Efficiency of land market institutions in The Gambia: Network level evidence of the importance of proximity

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Abstract

This study presents network level evidence of the importance of family ties and geographical proximity in helping to alleviate inefficiencies caused by missing markets and unequal land endowments. Departing from a simple model of dyad-level land transactions in the presence of imperfections in the land and labor market, we make predictions about the flow of land between households. We test the predictions using a household survey conducted in 2009 of complete input transaction networks in 52 villages in rural Gambia. According to the empirical findings, land transactions do flow in the predicted efficiency-enhancing directions, but not enough to achieve the most efficient outcome. Furthermore, we find evidence of the importance of family ties and geographical proximity in the land-market, indicating that enforcement and transaction costs between non-linked households hinders transactions. In particular, geographically proximate households conduct more efficiency enhancing transactions. In terms of policy, the major lessons of this paper are twofold: First, informal market exchange does

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not lead to equalisation of the most important factors of production in rural Gambia, implying that the indigenous system of rural land tenure is in need of reformation. Second, geographical proximity seem to lower transaction costs and increase efficiency-enhancing transactions. As geographical proximity is thought to reduce enforcement and monitoring costs, it indicates that reducing these costs through judicial reforms could increase efficiency.

JEL classification codes: O1, D1

Alternative JEL classification codes: O1, D4

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1 Introduction

Land markets in developing countries are often found to be plagued by inefficiencies due to high transaction costs, poor institutional frameworks and constrained access to credit. This leads to inefficient outcomes in both theoretical models and in empirical applications (de Janvry, Fafchamps and Sadoulet, 1991; Skoufias, 1995; Otsuka, 2007). A fast growing literature is highlighting the important role of informal networks in alleviating the negative effects of missing markets (Fafchamps, 1992; Fafchamps and Lund, 2003). However, previous empirical studies of efficiency of land markets fail to account for the importance of social networks. The present paper develops network-level evidence of the effects of family ties and of geographical proximity on allocative efficiency of land. First, it proposes a novel way of testing the impact of link characteristics on allocative efficiency. In order to do this, we use complete land transaction network data of 52 villages in The Gambia. Second, using data on the complete kinship networks in these villages, the paper highlights the importance of interpersonal relationships in resource allocation among rural farmers in order to obtain a deeper understanding of the importance of social networks in the functioning of land markets in developing countries.

Land market efficiency is of crucial importance in many African countries, since it has direct implications for prospects of poverty and inequality reduction as well as economic growth. The issue is particularly important in The Gambia, where land tenancy and distribution is an increasing concern as land scarcity increases as a consequence of a growing population and already high population density (African Development Bank, 2005). Contributing factors are the continued problem of low agricultural productivity, food insecurity and poverty (Gajigo and Saine, 2011). While steps have been taken to reform the tenancy system in and around urban areas, a complex indigenous system of land tenure dominates the rural areas of The Gambia (Freudenberger, 2000). Whether such informal institutions are well-functioning and able to achieve an efficient outcome even in the presence of multiple market failures, is a matter of debate and depend crucially on the country in question. Critics argue that informal arrangements are causing inequality and stagnation due to a failure to allocate land equitably. If the inverse relationship between farm size and productivity exist, this will lead to allocative inefficiency because land is not being reallocated from less productive land abundant farmers towards more productive small farmers (Place and Hazell, 1993; Pender, Nkonya, Jagger, Sserunkuuma and Ssali, 2004). Others argue with reference to tenure and investment decisions that the indigenous system may be preferable (Fenske, 2011).

This study examines allocative efficiency in the informal land market in rural The Gambia. Using an original methodology, we test presence of allocative efficiency in a social network setting, as well as the importance of social and geographical proximity. We find that land flow as to equalize land-labor ratios, but the most efficient outcome is not achieved. Interpersonal relations in terms of family ties and geographical proximity are found to increase household's access to land, however, only transactions between geographically proximate households are found to be efficiency enhancing. To promote efficiency of agriculture, these findings imply that the indigenous system of rural land tenure is in need of reformation. The empirical evidence further suggest that action taking towards reducing transaction costs in the informal land market will help increase agricultural efficiency in rural areas in The Gambia.

The rest of this paper is organized as follows. Section 2 provides a brief introduction to the literature before section 3 discusses the case of rural Gambia. Section 4 introduces the data underlying the empirical analysis. Section 5 formalizes this in a simple theoretical framework structuring the subsequent empirical analysis. The empirical results testing predictions of the model are presented in section 6. Section 7 concludes.

2 Land markets and proximity

One of the most important production assets in rural societies in developing countries is land. Thus, access to land and a well-functioning land market are crucial for growth prospects, inequality and poverty reduction.[1] However, rural society in developing countries is plagued by imperfections, hindering efficient outcomes. These imperfections include both fixed and variable transaction costs such as costs of negotiation, searching and enforc-

[1]When discussing land markets, we have land renting and shareholder contracts in mind. Proper purchasing and selling of land is a much rarer phenomenon, especially in The Gambia due to the dominance of an indigenous tenure system (see the following section).

ing contracts (Carter and Yao, 2002; Pender and Fafchamps, 2005; Eswaran and Kotwal, 1986; Binswanger, Deininger and Feder, 1993). For land markets, poorly functioning institutions and asymmetric information about the quality of land have also been highlighted (Eswaran and Kotwal, 1986; Binswanger, Deininger and Feder, 1993). An additional constraint on land transactions are poorly functioning or non-existing credit markets. However, other input markets, such as the market for labor, are often found to be even less efficient, as monitoring and enforcement costs are even higher.[2] Both theoretical and empirical evidence suggest that in developing countries, the land market is the relatively best functioning of the input markets since problems of moral hazard are smaller, and thus adjustments of land-labor ratios in order to reduce unit costs of output are often found to take place here (Otsuka, 2007).

There is a substantial litterature conducting empirical tests of efficiency of land markets in developing countries. The efficiency concept employed in these studies, as well as the present study, is allocative efficiency. Allocative efficiency is achieved when production factors are allocated in such a way that households use factors in proportions such that a given amount of output is produced at the lowest possible price. This requires that marginal products of input factors are equal across households. In small scale agricultural production where land and labor are the main inputs in production, equalization of technical rates of substitution can either be achieved by land tenancy transactions or by exchange of labor. The available empirical evidence on the efficiency of land tenure markets is mixed. The majority of studies recently conducted on the African continent find significant inefficiency in rural land markets due to presence of high transaction costs (i.e. Holden, Keijiro and Place, 2009). Bliss and Stern (1982, 152) were the first to test the hypothesis of allocative efficiency among farmers in the Indian village Palanpur. They found clear signs of inefficiency in the land lease markets, but also that the market for labor was even more inefficient due to high transaction cost. Building on Bliss and Stern, Skoufias (1995) developed an empirical testable model of the effect of transaction costs and found significant transaction costs in the tenancy market. Common to the vast lit-

[2]This is not to say that households do not exchange labor. However our data confirm the suspicion that labor market transactions are primarily related to labor smoothing and are not contributing to equalization of land-labor ratios. We formally investigate this in the end of the paper.

erature that followed is that land markets are generally found to transfer land from land abundant farmers towards land scarce farmers; however, results on whether an efficient allocation is achieved remains unclear. Kevane (1997) finds allocative efficiency for those participating in the land market in western Sudan. In a case study of Ethiopian farmers, Pender and Fafchamps (2005) were unable to reject the hypothesis of efficient land rental markets estimating a CLAD model for the tenancy side of the market. In comparison, Teklu and Lemi (2004) examined the rental market behavior on the landlord side of the market in southern Ethiopia. They found that that the market was characterized by high transaction costs, resulting in only partial and therefore inefficient land adjustment. Two recent studies also found significant but partial land usage adjustments in the rental market in Ethiopia (Ghebru and Holden, 2009; Deininger, Ali and Alemu, 2009). Using panel data and correcting for unobserved household heterogeneity, Jin and Jayne (2013) confirm the findings of only partial adjustment of land-labor ratios through rental market participation.[3]

2.1 Interpersonal networks and efficiency

In order to motivate the focus on the interaction between proximity and efficiency, we start with an intuitive description of the importance of interpersonal networks, which draws on a similar argument as Fafchamps and Lund (2003). Consider an economy where everyone can potentially agree to exchange land with other households. If there are no transaction costs of doing so, an efficient outcome will generally be achieved. However, in reality, there are costs to land transactions as described in the section above, which leads to lower levels of activity and therefore reduces efficiency. However, transaction costs may be lower for some potential links than for others. In particular, interpersonal relations may lower transaction costs. In this case, exchange of land will tend to follow paths where costs are lowest. Thus, the inefficiencies caused by transaction costs can be mitigated by social networks.

Social networks can also have adverse effects on outcomes. It is increasingly recognized that norms of sharing within kinship groups can lead to inefficient savings-investment-consumption allocations (Baland, Guirkinger

[3]For a review of land market finding in African countries see Holden, Keijiro and Place (2009).

and Mali, 2011; di Falco and Bulte, 2011). Social networks can potentially be used for elite capture through collusion, price fixing and preferential treatment (Cox and Fafchamps, 2007). While it is intuitively appealing that pre-existing network structures can also hinder efficiency of land allocations in a similar way, to the best of our knowledge, these issues have not been investigated empirically.

In a number of different markets, it has been argued that social and geographical proximity can facilitate economic interactions by lowering transaction costs. Udry and Conley (2004) find that geographical proximity also increases the probability of land links, as costs of social interactions are expected to rise with distance. In the land market, geographical proximity may also lower monitoring and enforcement costs. Interpersonal relations are found to be particularly important when institutions are weak or non-existing and markets are imperfect (Fafchamps, 1996). The fact that repeated interaction increases the cost of defaulting on a contract has been highlighted for facilitating informal mutual insurance arrangements (Fafchamps, 1992; Fafchamps and Lund, 2003). Furthermore, since forming connections is costly in terms of time and effort, agents will choose to concentrate on a limited number of arrangements building on pre-existing social relationships, including kinship and neighbourhood. Kinship networks have been studied empirically in the contexts of learning about new technologies (Foster and Rosenzweig, 1995; Bandiera and Rasul, 2006; Conley and Udry, 2010) and on informal risk sharing (Dercon and Weerdt, 2006). More recently, other forms of network-based mutual support systems have been documented, such as work parties (Krishnan and Sciubba, 2009). The fast growing number of studies on this topic all find that interpersonal relationships matter, and that they often take on roles that are commonly assumed by economists to be fulfilled by markets (for a review, see Cox and Fafchamps, 2007).

