical significance in the IV-Probit estimation. This is not surprising, as the IV-Probit estimation has led to greater imprecision, with a standard error increasing from 0.066 to 0.177. The probit estimate, that is valid according the results of the Wald test and DWH test, however suggest that the share of migrants in the village has a positive and significant effect on land sales market activity.

Regarding the control variables, the IV estimations confirm the results of the Probit model. Villages with access to electricity are more likely to have an active land sales market. An increase of 10 kilometers in the distance to the major urban center decreases the probability of having an active land sales market in the village by 1.3 percentage points. I also found that access to public transportation facilities increases the probability of having a land sales market in the village. For example, access to Bush-taxi increases the likelihood of having a land market by 10.8 percentage points (table 5, column (2)) and villages with an all-season road have 3.9 percentage points more likely to have an active land sales market. These results may potentially reflect the fact that land sales markets are more likely to be active in villages with a better access to output markets that is in line with previous findings in the literature.

Furthermore, the results suggest that villages where access to non-farm activities (temporary labor migration) exists and where the degree of agricultural commercialization is high (relatively to subsistence agriculture) are less likely to have an active land sales market. Surprisingly, having access to non-farm activities reduces the likelihood of having a land sales market by 7.6 percentage points. Similarly, villages where agriculture is mainly commercial are 5.1 percentage points less

[27] Results of the linear probability model with instrumental variables are only reported for comparison.

Table 5: IV estimates of the effects of internal migration on land sales market activity

	Probit marginal effects (1)	IV-Probit marginal effects (2)	Linear 2SLS (3)
Share of migrants	0.216***	0.108	0.243
	(0.066)	(0.177)	(0.206)
Population density	0.000343**	0.000347***	0.000692**
	(0.000145)	(0.000095)	(0.000349)
Land availability dummy	-0.001	-0.001	-0.002
	(0.021)	(0.018)	(0.021)
Distance to the major urban center	-0.001312***	-0.001341***	-0.000992***
	(0.000446)	(0.000385)	(0.000311)
Access to an all-season road	0.042*	0.039*	0.054**
	(0.021)	(0.020)	(0.023)
Public transportation= Bus	0.040	0.034	-0.011
	(0.042)	(0.042)	(0.022)
Public transportation= Truck	0.106***	0.108***	0.087***
	(0.038)	(0.039)	(0.026)
Public transportation= Bush-taxi	0.101***	0.103**	0.059*
	(0.039)	(0.041)	(0.035)
Primary school	-0.028	-0.031	-0.056
	(0.027)	(0.022)	(0.034)
Health center	0.003	-0.005	-0.017
	(0.023)	(0.024)	(0.030)
Access to Electricity	0.045**	0.045*	0.046*
	(0.022)	(0.023)	(0.025)
Temporary emigration	-0.074**	-0.076**	-0.052**
	(0.034)	(0.030)	(0.025)
Commercial Agriculture	-0.052**	-0.051**	-0.049**
	(0.022)	(0.021)	(0.020)
Rainfall Standard -deviation at destination	0.002	0.001**	0.000
	(0.001)	(0.001)	(0.000)
Constant			-0.167
			(0.335)
Observations	454	454	454
% correct prediction overall	95.15	94.71	
% correct prediction positive outcome	33.33	18.52	
% correct prediction negative outcome	99.06	99.53	
p-value Hansen J-stat			0.955
Weak identification test			
Kleibergen-Paap F-stat			41.56
Stock-Yogo weak critical values			
10% maximal IV size			19.93
15% maximal IV size			11.59
20% maximal IV size			8.75
25% maximal IV size			7.25

Note: Robust standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1% .

likely of having a land sales market. While these results are unexpected, they are consistent with micro-level findings suggesting that people lacking access to non-farm activities may be forced to sell their land to meet subsistence needs (André and Platteau, 1998). The results also confirm the positive and highly significant (at the 1% level) effect of population density on the probability of having a land sales market in the village. Regarding the effect of rainfall variability, the results of the probit estimate suggest that rainfall variability has no statistically significant impact on the probability of having an active land sales market in the villages[28].