Some effort has been directed towards the effect of kinship networks on land exchanges. Holden and Ghebru (2006) use the share of kinship contracts in a village to examine land market rationing, while Deininger, Ali and Alemu (2008) approximate networks with whether the household participated and has relation in a village association. The former study finds that tenants in communities with a high share of kinship contracts had easier access to rental markets for land. However, adjustment did not seem to be more efficient for contracts among kin than among non-kin tenants. Sadoulet, de Janvry and Fukui (1997) compared kinship sharecropping contracts with non-kin sharecropping contracts, and found sharecroppers with kinship relationship were not affected by the normal disincentive effect from sharecropping contracts, whereas other sharecroppers were.

However, the studies mentioned above fail to treat network links as endogenous to the rest of the network, possibly due to lack of adequate data. Another limitation to these studies is the assumption of independence between actors: Land market exchange is not explicitly modelled as depending on both own and partner's characteristics. Udry and Conley (2004) was the first to address these points, and more recently Arcand and Jaimovich (2010), by offering evidence on the determinants of endogenous link formation among farmers in Ghana. They map information, credit, labor and land-sharing networks and estimate the probability of link formation between any two farmers as a function of both their characteristics.[4] Udry and Conley (2004) finds that network interactions are more likely between proximate farmers, and that land transactions are more prevalent between farmers who share soil type but the land market is also the market that is least positively affected by belonging to the same lineage. To our knowledge existing studies has only examined the probability to create a link in the land market using a non-directed network. We take the analysis a step further and investigate the amount of land exchanged in a directed network.

3 Land exchange in The Gambia

The Gambian economy is dominated by agriculture which contributes about 33 pct. of GDP ((IMF, 2007) and employs 68 pct. of the labor force.[5] Rural Gambian households are typically organised in compounds, which correspond to a group of people (usually from the same family), who work jointly on common fields, eat together, and organize daily activities under the management of a single decision-maker. Depending on the household size and presence of friction between adult males within the kin-residence group, independent consumption and production units (*dababas)* can coexist

[4] Arcand and Jaimovich (2010) examine link formation in the land, labor, input, credit, marriage and kinship network in rural Gambia using the same data as under study in the present paper.

[5] World Bank Indicators (2010). http://data.worldbank.org/country/gambia

within the compound.

Although the state formally owns all land, de facto usage rights are determined by a complex indigenous land tenure system. Two types of land usage rights exist: Primary and secondary usage rights. A household with primary usage rights over a plot of land can decide what crops to grow and whether to lend or rent all or some of the land out. Traditionally, the descendants of those who first settled and cultivated the land as well as the village chief, called the Alkalo, retain considerable amounts of the primary usage rights in the village. Indeed, descent status continues to be of significance in determining primary rights to land in rural areas (Pamela, 2010). This creates a very unequal primary land rights allocation between households.[6] The first settler's families who possess surplus lands have a moral obligation to loan out land to those in need. These norm-driven secondary usage rights transactions are characterised by being non-monetary: The lenders typically receive no monetary payment for the land that they lend out while sometimes in return of a symbolic payment in kola nuts or cash (Freudenberger, 2000; Arcand and Jaimovich, 2010). We denote households who receive land from such a transaction as secondary land rights holders. Secondary rights are usually renegotiated every year. Thus, secondary right holders do not enjoy permanent occupation and cannot pass along the right to land through inheritance (Freudenberger, 2000).

Hence, rural households can access land in three ways: Through inheritance from primary rights holders, through moneyless assignments of land by the Alkalo and families of the first settlers, and normal market-based transactions. The latter has traditionally been dominated by agreements characterized by fixed rent contracts, but as land scarcity increases due to population growth, arrangements such as cash rental and sharecropping have become increasingly common in rural communities as an additional way of transferring land between households .

Smallholder farmers in Gambia mostly work on their own farm (Pamela, 2010), which fits with the depiction of rural labor markets as plagued by imperfections as described in the section above. The seasonal nature of agricultural production makes family labor periodically insufficient. The shortage is predominately before and during the rainy season in relation to

[6] In the words of Carney and Watts (1991) there has historically been no landlord class in Gambia, rather the predominate system of ownership is 'family' ownership.

the weeding and harvesting season, particularly with respect to groundnuts production which is highly labour intensive. To meet the periodical labour shortage household draw on different strategies (Swindell, 1987). Firstly, household may employ communal labor groups that undertake piece work in exchange of a fixed wage. Second, smallholders may hire an individual worker at the market wage or in exchange for goods, labour or even a marriage agreement. The sequential nature of land and labor flows over the growing season as described above ensures that we can analyse the land market without worrying that transactions in the labor market affect the network structure when deciding on land transactions, as labor transactions do not take place until after land had been assigned.

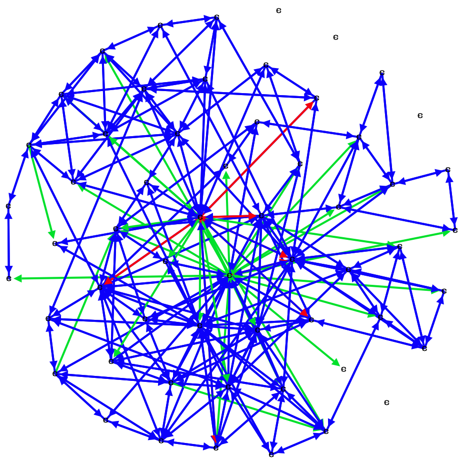
An additional feature of rural input markets in Gambia is worth noting: A system of seasonal migrant workers, so-called *strange farmers,* allows farmers to hire in labor in order to cultivate part of the farmers' plots. Strange farmers generally provide part-time labor for cultivation of their hosts' crops in exchange for the right to cultivate part of the household land for his own benefit. Hence, strange farmers are normally paid in term of access to land or given a portion of the crop that they have helped cultivate (i.e. host farmers do not pay a wage) (Swindell, 1987, 110). Due to data limitations on labor hiring from outside the village, strange farmers are not considered in this study.

3.1 Kinship and land network characteristics in a single village

To give an idea of the nature of the data, Figure 1 and 2 illustrate the land and labor network in a specific village in the dataset. In Figure 1, we graph all family and land links in the network.

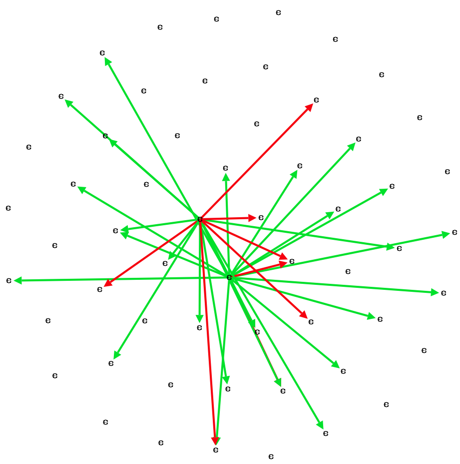
A couple of things are worth noting: First, two households send almost all land in the village (green and red links) - very few land transactions exist that do not originate from one of these two main senders. This corresponds well to the stylized description of the first settlers and Alkalo being the ones who control primary usage rights and distribute secondary usage rights. Secondly, the family network is quite dense in the village: Almost all households are connected to other households through the family network (blue and red links). Figure 2 shows only the network of those connected to the two main land sending households. This figure illustrates that the

Figure 1: Land and family village network



Blue links are family links; green links are land links; red links are where both family and land link is present

Figure 2: Land and family village network of land senders



Blue links are family links; green links are land links; red links are where both family and land link is present land sending households are sending land to a relatively large subset of the village, but not to all. Few households are receiving land from both of the two main sender households. There is some overlap between the households that are receiving land and the family network of senders. However, this overlap is not complete: many households are related through family to the two main sender households and receive no land and many others are not related to the sender households but do receive land. The dyad-level analysis in the subsequent section will formally investigate what role family linkages play in the land network.

4 Data and household level evidence

The data used in this paper comes from the baseline survey collected for the purpose of evaluating of the Community Driven Development Project (CDDP), conducted in 2009. The survey covers 60 Gambian randomly selected villages, representative of 6 out of 8 Local Government Areas across different agro-ecological zones, and with a population between 200 and 1,000 inhabitants. The wide geographical coverage of the sample is shown in Figure **??**. The dataset contains three categories of information: (1) village level information, (2) a standard household survey, and (3) information on six networks: land transactions, labour transactions of the household head, input, credit, marriage and detailed kinship information. The dataset is unique in that it contains information on the transactions between all households residing in the village for these six networks, as well as information on household endowments and structures.[7] Furthermore, for the land and labor networks, the transacted amount is available, measured in hectares of land and working days, respectively. The land network contains both non-monetary transfers of secondary usage rights as well as any cash-rental transactions and sharecropping agreements, if present.

Out of the 60 villages, we drop five villages due to substantial amounts of missing household-level information. Second, throughout the sample, land and labor arrangements are common in all but the three semi-urban villages. As we are concerned with land transactions in rural areas, these three

[7]Data was collected using a structured group approach with a median household coverage rate in the villages of 94 pct. For detailed information on the sampling methodology and data description, see Arcand and Jaimovich (2010).

villages are dropped from the analysis.[8] Moreover, as the subsequent theoretical model seeks to explain market outcomes among farmers, we restrict the sample to households where the main activity of the household head is related to farming.[9] This leaves us with 1,682 household observations across 52 villages, corresponding to 59,797 within village household pairs (i.e. dyads).

The definition of households adopted in the survey closely follows Matlon (1988 cited from Udry 1996: 1016). Notably, the data has the household and not the compound as the unit of observation. This means that if several households exist within one compound, the network between these will be present in our data. Around 14 pct. of the household heads in the sample are not the head of the compound where they live.

While the dataset does not contain information on households that reside outside the village, it includes information about the connections between households in the village and households outside the village. It is therefore necessary to assume that the village is the natural domain for potential exchanges. This assumption is supported by the fact that external actors are not very important in the land and labor network.[10] The low level of land transactions with households outside the village can likely to be explained by the immobility of land which leads to high transaction costs, as inputs must be brought to the land and output must be transported to the places of consumption and sale.

Table 1 provides household-level information for all farmers and separately for those participating in the two different sides in the land market and those in autarky. The data is consistent with the description of rural Gambian markets given in the last section: The largest households in the sample have more than 50 members (only 0.01 pct. of the sample). These

[8]In terms of network activity, some 2 pct. of the urban households participate in the land market, while 10 pct. participate in the labor market. The main reason for absence of labor sharing can possibly be ascribed to the very small land holdings in these areas (0.243 hectares per household compared to 10.282 in the rural villages) as well as increased options for employment outside the village.

[9]Some 13 landless households report that they rent out land without owning in any land. We interpret this as misreporting and drop them from the sample.

[10]Using the same data, Jaimovich (2013) examine the substituability between internal and external links and the impact on reciprocity. Summary statistics suggests that only 5 pct. rent out land to external partners, while 8 pct. receive land from non-village members. The author does find evidence supporting substitutability between internal and external links.

Table 1: Household-level descriptive statistics

	All farmers		By land participation status		
	Mean	Std. Dev.		Mean	
	(N=1682)		Autarky (N=672)	Senders (N=459)	Receivers (N=687)
Household size	13.961	14.749	12.18	15.486	15.288
Age of head	54.121	16.171	52.988	56.142	54.499
HH has family links in the village	0.958	0.201	0.946	0.987	0.953
HH head has family links in the village	0.851	0.356	0.830	0.919	0.84
Wife of HH head has family links in the village	0.517	0.5	0.5	0.61	0.499
HH have marriage links in the village	0.638	0.481	0.619	0.739	0.603
Female headed household	0.056	0.23	0.071	0.039	0.047
Illiterate	0.496	0.5	0.5	0.451	0.512
Formal education	0.09	0.287	0.1	0.092	0.079
Compound head	0.857	0.35	0.827	0.917	0.862
Monogamous	0.451	0.498	0.479	0.416	0.443
Polygamous	0.496	0.5	0.458	0.529	0.518
Christian	0.004	0.064	0.001	0.002	0.009
Ethnicity: Mandinka	0.522	0.5	0.552	0.501	0.523
Ethnicity: Fula	0.188	0.391	0.185	0.185	0.191
Ethnicity: Wollof	0.098	0.298	0.08	0.131	0.09
Land owned with official rights (hec.)	10.233	23.875	8.113	17.284	8.706
Land-labor ratio (ha. land per active worker)	2.711	7.274	2.503	4.458	1.976
Number of working adults	5.314	10.217	4.753	5.59	5.872
Income per working adult (1,000 GMD)	8.022	7.930	8.647	7.447	7.583
Agricultural share (share of income)	0.156	0.268	0.137	0.184	0.167
Emigrants	0.515	0.5	0.484	0.603	0.498
Receive remittances	0.448	0.497	0.414	0.532	0.441

Note: The number of observations in the three land participation columns sum to more than 1709 since some households are both senders and receivers of land.

large households are partly explained by the polygamous nature of the rural Gambian society (45 pct have more than one wife). The households in our sample are predominately lead by low educated men: Only 9 pct. have any formal education. The average monetary income per working capita is 8,022 Gambian Dalasis a year, corresponding to approximately 56.8 USD, of which 16 pct. is stemming from agricultural activities.[11] Households participating on either side of the land market tend to be larger in terms of household size and working adults than households in autarky. Interestingly, receivers of land and households in autarky have similar amounts of land with ownership rights (8.7 and 8.1 ha. respectively), whereas senders of land have larger primary rights landholdings (17.3 ha.). The initial land-labor ratio is lowest for the receivers of land, indicating that those with the lowest land-labor ratios are indeed more likely to receive land.

Furthermore, the villages are characterized by having a substantial number of kinship relationships: 85 pct. of households have relatives of the household head living in the village. Similarly, 52 pct. and 64 pct. have relatives of the wife living in the village and marriage ties to other households in the village, respectively. 96 pct. of households have at least one of these three kinds of links. Senders of land are more likely to have all three kinds of kinship ties to other households, stressing the fact that sender households, often being the first settlers, play an important role in the kinship networks in the village.

Table 1 showed that receivers of land have lower ex-ante landholdings. Table 2 investigates this in more detail by reporting the probability that a household is in the land market on either side against the initial landholdings in ha. per working adult. A striking pattern emerges: Overall, 44.8 pct. of the households in the sample engage in land transactions. Households with a higher initial land-labor ratios are simultaneously more likely to send land and less likely to receive land. Furthermore, 37 pct. of landless households receive land from other households in the sample.[12]

[11] Using an exchange rate of 141.17 Dalasis per USD (Source: World Economic Indicators). Note that consumption and bartering of own production is not included in this figure.

[12] At a first glance, the 2 pct. of landless households who send land seem like a paradox. However, these are households that also receive land and thus end up with a nonnegative amount of land. Households that have a negative amount of land taking into consideration all households in the villages are excluded from the sample and do therefore not appear in this table.

Table 2: Initial land-labor endowment across households

	All	Landless	0.1-0.6 ha/w	0.6-1.6 ha/w	1.6-3.0 ha/w	> 3.0 ha/w
% in land market	44.8	37.3	41.1	40.3	53.8	55.9
Land sender	20.9	2.0	14.4	19	30.4	40.4
Land receiver	28.4	37.0	31.9	25.3	30.0	20.9
Observations	1,682	303	263	546	273	297

5 Empirical framework

5.1 A dyad-level model of land exchange

In the following section, we introduce a simple theoretical framework to explain land flows at the dyad level that in a simple way incorporates the features described above. We exploit the sequential nature of the land and labor market and focus on land transactions. An equivalent model of labor exchanges can be formulated.

The following model is a modified version of a standard model of rural households from Sadoulet, Murgai and Janvry (2001) where we explicitly account for transactions and transaction costs at the dyad level. We consider a household optimisation problem where prices of both input factors and output are exogenously given.[13] A household i maximizes the value of its inputs by producing output as well as sending and receiving land. The production process entails use of the two essential inputs land, A_i, and labour, L_i. The amount land used in production by household i is determined by the endowment, $\bar{A}_i$, and the amount of land the household receives from j, A_{ij} and sends to other households j, A_{ji}. Thus, $A_{ij} \geq 0$ and $A_{ji} \geq 0$. While many of these transfers are moneyless assignments, these do provide a non-monetary value to the sender that is at least as high as the value he could get from renting out the land at the going rate - otherwise he would not conduct any non-monetary assignments. The production function q is identical for all households in a village, increasing in both inputs, twice differentiable, concave and identical between households. Furthermore, it

[13]As described in section 3 above, most land transactions will be moneyless assignments and therefore do not carry a price. The price of land in the model should therefore be thought of as the price on the actual rental market; this price may be very high due to high degrees of imperfections.

exhibits constant returns to scale.[14]

The Labour and land markets are assumed both to be imperfect. Variable costs are modelled as a variable cost of conducting a land and a labor transaction and is captured by the parameters α_{ij}^{A} and α_{ij}^{L}, respectively. We model these as an extra cost for receivers of land, but could equally well have been modelled as an extra cost for senders. Variable costs include enforcement and monitoring costs which can theoretically be affected by proximity. Thus, we allow the size of these imperfections to vary between dyads. Fixed costs are modelled by the parameters ψ_{ij} and ψ_{ij}, respectively.

For a household i, the maximization problem is (where j denotes all other households in the village):

$$\begin{aligned}
\max_{A_{ij},L_{ij}} \quad & p * q(\bar{A}_i + \sum_j A_{ij} - \sum_j A_{ji}, \bar{L}_i + \sum_j L_{ij} - \sum_j L_{ji}) \\
- \quad & r(\sum_j [A_{ij}(1+\alpha_{ij}^{A}) - A_{ji}]) \\
- \quad & w(\sum_j [L_{ij}(1+\alpha_{ij}^{L}) - L_{ji}]) \\
- \quad & \psi^{A} I[A_{ji} > 0] - \psi^{L} I[L_{ji} > 0]
\end{aligned} \tag{1}$$

For the aim of maximizing total harvest households can form new links or server existing ones. Whereas links can be deleted unilaterally, the link formation process is regarded as bilateral. Hence, for a transfer to take place (i.e. a link to be established) the consent of both parties are required.[15] The equilibrium concept employed to ensure this is a generalization of pairwise stability (Jackson and Wolinsky, 1996). A pairwise stable network is a network where no agent has an incentive to delete an existing link and no pair of agents both have an incentive to form a new link. This equilibrium concept allows agents to only review their relationships sequentially while still treating the network formation as endogenous. Thus, when a give exchange between two households is determined, all other exchanges in the network

[14]It has been argued that in the absence of large scale-mechanization, the assumption of constant returns to scale is not unrealistic (Hayami and Otsuka 1993; Deininger and Binswanger 2001). Note that the subsequent predictions of equal land-labor ratios under allocative efficiency also hold under the assumption of decreasing return to scale. However under decreasing return to scale, farm size should also be equalized.

[15]Bilateral link formation process means that i can only receive land if j agree to send land, i.e. $A_{ji} = -A_{ij}$. See Comola and Fafchamps (2011) for examples of bilateral and unilateral link formation.

are taken as given. We denote this exchange as the marginal exchange. We regard this stability concept to be appropriate due to the abiding nature of land market transactions. Furthermore, we abstract from potential benefits from indirect links.

Combining first order conditions for household i and j, we get the following expression which implicitly defines the size of the land transaction from j to i. Conditional on exchanging land (i.e. that the fixed transaction costs are not prohibitively high), the households will exchange land until the marginal value of land is equalized between the two households:

$$\begin{aligned} f(A_{ij}, \alpha_{ij}^A) &= p\frac{\partial q(\bar{A}_i + \sum_k A_{ik} - \sum_k A_{ki} + A_{ij}, \bar{L_i})}{\partial A_{ij}} - \alpha_{ij}^A \\ &- p\frac{\partial q(\bar{A}_j + \sum_k A_{jk} - \sum_k A_{kj} - A_{ij}, \bar{L_j})}{\partial A_{ij}} = 0 \qquad (2) \end{aligned}$$

Where $i \neq j$, $j \neq k$, $i \neq k$ and the production functions are evaluated taking all other exchanges in the network as given. Intuitively, if marginal values of land are different enough to overcome the cost of exchanging land, a land transaction will take place.