7.3 Determinants of land rental market activity

Column (2) in table 6 reports the results of the second stage of the IV-Probit estimation of the probability of having an active land rental market. The marginal effect of the variable of interest is strongly significant (at the 1% level) as in the Probit estimation. However, the magnitude of the effect is much higher than in the Probit model suggesting the presence of a large negative bias in the Probit estimation if the share of migrant is treated as exogenous[29]. A one percentage point increase in the share of migrants leads to 1.1 percentage points (compared to 0.33 percentage points in the Probit estimation) increase in the probability of having an active land rental market in the village. This result further highlight a negative bias of the probit estimation of the effect of migration. As hypothesized (see section 3), this result may reflect the fact that migrants choose to settle in villages where institutions are strong or where they can have access to land through customary modes of access to land (e.g. gifts and borrowing). While these are potential explanations for this negative bias, unfortunately, the data do not allow to formally test these hypotheses.

Regarding the effects of the control variables, estimates differ slightly to those obtained from the probit model. The effect of population density becomes only significant at the 10% level. An increase in population density by 10 p/sq.km leads to a 0.5 percentage point increase in the probability of having an active land rental market in the village. An increase of 10 kilometers in the distance to the major urban center decreases the probability of having an active land rental market in the village by 2 percentage points. As in the Probit estimation, the effects of access

[28] The effect of rainfall variability is also non-significant in the linear probability model suggesting further to be cautious when interpreting the IV-Probit estimate.

[29] As shown in table B.1, column (3), using only one instrument do not substantially change the results, although the bias in the Probit estimation appears larger (standard errors are larger when using only one instrument).

Table 6: IV estimates of the effects of internal migration on land rental market activity

	Probit marginal effects (1)	IV-Probit marginal effects (2)	Linear 2SLS (3)
Share of migrants	0.327***	1.083***	1.353***
	(0.113)	(0.262)	(0.398)
Population density	0.000683***	0.000485*	0.000689**
	(0.000164)	(0.000262)	(0.000315)
Land availability dummy	0.055	0.063*	0.075*
	(0.034)	(0.033)	(0.040)
Distance to the major urban center	-0.002921***	-0.002113***	-0.002285***
	(0.000602)	(0.000559)	(0.000564)
Access to an all-season road	0.028	0.047	0.052
	(0.037)	(0.035)	(0.041)
Public transportation= Bus	-0.024	-0.036	-0.038
	(0.051)	(0.048)	(0.054)
Public transportation= Truck	0.015	-0.039	-0.033
	(0.045)	(0.045)	(0.048)
Public transportation= Bush-taxi	-0.003	-0.062	-0.079
	(0.049)	(0.048)	(0.056)
Primary school	-0.020	-0.010	-0.003
	(0.047)	(0.045)	(0.054)
Health center	0.048	0.078**	0.089*
	(0.039)	(0.038)	(0.047)
Access to Electricity	0.048	0.024	0.029
	(0.037)	(0.036)	(0.042)
Temporary emigration	-0.007	0.023	0.039
	(0.047)	(0.044)	(0.052)
Commercial Agriculture	-0.052	-0.040	-0.049
	(0.035)	(0.033)	(0.038)
Rainfall Standard -deviation at destination	0.003**	0.003***	0.003**
	(0.001)	(0.001)	(0.001)
Constant			-1.715**
			(0.746)
Observations	454	454	454
% correct prediction overall	81.50	80.62	
% correct prediction positive outcome	5.95	30.95	
% correct prediction negative outcome	98.92	91.89	
p-value Hansen J-stat			0.541
Weak identification test			
Kleibergen-Paap F-stat			41.56
Stock-Yogo weak critical values			
10% maximal IV size			19.93
15% maximal IV size			11.59
20% maximal IV size			8.75
25% maximal IV size			7.25

Note: Robust standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted category is *No public transportation*.

to transport facilities and to an all-season road are not significantly different from zero. Similarly, having access to non-farm activities and agricultural commercialization do not significantly influence the probability of having an active land rental market in the village. The results further show a positive and strongly significant (at the 1% level) impact of rainfall variability on the probability of having a land market in the village. As suggested by previous findings in the literature, this result may potentially reflect the use of land rentals by households as buffers against income shocks. For instance, households may sell their land to cope with income shocks.

7.4 Who buys land?

This section tries to give some insights into the types of participants in land markets. While the results may indicate that land markets allow land-poor agents, i.e. in-migrants, to gain access to land in the villages, whether land markets develop because of land demand from urban dwellers remains ambiguous. For instance, in theory, the estimated positive effect of urban proximity on land market activity may be explained by the demand of land by urban dwellers (for agricultural or housing use) or by the better access to output and input markets. If land markets develop because of land demand from urban dwellers, this may have negative implications for the efficiency and equity enhancing role of land markets (see GRAF, 2011).