Now, consider the case where the marginal value of production of land is higher for household i than for household j before the marginal exchange, i.e. $\frac{\partial q(\bar{A}_i + \sum_k A_{ik} - \sum_k A_{ki}, \bar{L_i})}{\partial A_{ij}} > \frac{\partial q(\bar{A}_j + \sum_k A_{jk} - \sum_k A_{kj}, \bar{L_j})}{\partial A_{ij}}$. Thus, a transfer from j to i will increase efficiency. First, note that due to the assumption of constant returns to scale, if $\alpha_{ij}^A = 0$, land-labor ratios will equalize perfectly. The equalizing land exchange is then $A_{ij}^* = \frac{\bar{L}_i A_{j/-ij} - \bar{L}_j A_{i/-ij}}{\bar{L}_j + \bar{L}_i}$, where $A_{i/-ij} = \bar{A}_i + \sum_k A_{ik}$. However, in general, transaction costs will be present, resulting in less than perfectly equalized land-labor ratios. Applying the implicit function theorem on equation 2 we find for $A_{ij} > 0$: $\frac{dA_{ij}}{d\alpha_{ij}^A} = -\frac{\partial f/\partial \alpha}{\partial f/\partial A_{ij}} = (p * (\frac{\partial^2 q_i}{\partial A_{ij}^2} + \frac{\partial^2 q_j}{\partial A_{ij}^2}))^{-1} < 0$ where q_i and q_j are the production functions of the two households evaluated at their ex-post input amounts. Thus, when equalization is imperfect, i.e. when $\alpha_{ij}^A > 0$, the optimally exchanged amount from j to i will be lower than the equalizing amount, the larger α_{ij}^A is. We approximate this result by allowing transaction costs to affect the transacted amount from j to i in a linear fashion:

$$A_{ij} = max[0, -\alpha_{ij}\theta_0 + (1 - \alpha_{ij}\theta_1)A_{ij}^*] \qquad (3)$$

Alternatively, consider the allocation of land as the problem of a benevolent social planner. The social planner wants to equalize land-labor ratios but realize that transactions are costly. Thus, he wants to minimize the amount of land that needs to be transferred. This corresponds to norm-driven transactions where the reference point of households is the average land-labor ratio rather than the land-labor ratio of a single counterparting household. In this case, households with higher-than average land-labor ratios will send land until the land-labor ratio is equal to the village average V^v. The receiving households will be those with inital land-labor ratios below the village average. They will receive land until their land-labor ratio is equal to the village average. Thus, the land transaction between i and j will be given by

$$A_{ij}^v = min(A_{ij}^{vi}, A_{ij}^{vj}) \tag{4}$$

where A_{ij}^{vi} and A_{ij}^{vj} are implicitly defined by

$$p\frac{\partial q(\bar{A}_i + \sum_k A_{ik} - \sum_k A_{ki} + A_{ij}^{vi}, \bar{L}_i)}{\partial A_{ij}} - \alpha_{ij}^A = v \tag{5}$$

$$p\frac{\partial q(\bar{A}_j + \sum_k A_{jk} - \sum_k A_{kj} - A_{ij}^{vj}, \bar{L}_j)}{\partial A_{ij}} = v \tag{6}$$

If there are no transaction costs, the transaction taking place is the smallest transaction that allows one of the households to get to the village level average: $A_{ij}^{*v} = min(\bar{A}_i + \sum_k A_{ik} - \sum_k A_{ki} - v\bar{L}_i, \bar{A}_j + \sum_k A_{jk} - \sum_k A_{kj} - A_{ij}^{vj} - v\bar{L}_j)$

Again, transaction costs will lower the transacted amount if the transacted amount is positive in the absence of transaction costs.[16] We approximate this result by allowing transaction costs to affect the transacted amount in a linear fashion:

$$A_{ij}^v = max[0, -\alpha_{ij}\theta_0^v + (1 - \alpha_{ij}\theta_1^v)A_{ij}^{*v}] \tag{7}$$

[16] From the equations, it can also be seen that transaction costs are only affecting A_{ij}^{vi} and not A_{ij}^{vj}. This is an artifact of the fact that transaction costs are put on the receivers of land and labor. In reality, we could easily think of transaction costs affecting both the price of receivers and senders of land.

5.2 Estimation strategy

While we model parts of the dyad-specific transaction costs, much dyad-specific information is unobserved. One aspect of such unobserved information that affects A_{ij} is trust between two households. If trust is low, a potential sending household will be reluctant to send land to a potential receiver. We model this as an unobserved shock ϵ_{ij} to the amount that households want to transfer: $A_{ij} = max[0, \alpha_{ij}\theta_0 + (1 - \alpha_{ij}\theta_1)A^*_{ij} + \epsilon_{ij}]$. If $\alpha_{ij}\theta_0 + (1 - \alpha_{ij}\theta_1)A^*_{ij} + \epsilon_{ij} > 0$, a transfer will take place.

Assuming dyad-specific shocks to the transacted amount are normally distributed, the model above can be estimated by a tobit-model. To ensure identification of the attributes we adopt the analytical approach to link formation proposed by Fafchamps and Gubert (2007). Denoting link specific variables affecting transaction costs w_{ij} and denote household specific attributes affecting transaction costs (z_i, z_j), our estimating equation is:

$$\begin{aligned} A_{ij} \quad = \quad & max(0, \gamma_o + \gamma_1 A^*_{ij} + \gamma_2 A^{*v}_{ij} + \gamma_3 w_{ij} + \gamma_4 w_{ij} A^*_{ij} + \gamma_5 w_{ij} A^{*v}_{ij} + \\ & \beta_1(z_i - z_j) + \beta_2(z_i + z_j) + \epsilon_{ij}) \end{aligned} \tag{8}$$

Where the amount of land i receive from j, A_{ij} is measured in hectares. It is important to note that allocative efficiency can be acheived even though *some* dyads experience transaction costs. However, efficiency is only achieved if households have sufficient links where there are no transaction costs such that these households are able to equalize land-labor ratios. Thus, under the assumption of allocative efficiency, if land-labor ratios are not equalized before the marginal transaction (meaning that $A^*_{ij} \neq 0, \; A^{*v}_{ij} \neq 0$), the marginal transaction will always equalize land-labor ratios. We do not include A^*_{ij} and A^{*v}_{ij} in the same model due to collinearity issues. Thus, a test of $\gamma_0 = 0 \;\wedge\; \gamma_h = 1, \; h = \{1, 2\}$ in the restricted model where $\gamma_3 = \gamma_4 = \gamma_5 = \beta_1 = \beta_2 = 0 \;\wedge (\gamma_1 = 0 \;\vee\; \gamma_2 = 0)$ is a test of allocative efficiency in the sense that land-labor ratios equalize perfectly through transactions. If we fail to accept the hypothesis of allocative efficiency, land may still flow in the predicted directed. $\gamma_1 > 0 \;\vee\; \gamma_2 > 0$ support the prediction that land flow as to enhance allocative efficiency. It is worth noting that this could also have been observed by investigating land-labor ratios of households directly. However, such a simple model provides a baseline against which we can examine the effect of specific link-characteristics.

As indicated earlier, the price of output will affect the transacted amount. This may vary between villages. This is one reason for including village-fixed effects.[17] It is essential to correct standard errors for non-independence across observations, which arises principally because residuals from dyadic observations involving the same individual i and j are correlated with each other. Thus, we cluster standard errors on villages. This approach is conservative in the sense that we do not assume anything about the dependency of dyadic observations inside the villages (Fafchamps and Söderbom, 2011).

Other variables of interest

Apart from the predicted household level and village level efficiency accomplishing transactions (A^*_{ij} and A^{*v}_{ij}, respectively), our main variables of interest are social and geographical proximity. In order to examine if transaction costs affect the transacted amount - and whether proximity is efficiency enhancing - we include social and geographical proximity as link-specific indicators included in w_{ij}. If $\gamma_3 \neq 0$, it is a sign of market segmentation: Some link-specific attributes affect access to land. Given proximity affects transaction costs negatively, we expect $\gamma_3 > 0$, i.e. to increase the potential for transactions. To test whether market segmentation enhance allocative efficiency, we introduce interaction terms between link-specific characteristics and the efficiency accomplishing predictors. Thus, if $\gamma_h > 0,\ h = \{4, 5\}$ then transactions between proximate household flow as to enhance efficiency. On the other hand, $\gamma_3 > 0 \wedge \gamma_h = 0,\ h = \{4, 5\}$ is evidence supporting the view that market segmentation create a system of insiders and outsiders where some households get preferential access.

The first measure of social proximity is an aggregated kinship measure taking the value 1 if two households are family related through the household head, the wife or marriage arrangements. To more closely examine what kind of family links that matter for the possibility of receiving land, the kinship measure is disaggregated into kin of the household head, kin of the wife of the household head and marriage links. Table A1 report dyad-level descriptive statistics.

[17]Usually, the inclusion of fixed effects is not feasible in a tobit model due to the problem of incidental parameters. However, this is an issue only when there are few observations for each fixed effect. Due to the dyadic nature of the regressions, there are many observations for each fixed effect, varying from 198 to 3600. Thus, we include village fixed effects.

Geographical distance is measured by two variables: (i) a dummy variable taking the value 1 if household i and j is neighboring compounds, and 0 otherwise, and (ii) a dummy variable taking the value 1 if household i and j have neighbouring plots, and 0 otherwise.[18] Data on geographical distance was only collected for a subsample of the villages. This means that the sample on neighboring compounds (plots) is reduced to 25 (19) villages, corresponding to 856 (637) households. In the reduced sample, some 10 pct. of the households are regarded as compound and/or plot neighbors.

Controls

To the extent that other variables are correlated with the actual amount of land exchanged as well as the explanatory regressors, it is essential to control for these in order to obtain the true effect of social and geographical proximity. We therefore include various control variables. Summary statistics are reported in Table A1.

A total of five additional link-specific indicators (w_{ij}) are included alongside the measures of social and geographical proximity. We correct for religion as there may exist informal enforcement mechanisms available within religious groups (Udry and Conley, 2004). We include two measures of religious affiliation: (i) whether the households belong to the same religion, and (ii) the extent to which the household practice according to the Koran. It has alsobeen suggested that group membership such as ethnicity play an important role in market exchange as it facilitate trust (Fafchamps, 2000).[19]

Illiterate households may find it useful to create a link to households with literate members, while literate households may be less willing to lend land to illiterate households under the presumption that the educational level of the head can be used as a proxy for managerial ability. The later effect may however be dominated by altruistic behaviour, in which case we would expect pairs of illiterate households to transact less land. The sign of γ_3 for illiteracy will therefore depend on which effect is dominating. Households initial land-labor ratio and thus demand for land is directly affected by

[18] The two geographical variables are positively correlated but only imperfectly (0.18).

[19] Arcand and Jaimovich (2012) find that households of the same ethnic group are less likely to form a land link using the same data as in the present study. However, Gajigo and Foltz (2010) show that households of the Serahule ethnic group in Gambia are more likely to provide credits among them, partly explaining the entrepreneurial success of the group.

household emigration, and thus we include an indicator variable for whether both households have at least one household member that have emigrated to another village.

In addition, a total of three household specific attributes are included. To allow for $E[A_{ij}] \neq E[A_{ji}]$, regressors must enter the estimation in an asymmetric form. For individual attributes this requirement is satisfied by letting the regressors enter in the form $(z_i - z_j)$ and $(z_i + z_j)$. The coefficient on $(z_i - z_j)$ captures the effect of differences: If $\beta_1 < 0$, it indicates that the higher z_j is relative to z_i, the more land i receive from j. The coefficient on $(z_i + z_j)$ captures the direct effect of the combined level of the variable z on $E[A_{ij}]$.

The first attribute included is the household size, as larger households are likely to have a higher demand for land. The second is the relative wealth level measured using a subjective measure of wealth where household self-selects into four wealth categories. In the land network Udry and Conley (2004) find that the absolute value of the wealth difference is important for the probability to form a link in the land market. If relatively richer households send more land, then we expect $\beta_1 > 0$. Moreover, if $\beta_2 > 0$ then households on a relatively higher wealth level are more likely to engage in land transactions. Thirdly, since land in rural Gambia is allocated according to traditional customary law, we expect young households to have lower initial land holdings and thus older households may be obligated to enhance factor equalization. In line with the findings by Udry and Conley (2004) we expect the difference-coefficient on age to be negative.[20]

6 Results

6.1 Baseline results

Following the discussion above, a dyadic tobit regression model is estimated. Baseline estimation results are presented in Table 3. Columns (1) and (3) present baseline models using the two predictors of the efficiency accomplishing transaction: Column (1) uses the predictor of the household level efficiency accomplishing transaction A^*_{ij} while column (3) employs the predictor of the village lavel efficiency accomplishing transaction A^{*v}_{ij}. Both

[20] Udry and Conley (2004) find that the absolute difference in the age of the household head increases the probability to exchange land.

predictors are significant and positive as expected. However, they are also significantly smaller than 1. Combined with the signficantly negative constant terms, this implies that some adjustment towards allocative efficiency does take place, but that the adjustment is only partial.[21]

Columns (2) and (4) add additional explanatory variables. The coefficient estimates of the predictors change only marginally when including additional explanatory variables. Thus, the effect picked up by this predictor cannot be explained by any of the additional explanatory variables: The relative land-labor endowents have an additional effect.

Furthermore, magnitude and significance of the additional explanatory variables do not change depending on the predictor used. Three variables are statistically significant. First, household i receives more land if the head of household is older than the head of household j. While previous studies examining a non-directed land network find that differential age among household heads increase the probability to exchange land (Udry and Conley, 2004), our result imply that households with older heads tend to receive more land. Second, the negative and significant (at the 10% level) estimate of the effect of differential wealth level suggests that less wealthy households receive more land from weathier households. Finally, the positive sign on the sum of households wealth level indicate that households on a higher relative wealth level are more likely to exchange land.

6.2 Importance of family ties

Table 4 include a dummy variable for a kinship tie at the dyad level.[22] The coefficient estimate on kinship is positive and significant using either predictor in column (1) and (3). Hence, households connected by kinship trust each other more, possibly because repeated interactions reduce moral hazard due to higher cost associated with not upholding a contract. This implies that kin related households have easier access to land, leading to market segmentation in rural Gambian villages.

[21] Employing a test of efficiency of the land market first proposed by Skoufias (1995) which takes the household as the level of observation (as opposed to the dyad as the level of observation in the present paper) gives a similar result: Households do adjust land holdings towards the optimal size, but only partially. Results of this test can be found in A2.

[22] Estimation output for the additional explanatory variables are avaiable from the authors apun request.

Table 3: Regression results: Baseline

	(1)	(2)	(3)	(4)
A^*_{ij}	0.047***	0.044***		
	(0.009)	(0.009)		
A^{*v}_{ij}			0.086***	0.081***
			(0.027)	(0.022)
Additional expl. variables				
Same ethnicity		0.210		0.236
		(0.194)		(0.192)
Both coranic literate		-0.299		-0.310
		(0.297)		(0.295)
Same religious affiliation		0.077		0.084
		(0.652)		(0.650)
Both illiterate		-0.008		-0.011
		(0.217)		(0.217)
Both have emigrated members		0.011		0.005
		(0.172)		(0.170)
Diff. household size		-0.004		-0.004
		(0.003)		(0.003)
Sum household size		0.007		0.006
		(0.006)		(0.007)
Diff. age of head		0.446**		0.449**
		(0.178)		(0.178)
Sum age of head		-0.219		-0.213
		(0.196)		(0.191)
Diff. wealth level		-0.164*		-0.167*
		(0.093)		(0.093)
Sum wealth level		0.411***		0.420***
		(0.097)		(0.098)
Observations	59,797	59,797	59,797	59,797

Note: Dependent variable: Amount of land i receives from j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

Table 4: Regression results: Social proximity

	(1)	(2)	(3)	(4)
A^*_{ij}	0.043***	0.043***		
	(0.009)	(0.009)		
A^{*v}_{ij}			0.078***	0.080***
			(0.022)	(0.022)
Kin tie	1.594***		1.609***	
	(0.315)		(0.316)	
Kin of head		1.570***		1.589***
		(0.393)		(0.396)
Kin of wife		0.943*		0.951*
		(0.566)		(0.571)
Marriage kin		0.613		0.651
		(0.500)		(0.498)
Additional expl. variables	Yes	Yes	Yes	Yes
Observations	59,797	59,797	59,797	59,797

Note: Dependent variable: Amount of land i receives from j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

In columns (2) and (4), we split the kinship variable into kin of the household head, kin of a wife of the household head and marriage links. The coefficient estimate on kin of the household head is large in size and statistically significant on a 1 pct. level. In comparison, the coefficient estimate on relatives of the wife is almost half in size and only statistically significant on a 10 pct. level. The patrilocal nature of the Gambian society is likely to explain why relatives of the wife(s) are less important in determining land formation. The positive estimate of both confirm that market segmantation is caused by both family ties related to the household head as well as the wife(s) of the head. Being connected by marriage is not significant in the two models. This is evidence of the fact that not all family links are created equally: Some family connections are stronger and thus decrease transaction costs more.

6.3 Importance of geographical proximity

Like social proximity, geographical proximity can help alleviate transaction costs as households that reside close to each other have clear informational

Table 5: Regression result: Geographical proximity

	(1)	(2)	(3)	(4)	(5)	(6)
A^*_{ij}	0.057***	0.055***	0.054***			
	(0.015)	(0.015)	(0.014)			
A^{*v}_{ij}				0.120**	0.116***	0.119***
				(0.047)	(0.044)	(0.043)
Kin of head	1.823***	1.631***	1.320***	1.855***	1.662***	1.345***
	(0.520)	(0.488)	(0.482)	(0.526)	(0.494)	(0.488)
Kin of wife	0.989	0.954	0.690	1.031	0.989	0.722
	(0.774)	(0.779)	(0.738)	(0.783)	(0.792)	(0.750)
Marriage kin	0.724	0.624	0.633	0.703	0.603	0.613
	(0.698)	(0.704)	(0.694)	(0.715)	(0.720)	(0.711)
Neighbor compound		1.250***	0.696*		1.263***	0.704*
		(0.354)	(0.406)		(0.350)	(0.404)
Neighbor plot			2.315***			2.334***
			(0.393)			(0.395)
Additional expl. variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,574	24,574	24,574	24,574	24,574	24,574

Note: Dependent variable: Amount of land i receives from j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

advantages. Table 5 include measures for geographical proximity. To ensure that the results are not driven by the smaller sample, the baseline regression is re-estimated on the smaller sample in column (1).[23] Comparing with results of Table 3, sign and significance of the variables of interest are unchanged. Turning to the additional explanatory variables (not shown), the relative wealth level and age of the household head are no longer significant. Contrary, whether both households are Koranic literate is now significant and negative on a 10 pct. level: Koranic literate households exchange less land with each other.

Including the compound proximity variable in (2) and (5), it is positive and significant. However, when also including the plot proximity variable

[23]There an issue with the standard errors of these tables as the number of villages (20) is so low that the standard cluster correction approach tend to overreject. Suggestions are welcome!

which is positive and significant in (3) and (6), the compound proximity variable is only significant on a 10 pct. level. Thus, as expected, geographical proximity, especially plot proximity, positively affect the exchanged amount. Magnitude and significance of all other variables is unchanged.

6.4 Are social and geographical proximity efficiency enhancing?

As the results above indicate socially and geographically proximate households do indeed exchange more land, a natural next question to ask is whether the presence of proximity-effects can be efficiency enhancing by increasing the number of feasible efficiency-enhancing transactions. In the framework of the model, we test this by including interaction terms between the proximity-dummies and A^*_{ij}. Results of social proximity are reported in Table 6. There are no efficiency-enhancing effects using either predictor. This is true both when including the aggregated kinship-dummy (column 1 and 3), and when splitting it up into its components (column 2 and 4). This implies that kinship networks provide a basis for creating a system of insiders and outsiders, where family members of the first settlers get preferential treatment in terms of access to land.

Results of efficiency enhancing effects of geographical proximity are reported in Table 7. Interestingly, geographical proximity does increase exchanges in efficiency-enhancing ways. Using A^*_{ij} as the predictor in column (1), both having proximate plots and proximate compounds increases the probability of conducting efficiency-enhancing exchanges. The non-interacted predictor is now insignificant and the point estimate is halved. Using A^{*v}_{ij} as a predictor, having proximate compounds increase the probability of conducting efficiency-enhancing exchanges. The non-interacted predictor is now only significant at the 10 percent level. These results indicate that, efficiency-enhancing exchanges of land takes place between geographically proximate households, underlining the importance of trust and/or enforcability when conducting land exchanges.