While I cannot assure that the estimated effects of urban proximity only reflect the effects of access to input and output markets I present evidence consistent with the fact this channel plays a role in explaining the result. Table 7 reports the predicted probability of having an active land sales market in the village at various distances from the major urban center (respectively 10, 25, 50, 75 and 100 kilometers) and given the road quality. As suggested by the study by Benjaminsen and Sjaastad (2002) and other works on the role of urban dwellers on observed land transactions in Mali and other African countries, land transactions involving urban dwellers are more likely to occur in close proximity to the city (10-25 kilometers). The results in table 7 show that even at a distance of 75 kilometers from the city, the probability of having a land sales market if the village has access to an all-season road is significantly higher compared to the situation in which the village does not have access to the road. These results suggest that accessibility plays a role in the emergence of land sales market activity in the villages.

Table 7: Predicted probability of land sales market activity at different distances to the major urban center and different road qualities

Access to an all-season road	**Distance to the major urban center in kilometers**	**Probability Land sales market activity=1**
Observed level	Observed level	0.057***
		(0.010)
0	10	0.117***
		(0.045)
0	25	0.083***
		(0.030)
0	50	0.042***
		(0.016)
0	75	0.020**
		(0.009)
0	100	0.008
		(0.005)
1=yes	10	0.211***
		(0.054)
1=yes	25	0.159***
		(0.036)
1=yes	50	0.092***
		(0.019)
1=yes	75	0.048***
		(0.015)
1=yes	100	0.023**
		(0.012)

Note: IV-Probit estimates. Robust standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. Probability of land rental market and land sales market being active calculated at specific values of the distance to the major urban center and quality of road, and at observed levels of the other independent variables.

8 Conclusion

This paper aims to provide a first insight into the functioning of land markets in Burkina Faso and more specifically into the way these markets are emerging. Indeed, this study was motivated by the fact that while land markets are active in the study area, very little is known about the factors influencing land market activity in this zone. Given the potential equity- and efficiency-enhancing effects of land markets, an understanding of the factors driving land market activity is of great importance. The empirical analysis builds on the theoretical literature, in particular the model developed by Zimmerman and Carter (1996) to analyze the effect of heterogeneity in land endowment on land sales and rental market activity. Differences in the study villages in terms of the share of migrants coming from the other parts of Burkina Faso and the use of instrumental variable estimations enable me to overcome some of the data limitations and to draw conclusions regarding the effect of land scarcity on land market activity. Indeed, to account for the endogeneity of the share of migrants in the villages, I use historical features of the study area, namely the exposure to the Onchocerciasis Control Program (OCP) that enable the eradication of onchocerciasis in this zone, and rainfall shocks in the migrant provinces of origin.

I find that rainfall shocks and exposure to OCP both have a significant impact on the share of internal migrants in the study area. Using these variables as instruments, I find that an increase in the share of migrants in villages leads to an increase in the probability of having an active land rental market. The results suggest that in-migration is not endogenous to land sale market activity and that in-migration has a positive effect on land sale market activity. These results are robust to the inclusion of controls for population density and availability of fallow land in the villages. Consistent with the model of Zimmerman and Carter (1996), these findings suggest that scarcity *per se* is not the principal driver of land activity; heterogeneity in land endowment plays an important role in the emergence and development of land markets. These findings further suggest that land markets play an equalizing role as they transfer land to land-poor agents (in-migrants). Important policy implications can be drawn from this analysis as migrants are considered to be a marginalized group in terms of access to land (like women and young people for instance). Indeed if migrants have access to land through land markets, an intervention of the government aiming at redistributing land to migrants may be unnecessary. However, an important question is whether

migrants may have access to fertile land or whether they end up systematically with low quality land? While our data do not allow to address this question in this paper, this analysis is a potential research to be undertaken in the future.

Furthermore, the findings are in line with other studies that highlight the existence of distress land rental and sales transactions in response to income shocks for example. Indeed the results suggest that rainfall variability has a positive impact on land market activity, while access to off-farm activities and commercialization of agriculture are negatively associated with land market activity. Although further analyses using micro-level data are needed to better understand the reasons underlying land transactions, these findings call for policies aiming at reducing agricultural productivity risks such as investments in irrigation and in drought-tolerant varieties, as well as the promotion of agricultural commercialization. The positive impact of urban proximity and access to transport facilities on land market activity also suggest measures related to infrastructure development to promote land market activity.