Table 6: Efficiency and social proximity

	(1)	(2)	(3)	(4)
A^*_{ij}	0.043***	0.043***		
	(0.011)	(0.011)		
A^{*v}_{ij}			0.081***	0.080***
			(0.030)	(0.027)
Kin tie	1.597***		1.619***	
	(0.325)		(0.325)	
Kin of head		1.559***		1.572***
		(0.398)		(0.398)
Kin of wife		1.044*		1.017*
		(0.570)		(0.583)
Marriage kin		0.542		0.597
		(0.513)		(0.503)
A^*_{ij}* kin tie	-0.001			
	(0.009)			
A^{*v}_{ij} kin tie			-0.009	
			(0.027)	
A^*_{ij}* kin of head		0.002		
		(0.012)		
A^*_{ij}* kin of wife		-0.027*		
		(0.016)		
A^*_{ij}* marriage kin		0.011		
		(0.015)		
A^{*v}_{ij}* kin of head				0.007
				(0.022)
A^{*v}_{ij}* kin of wife				-0.042
				(0.032)
A^{*v}_{ij}* marriage kin				0.024
				(0.045)
Additional expl. variables	Yes	Yes	Yes	Yes
Observations	59,797	59,797	59,797	59,797

Note: Dependent variable: Amount of land i receives from j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

Table 7: Efficiency and geographical proximity

	(1)	(2)
A^{*}_{ij}	0.029	
	(0.020)	
A^{*v}_{ij}		0.076*
		(0.039)
Kin of head	1.278***	1.283***
	(0.466)	(0.477)
Kin of wife	0.712	0.722
	(0.724)	(0.740)
Marriage kin	0.625	0.581
	(0.682)	(0.713)
Neighbor compound	0.537	0.476
	(0.384)	(0.379)
Neighbor plot	2.298***	2.413***
	(0.393)	(0.400)
A^{*}_{ij}* neighbor compound	0.067***	
	(0.020)	
A^{*}_{ij}* neighbor plot	0.070**	
	(0.028)	
A^{*v}_{ij}* neighbor compound		0.270***
		(0.070)
A^{*v}_{ij}* neighbor plot		-0.009
		(0.099)
Observations	24,638	24,638

Note: Dependent variable: Amount of land i receives from j. A^{*}_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

6.5 Sensitivity analysis

Sample split

Despite absence of allocative efficiency, the empirical analysis confirmed that both the predicted household and village level efficiency accomplishing transactions help explain land market formation. Hence, households relative land-labor ratios are important for the allocation of land among rural farmers in The Gambia, and land does indeed flow in the direction predicted by the theoretical model. Furthermore, evidence support the hypothesis that social and geographical proximity decrease transaction costs, thereby increasing land market transactions. In the subsequent analysis we investigate the sensitivity of the results by splitting the sample along different dimensions. All estimations are run on the whole sample to ensure a sufficient sample size, and thus power of the estimates.

Majority owners The complex indigenous land tenure system generally creates a highly unequal allocation of land rights within rural Gambian villages. To investigate whether social proximity alleviate transaction costs more in villages characterized by high land ownership inequality, we split the sample into two categories: villages where land belong to the first settlers and villages where land ownership is mixed. This also allow us to examine whether higher inequality in land ownership lead to more efficiency enhancing transactions compared to mixed ownership where a larger number of villagers own land. Estimation results are shown in Table 8, column (1). Several interesting findings emerge. First, considering A^{*}_{ij}, more efficiency enhancing transactions are taken place in villages where primary usage rights belong to households of the first settlers, whereas A^{*v}_{ij} imply that more efficient transaction take place in villages with mixed land ownership. Second, family ties of the head and the wife increase land transactions in villages where land is distributed by the first settlers, while unimportant in villages characterized by mixed ownership. Third, marriage ties increase land transactions in mixed ownership villages. This may imply that households marry to access land, similar to the labor market where marriage arrangements are sometimes used in exchange of outside labor (Swindell, 1987).

Table 8: Land transactions by land ownership status

	(1) Land ownership		(2) Village production	
	First setlers	Mixed	Groundnuts	Various crops
A^*_{ij}	0.048***	0.031*	0.027**	0.051***
	(0.012)	(0.018)	(0.011)	(0.013)
Kin of head	1.765***	0.754	0.760	1.983***
	(0.437)	(0.868)	(0.831)	(0.455)
Kin of wife	1.269**	-0.482	-0.109	1.104*
	(0.609)	(1.433)	(1.583)	(0.619)
Marriage kin	-0.044	2.116**	0.151	0.799
	(0.616)	(0.969)	(1.039)	(0.553)
A^{*v}_{ij}	0.072***	0.119**	0.045***	0.127***
	(0.022)	(0.057)	(0.010)	(0.039)
Kin of head	1.783***	0.804	0.771	2.011***
	(0.440)	(0.867)	(0.833)	(0.458)
Kin of wife	1.287**	-0.452	-0.102	1.122*
	(0.616)	(1.416)	(1.614)	(0.621)
Marriage kin	0.006	2.167**	0.206	0.782
	(0.616)	(0.957)	(1.048)	(0.559)
Additional expl. variables	Yes	Yes	Yes	Yes
Observations	48,835	9,652	18,091	39,056

Note: Dependent variable: Amount of land i receives from j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All estimations include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

Village production Next, we split the sample depending on village's agricultural production. We categorize villages into two groups: villages that only cultivate groundnuts, and villages that cultivate various crops. Since groundnuts cannot be grown in the wet lowland along the Gambian River basin and are solely produced for the market, this measure is considered to be a rough proxy for sole upland cash crop villages. Column (2) in Table 8 show that the predicted efficiency accomplishing transaction is statistically significant and positive for both samples. In terms of magnitude, more efficiency enhancing transactions are taking place in lowland villages cultivating at least two types of crops. Interestingly, kinship ties are not a significant determinant of land formation in groundnut producing villages.

Arable land Land rental markets in African countries are argued to be more active in densely populated areas, however the impact on efficiency is largely unknown (Holden, Keijiro and Place, 2009; Jin and Jayne, 2013).[24] We split the sample by arable land per villager to examine whether areas with a higher population density is characterised by more efficiency enhancing transactions. The cut-off chosen is the median, corresponding to 1.87 hec. per person.[25] Table 9, column (1) report estimation results by population density. Coefficient estimates on our two predictors are statistically significant and their magnitude corresponds somewhat to the previous findings. The size of the coefficients confirm that more efficiency enancing transactions take place in more densely populated villages. Furthermore, kin of the wife is found to be unimportant i high populated villages, while statsitically significant and large in magnitude in villages charcaterised by lower population density.

Ethnic fragmentation If there exist lower trust between different ethnic groups and less social and economic link are created in ethnic diverse societies as suggested by Easterly (2001, 689), then less transactions should take place in ethnically heterogeneous villages. Lower trust is associated with higher transaction costs in the market for land, and thus we would expect fewer efficiency enhancing transactions to take place in more ethnic diverse villages. Contrary to expectations, column (2) in Table 9 show that

[24]Jin and Jayne (2013) find that village population density have no determining impact on the net land rented in or out in Kenya.

[25]The estimation results is not sensitive to cut-offs in the same range.

Table 9: Land transactions by ethnic diversity

	(1) Population density		(2) Ethnical diversity	
	Low	High	Heteroge-neous	Homogenous
A^*_{ij}	0.065*	0.044***	0.057***	0.038***
	(0.035)	(0.010)	(0.013)	(0.010)
Kin of head	1.134**	1.814***	2.043***	1.225**
	(0.458)	(0.534)	(0.592)	(0.537)
Kin of wife	-0.271	1.565**	0.087	1.434**
	(0.773)	(0.715)	(0.802)	(0.715)
Marriage kin	0.171	0.856	0.751	0.513
	(0.867)	(0.597)	(0.693)	(0.664)
A^{*v}_{ij}	0.095	0.086***	0.140**	0.066***
	(0.064)	(0.026)	(0.055)	(0.020)
Kin of head	1.134**	1.844***	2.064***	1.249**
	(0.459)	(0.538)	(0.592)	(0.542)
Kin of wife	-0.266	1.581**	0.078	1.456**
	(0.777)	(0.723)	(0.791)	(0.725)
Marriage kin	0.129	0.917	0.705	0.579
	(0.880)	(0.592)	(0.686)	(0.660)
Additional expl. variables	Yes	Yes	Yes	Yes
Observations	18,037	42,010	28,546	31,501

Note: Dependent variable: Amount of land i receives from j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. The cut-off between low and high population density is the median (1.87 hec pp). All estimations include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

more efficient land transactions take place in heterogeneous villages. In more ethnic diverse villages family ties of the household head is the primary determinant of land formation, whereas family ties of the wife also increase land transactions in more homogenous villages.

6.6 Labor market

According to the theoretical model land transactions are not the only factor that can be used to equalize factor ratios across households. Another option is to adjust the amount of labor. If indeed the labor market is used to equalize land to labor ratios we would expect households with low land-labor ratios to take up wage labor, while households with high land-labor ratios to hire workers. We construct a similar set of predictions for labor transactions where households land-labor ratio is based on the amount of land cultivated after all land exchanges has taken place. The underlying reason for this is the sequential nature of land and labor exchanges described earlier, where labor exchange takes place after land allocation. Table A3 report summary statistics on households participation in the labor market depending on their land to labor ratio. The pattern is less clear compared to the market for land: While land abundant households are more likely to receive land than households with smaller land endowments, indicating that exchanges offset initial inequalities in endowments, land abundant households are also more likely to send land, compared to slightly less land abundant households. Hence, the descriptive evidence indicate that other mechanisms than equalization of land-labor ratios may be driving exchanges of labor.[26]

To more formally investigate this, we reestimate equation (8) substituting the dependent variable to examine the labor market with labor transactions of the household head, measured in work-days. To ease interpretation in the sense that the expected signs correspond to the regression results presented on land exchanges the dependent variable is now defined as the amount of labor household i *send* to j. Baseline results are presented in Table A4, while Table A6 and A5 include social and geographical proximity. The control variables in both tables correspond to the ones included in the land market. Correcting for various household characteristics in the baseline regressions we find that none of the predictors of labor transactions are

[26]We obtain similar results if we use initial land endowment rather than the ex-post amount of land cultivated.

statistically significant at a 5 pct. level.

In terms of social proximity, we find that kin related households exchange more labor (column 1 and 3 in Table A5), possibly because social proximity reduce monitoring costs and facilitate enforcement mechanisms. This is in line with the literature on risk sharing where it is found that transfers that are performed in order to offset the impact of shocks often travel along family networks. Disaggregating kinship, we see that the effect of family relations on labor transactions can be attributed to kin effects of both the head, wife(s) as well as marriage ties.

In accordance with expectations, geographical proximity of compounds and agricultural plots decrease monitoring and enforcement costs associated with labor: Households located close to each other are more likely to be linked through labor exchange. In comparison to the land market, the magnitude of the coefficient estimates attributed to social and geographical proximity is considerably smaller. While we find that proximity increase labor market access, these transactions does not flow as to increase allocative efficiency. This is evident from the insignificant interaction terms between our predictors of allocative efficiency and the link specific characteristics reported in Table A7 and A8.

7 Conclusion

This paper examines allocative efficiency and the importance of social and geographical proximity in land markets using a social network approach. The analysis is based on complete network data covering farmers in 52 rural villages in The Gambia. To our knowledge, this is the first study that operationalizes the concept of allocative efficiency using dyad-level analysis. The paper also contributes to an understanding of the processes by which social and geographical proximity affect resource allocation among smallholder farms. The analysis has three main findings:

First, land markets in The Gambia do not fully equalize land-labor ratios due to presence of high transaction costs and/or other imperfections. While the efficient outcome is not achieved, land transactions do flow in the predicted efficiency-enhancing directions. Though both our efficiency accomplishing land predictors provide similar results, the household-level predictor, A^*_{ij} is taken as the preferred since this measure can be applied even in absence of complete social network information.[27]

Second, interpersonal relations in terms of social and geographical proximity are found to increase inforceability and lower transaction costs. This results in market segmentation where land follows paths where costs are lowest.

Third, geographically proximate households conduct more efficiency enhancing transactions, whereas transaction between family related household does not improve efficiency. Hence, the indigenous tenure system allows for kinship ties to create a structure of land exchange where some households have easier access to land even though these transactions are not efficiency-enhancing. As geographical proximity is thought to reduce enforcement and monitoring costs, this result indicate that reducing these costs through judicial reforms may increase efficiency.

To investigate the strength of the proposed approach and main findings the model was re-estimated for the labor market. Evidence implies that labor market transactions are not contributing to equalization of land-labor ratios, but rather to labor smoothing over shorter periods. This is in line with the common understanding that rural labor markets are plagued by imperfections, leading smallholder farmers to primarily work on their own farm.

Our theoretical model as well as the subsequent empirical analysis assumed that farmers are homogenous, meaning that inputs of machinery and draft animals, managerial abilities, soil quality and technological advancement are identical within villages across households. The result of only partial adjustment through the land market suggests presence of large transaction costs. One may argue that this is driven by differences in productivity. In terms of differences in human capital, the education variable included in the empirical analysis was found to be unimportant in all estimations. Including cattle-ownership as a rough proxy for draft animals, and a subjective measure of soil quality does not change the results either.[28] It

[27] A comparison of the likelihood values between the two models suggests that the model using the household level predictor, A^*_{ij} are more likely to predict the data at hand. This is further confirmed by the higher adjusted R^2 for the model using the household level predictor.

[28] Cattle-ownership and soil quality was included in differences and sums. The sum of both variables is positive and statistically significant in the baseline regressions. Hence, holding everything else constant, households with at least one cattle, and the same land quality exchange more land.

can further be argued that the villages considered in the present study are very small in terms of population and arable land, and thus farmers are not likely to differ significantly. Moreover, Conley and Udry (2010) have found that social learning play an important role and that farmer's respond to news about the productivity of fertilizer on plots cultivated by their peers. If the process of learning about new technologies and best practices are *social*, then farmers within small isolated communities are likely to be similar, and the assumption of homogenous farmers is less restrictive.

References

Arcand, J.-L. and D. Jaimovich (2010): "Social and Economic Networks in Rural Gambia," Working paper.

Arcand, J.-L. and D. Jaimovich (2012): "Does ethnic diversity decrease economic interactions? Evidence from exchange networks in rural Gambia," .

Baland, J.-M., C. Guirkinger and C. Mali (2011): "Pretending to Be Poor: Borrowing to Escape Forced Solidarity in Cameroon," *Economic Development and Cultural Change*, 60(1), 1–16.

Bandiera, O. and I. Rasul (2006): "Social networks and technology adoption in northern Mozambique," *Economic Journal*, 116, 869–902.

Bank, A. D. (2005): *Appraisal report: farmer managed rice project*. Agricultural and Rural Development Department, Central and West Regions, African Development Bank Group. Tunis, Tunisia.

Binswanger, H. P., K. Deininger and G. Feder (1993): "Agricultural Land Relations in the Developing World," *American Journal of Agricultural Economics*, 75, 1242–1248.

Bliss, C. and N. Stern (1982): *Palanpur: The Economy of an Indian Village*. Oxford, Clarendon Press.

Carney, J. and M. Watts (1991): "Disciplining Women? Rice, Mechanization, and the Evolution of Mandinka Gender Relations in Senegambia," *Journal of Women in Culture and Society*, 16(4), 651–681.

Carter, M. R. and Y. Yao (2002): "Local versus global separability in agricultural household models: The factor price equalization effect of land transfer rights," *American Journal of Agricultural Economics*, 84(3), 702–715.

Comola, M. and M. Fafchamps (2011): "Are Gifts and Loans between Households Voluntary?," Working paper.

Conley, T. and C. Udry (2010): "Learning about a new technology: Prinapple in Ghana," *American Economic Review*, 100, 35–69.

Cox, D. and M. Fafchamps (2007): "Extended Family and Kinship Networks: Economic Insights and Evolutionary Directions," *Handbook of Development Economics, Chapter 58*, 4, 3711–3784.

de Janvry, A., M. Fafchamps and E. Sadoulet (1991): "Peasant Household Behaviour with Missing Markets: Some Paradoxes Explained," *The Economic Journal*, 101, 1400–1417.

Deininger, K., D. A. Ali and T. Alemu (2008): "Assessing the Functioning of Land Rental Markets in Ethiopia," *Economic Development and Cultural Change*, 57(1), 67–100.

Deininger, K., D. A. Ali and T. Alemu (2009): *Land rental markets: Transaction costs and tenure insecuity in rural Ethiopia*chap. 3 in The emergence of land markets in Africa: Impacts on poverty, equity, and efficiency. Routledge; First edition.

Dercon, S. and J. D. Weerdt (2006): "Risk-sharing networks and insurance against illness," *Journal of Development Economics*, 81.

di Falco, S. and E. Bulte (2011): "A Dark Side of Social Capital? Kinship, Consumption, and Savings," *Journal of Development Studies*, 47(8), 1128–1151.

Eswaran, M. and A. Kotwal (1986): "Access to Capital and Agrarian Production Organisation," *The Economic Journal*, 96(382), 482–498.

Fafchamps, M. (1992): "Solidarity Networks in Preindustrial Societies: Rational Peasants with Moral Economy," *Economic Development and Cultural Change*, 41(1), 147–174.

——— (1996): "The enforcement of commercial contracts in Ghana," *World Development*, 24(3), 427–448.

Fafchamps, M. and F. Gubert (2007): "The formation of risk sharing networks," *Journal of Development Economics*, 83, 326–350.

Fafchamps, M. and S. Lund (2003): "Risk-sharing networks in rural Philippines," *Journal of Development Economics*, 71, 261–287.

Fenske, J. (2011): "Land tenure and investment incentives: Evidence from West Africa," *Journal of Development Economics*, 95, 137–156.

Foster, A. and M. Rosenzweig (1995): "Learning by doing and learning from others: human capital and technical change in agriculture," *Journal of Political Economy*, 103(6), 1176–209.

Freudenberger, M. S. (2000): "Tenure and Natural Resources in The Gambia: Summary of Research Findings and Policy Options," Land Tenure Center. University of Wisconsin-Madison. Working paper no. 40.

Gajigo, O. and J. D. Foltz (2010): "Ethnic Networks and Enterprise Credit: The Serahules of The Gambia," AAEA, CAES & WAEA Joint Annual Meeting 2010, Denver, Colorado.

Gajigo, O. and A. Saine (2011): "The effects of government policies on cereal consumption pattern change in the Gambia," *Review of African Political Economy*, 38(130), 517–536.

Ghebru, H. and S. T. Holden (2009): *Factor market imperfections and rural land rental markets in Northern Ethiopian Highlands*chap. 4 in The emergence of land markets in Africa: Impacts on poverty, equity, and efficiency. Routledge; First edition.

Holden, S. and H. Ghebru (2006): "Kinship transaction costs and land rental market participation," Department of Economics and Resource Management. Norwegian University of Life Sciences.

Holden, S. T., O. Keijiro and F. Place (eds.) (2009): *The Emergence of Land Markets in Africa: Impacts on Poverty, Equity, and Efficiency.* Washington, DC: Resources for the Future.

IMF (2007): "The Gambia: Poverty strategy reduction paper," IMF country report no. 07/308. Washington, DC: IMF.

Jackson, M. O. and A. Wolinsky (1996): "A Strategic Model of Social and Economic Networks," *Journal of Economic Theory*, 71(0108), 44–74.

Jaimovich, D. (2013): "Missing links, missing markets: Internal exchanges, reciprocity and external connections in the economic networks of Gambian villages," MPRA Paper No. 44080.

Jin, S. and T. S. Jayne (2013): "Land Rental Markets in Kenya: Implications for Efficiency, Equity, Household Income, and Poverty," *Land Economics*, 89(2), 246–271.

Kevane, M. (1997): "Land tenure and rental in Western Sudan," *Land use Policy*, 14(4), 295–310.

Krishnan, P. and E. Sciubba (2009): "Links and Architecture in Village Networks," *The Economic Journal*, 119, 917–949.

Otsuka, K. (2007): "Efficiency and Equity Effects of Land Markets," *Handbook of Agricultural Economics*, 3, 2671–2703.

Pamela, K. (2010): *Land, labour and entrustment : West African female farmers and the politics of difference*. Leiden, Boston.