However, the issue of the efficiency role of land markets remains an open question. Indeed, this study tries to provide some insight into the determinants of land market activity in the study area, the role of land scarcity and access to markets for instance. Exploring the mechanisms underlying some of the results presented in this paper appears fundamental to gain further insight into the role of land markets in rural Africa.

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Appendix A Figures

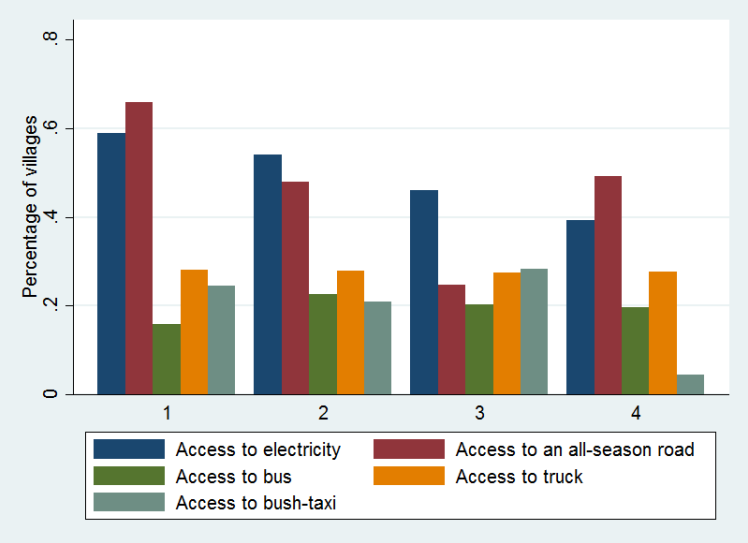

Figure A.1: Infrastructures distribution by distance to the urban center

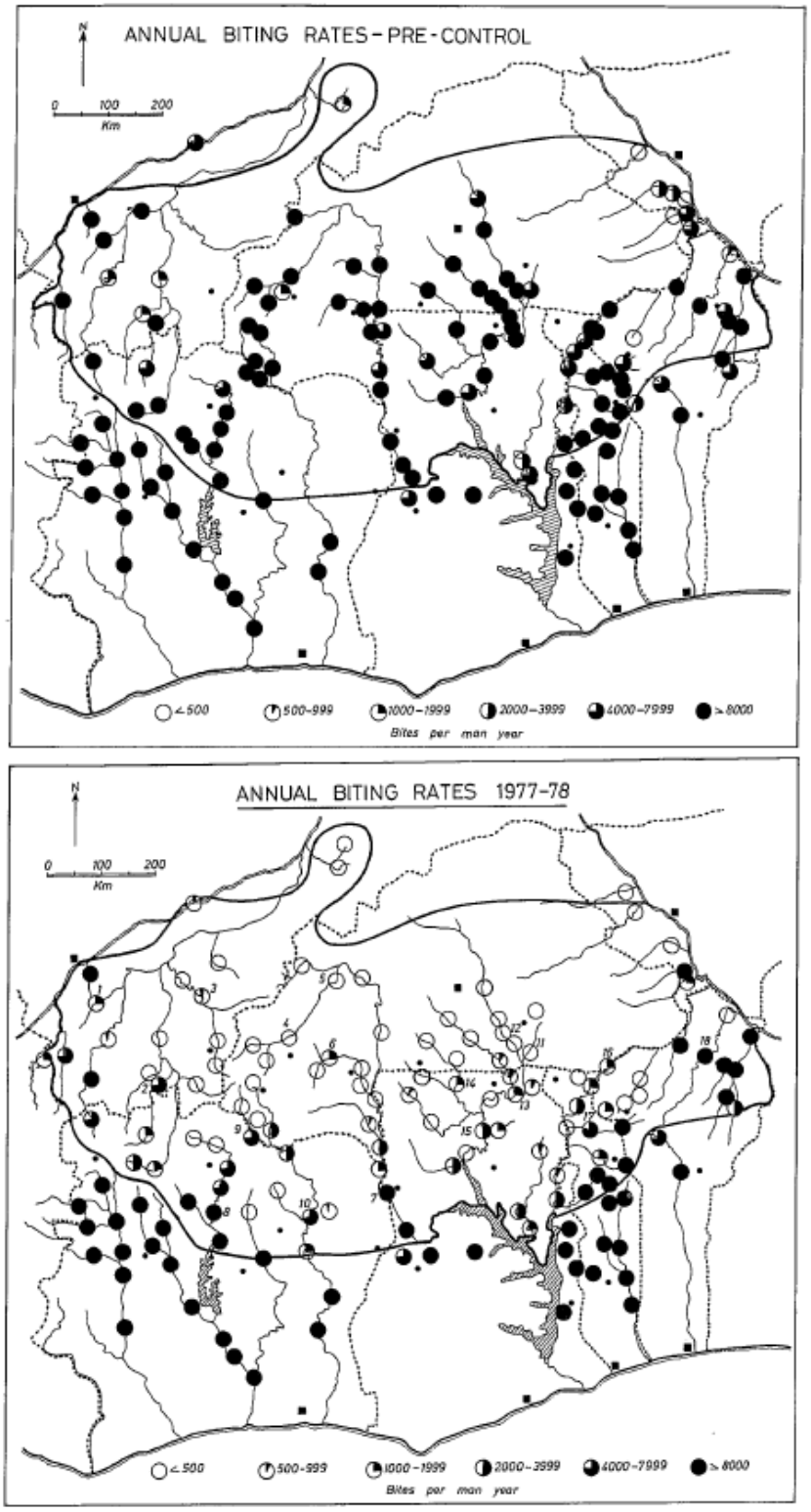

Figure A.2: Annual biting rates for pre and post-control period 1977/1978
Source: adapted from (Walsh et al., 1979)

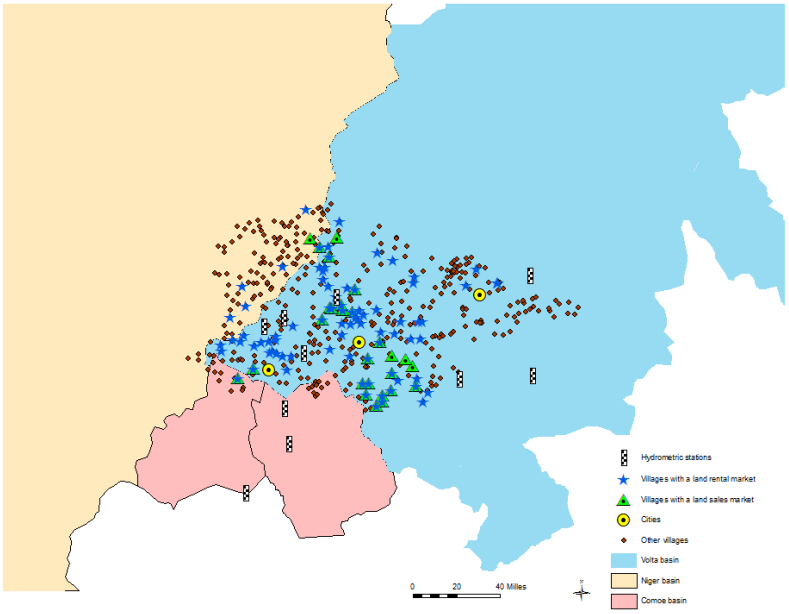

Figure A.3: Location of functioning hydrometric stations (1974-1979) in the study area

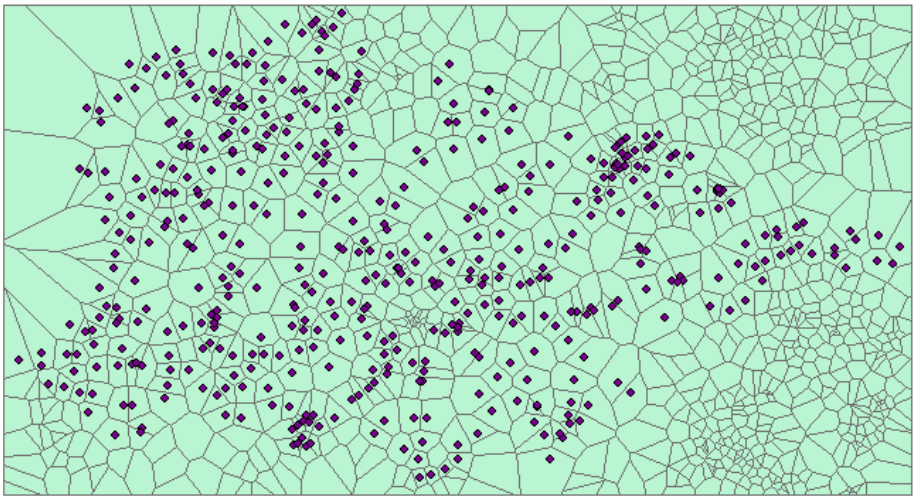

Figure A.4: Thiessen polygons boundaries for Hauts-Bassins villages

Appendix B Tables

Table B.1: IV estimates of the effects of internal migration on land sales and rental market activity

Dependent variable	Land sales market activity		Land rental market activity	
	IV-Probit marginal effects	Linear 2SLS	IV-Probit marginal effects	Linear 2SLS
	(1)	(2)	(3)	(4)
Share of migrants	0.231	0.230	1.374***	1.700**
	(0.436)	(0.335)	(0.353)	(0.734)
Population density	0.000344**	0.000693**	0.000407	0.000659**
	(0.000147)	(0.000351)	(0.000339)	(0.000324)
Land availability dummy	0.001	-0.002	0.059*	0.079*
	(0.022)	(0.022)	(0.032)	(0.043)
Distance to the major urban center	-0.001317***	-0.000995***	-0.001924***	-0.002230***
	(0.000466)	(0.000305)	(0.000661)	(0.000607)
Access to an all-season road	0.043*	0.054**	0.044	0.058
	(0.025)	(0.024)	(0.033)	(0.046)
Public transportation= Bus	0.034	-0.011	-0.028	-0.040
	(0.043)	(0.022)	(0.046)	(0.057)
Public transportation= Truck	0.102***	0.088***	-0.047	-0.050
	(0.037)	(0.029)	(0.045)	(0.058)
Public transportation= Bush-taxi	0.097**	0.059	-0.074	-0.100
	(0.039)	(0.039)	(0.049)	(0.070)
Primary school	-0.030	-0.057	0.004	0.007
	(0.027)	(0.036)	(0.047)	(0.059)
Health center	-0.000	-0.018	0.084**	0.102*
	(0.028)	(0.030)	(0.039)	(0.054)
Access to Electricity	0.045**	0.046*	0.011	0.020
	(0.022)	(0.026)	(0.037)	(0.047)
Temporary emigration	-0.074**	-0.052*	0.031	0.051
	(0.034)	(0.027)	(0.045)	(0.057)
Commercial Agriculture	-0.052**	-0.049**	-0.035	-0.047
	(0.023)	(0.021)	(0.033)	(0.040)
Rainfall Standard -deviation at destination	0.001	0.000	0.003***	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)
Constant		-0.154		-2.055**
		(0.412)		(0.941)
Observations	454	454	454	454
% correct prediction overall	95.37		77.09	
% correct prediction positive outcome	37.04		35.71	
% correct prediction negative outcome	99.06		86.49	
Weak identification test				
Kleibergen-Paap F-stat		20.68		20.68
Stock-Yogo weak critical values				
10% maximal IV size		16.38		16.38
15% maximal IV size		8.96		8.96
20% maximal IV size		6.66		6.66
25% maximal IV size		5.53		5.53

Note: Robust standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted category is *No public transportation*.

Table B.2: First stage

Dependent variable :	Share of migrants
RAIN (Rainfall shocks at origin)	0.006***
	(0.001)
Population density	0.000055
	(0.000081)
Land availability dummy	-0.008
	(0.013)
Distance to the major urban center	-0.000061
	(0.000179)
Access to an all-season road	-0.011
	(0.012)
Public transportation= Bus	-0.005
	(0.018)
Public transportation= Truck	0.032*
	(0.017)
Public transportation= Bush-taxi	0.042**
	(0.018)
Primary school	-0.033
	(0.021)
Health center	-0.038***
	(0.013)
Access to Electricity	0.029**
	(0.013)
Temporary labor migration	-0.036**
	(0.014)
Commercial Agriculture	-0.008
	(0.013)
Rainfall Standard -deviation at destination	-0.001***
	(0.000)
Constant	0.772***
	(0.229)
Observations	454
R-squared	0.133

Note: OLS estimates. Robust standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted category is *No public transportation.*