Pender, J. and M. Fafchamps (2005): "Land Lease Markets and Agricultural Efficiency in Ethiopia," *Journal of African Economies*, 15(2), 251–284.

Pender, J., E. Nkonya, P. Jagger, D. Sserunkuuma and H. Ssali (2004): "Strategies to increase agricultural productivity and reduce land degradation: evidence from Uganda," *Agricultural Economics*, 31(2-3), 181–195.

Place, F. and P. Hazell (1993): "Productivity Effects of Indigenous Land Tenure Systems in Sub-Saharan Africa," *American Journal of Agricultural Economics*, 75(1), 10–19.

Sadoulet, E., A. de Janvry and S. Fukui (1997): "The meaning of kinship in sharecropping contracts," *Amrical Journal of Agricultural Economics*, 79(2), 394–407.

Sadoulet, E., R. Murgai and A. D. Janvry (2001): *Access to Land, Rural Poverty, and Public Action*Ch. 8, Oxford University Press.

Skoufias, E. (1995): "Household Resources, Transaction Costs, and Adjustment through Land Tenancy," *Land Economics*, 71(1), 42–56.

Swindell, K. (1987): "Family Farms and Migrant Labour: The Strange Farmers of the Gambia," *Canadian Journal of African Studies*, 12(1), 3–17.

Teklu, T. and A. Lemi (2004): "Factors affecting entry and intensity in informal rental land markets in Southern Ethiopian highlands," *Agricultural Economies*, 30, 117–128.

Udry, C. and T. Conley (2004): "Social Networks in Ghana," Working paper.

Table A1: Descriptive: dyad-level

	Mean	Std. Dev.	Min.	Max.	Obs.
Receives land dummy	0.010	0.099	0	1	59797
A^{*}_{ij}	2.701	9.759	0	237.2	59797
A^{*v}_{ij}	0.869	3.758	0	133.6	59797
Kinship tie	0.133	0.340	0	1	59797
Kin of head	0.060	0.237	0	1	59797
Kin of wife	0.028	0.164	0	1	59797
Marriage kin	0.022	0.145	0	1	59797
Neighbor compound	0.096	0.294	0	1	32733
Neighbor plot	0.096	0.295	0	1	24574
Same ethnicity	0.725	0.447	0	1	59797
Both coranic literate	0.591	0.492	0	1	59797
Same religious affiliation	0.985	0.121	0	1	59797
Both illiterate	0.569	0.495	0	1	59797
Both have emigrated members	0.539	0.498	0	1	59797
Diff. cattle-ownership	0.001	0.501	-1	1	59797
Sum cattle-ownership	0.367	0.590	0	2	59797
Diff. household size	-0.001	17.252	-395	395	59797
Sum household size	26.651	18.343	2	430	59797
Diff. age of head	0.017	21.981	-77	77	59797
Sum age of head	108.262	23.403	35	200	59797
Diff. wealth level	0.001	1.129	-3	3	59797
Sum wealth level	3.482	1.178	2	8	59797

Note: A^{*}_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. Information on neighbor compound and neighbor plot is only available for a subsample of the data, corresponding to at least 20 villages. The measure of wealth refer to the relative wealth level reported by households (low, mid-low, mid-high, and high).

Figure A1: Location of surveyed villages

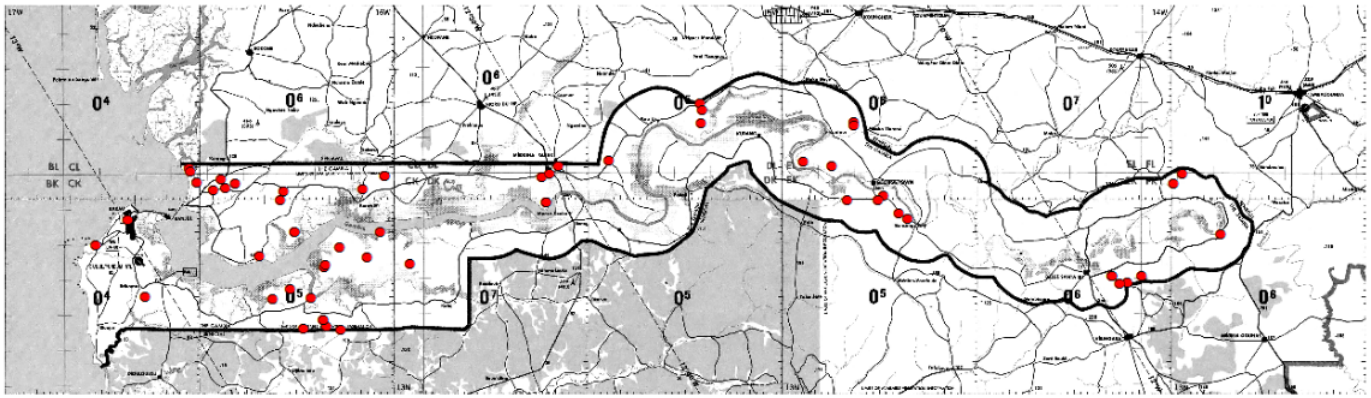


Table A2: Net land leased in

	(1)		(2)	
	Send	Receive	Send	Receive
Land endowment (ha)	-0.051***	-0.037*	-0.054***	-0.032*
	(0.016)	(0.020)	(0.017)	(0.019)
Labor (active adult members)	0.020*	0.018	0.013	0.016
	(0.011)	(0.017)	(0.012)	(0.017)
Kin of head			-1.779***	-1.255***
			(0.549)	(0.461)
Kin of wife			-0.561	-0.121
			(0.404)	(0.347)
Marriage kin			-1.690***	-0.435
			(0.440)	(0.312)
No of nonworking members	-0.107***	0.064**	-0.112***	0.072***
	(0.032)	(0.028)	(0.033)	(0.027)
No long-term sick members	0.672*	0.489	0.792**	0.588*
	(0.362)	(0.312)	(0.318)	(0.314)
Female headed household	0.055	-1.538**	-0.226	-1.861***
	(0.954)	(0.621)	(0.923)	(0.663)
Corrugated hut	-0.482***	0.016	-0.337**	0.038
	(0.166)	(0.136)	(0.157)	(0.143)
Alkalo (village chief)	-6.688***	-2.032	-7.295***	-0.986
	(1.419)	(1.401)	(1.434)	(1.528)
Age of Alkalo	-0.020	-0.009	-0.016	-0.013
	(0.014)	(0.009)	(0.012)	(0.010)
Illiterate	1.026**	0.111	0.900*	0.129
	(0.502)	(0.372)	(0.464)	(0.376)
Unmarried	-0.519	0.963	-0.918	1.163
	(1.161)	(0.895)	(1.290)	(0.898)
Polygamous (>1 wife)	0.560	0.452	0.769	0.362
	(0.510)	(0.292)	(0.504)	(0.309)
Ethnicity: Mankinka	-0.687	-0.054	-0.562	0.088
	(1.156)	(1.022)	(1.149)	(0.999)
Ethnicity: Fula	1.280	0.711	1.275	0.562
	(1.085)	(0.738)	(1.025)	(0.716)
Villages level dummies	Yes	Yes	Yes	Yes
Observations	1,686	1,686	1,682	1,682

Note: Dependent variable: net land leasing in. Maximum likelihood estimares. To ease interpretation all coefficients in the sending regressions are multiplied by -1. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

Table A3: Land-labor endowment across households (ex-post land transactions)

	All	Landless	0.1-0.6 ha/w	0.6-1.6 ha/w	1.6-3.0 ha/w	> 3.0 ha/w
% in labor market	54.3	42.6	49.4	56.2	64.8	57.6
Labor sender	37.2	31.0	33.8	39.7	44.3	35.0
Labor receiver	32.4	24.1	27.8	30.8	40.7	40.4
Observations	1,685	303	263	546	273	297

Table A4: Regression results labor: Baseline

	(1)	(2)	(3)	(4)
A^*_{ij}	-0.000	-0.000		
	(0.000)	(0.000)		
A^{*v}_{ij}			0.001*	-0.000
			(0.001)	(0.001)
Additional expl. variables				
Same ethnicity		0.027***		0.027***
		(0.006)		(0.006)
Both coranic literate		-0.005		-0.005
		(0.004)		(0.004)
Same religious affiliation		-0.004		-0.004
		(0.009)		(0.009)
Both illiterate		0.004		0.004
		(0.003)		(0.003)
Both have emigrated members		-0.000		-0.000
		(0.003)		(0.003)
Diff. household size		-0.000**		-0.000***
		(0.000)		(0.000)
Sum household size		0.000**		0.000**
		(0.000)		(0.000)
Diff. age of head		0.008***		0.008***
		(0.003)		(0.003)
Sum age of head		-0.004*		-0.004*
		(0.002)		(0.002)
Diff. wealth level		-0.003**		-0.003**
		(0.001)		(0.001)
Sum wealth level		0.004**		0.004**
		(0.002)		(0.002)
Observations	59,797	59,797	59,797	59,797

Dependent variable: amount of labor i send to j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

Table A5: Regression results labor: Social proximity

	(1)	(2)	(3)	(4)
A^*_{ij}	-0.000	-0.000		
	(0.001)	(0.000)		
A^{*v}_{ij}			-0.000	0.000
			(0.001)	(0.001)
Kin tie	0.053***		0.053***	
	(0.010)		(0.010)	
Kin of head		0.057***		0.057***
		(0.012)		(0.012)
Kin of wife		0.022***		0.022***
		(0.007)		(0.007)
Marriage kin		0.014**		0.014**
		(0.006)		(0.006)
Additional expl. variables	Yes	Yes	Yes	Yes
Observations	59,797	59,797	59,797	59,797

Note: Dependent variable: amount of labor i send to j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

Table A6: Regression results labor: Geographical proximity

	(1)	(2)	(3)	(4)	(5)	(6)
A^*_{ij}	-0.000	-0.000	-0.000			
	(0.000)	(0.000)	(0.000)			
A^{*v}_{ij}				-0.001	-0.001	-0.001
				(0.001)	(0.001)	(0.001)
Kin of head	0.033***	0.031***	0.026***	0.033***	0.031***	0.026***
	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)
Kin of wife	0.021***	0.021***	0.019***	0.021***	0.021***	0.019***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Marriage kin	0.016***	0.015***	0.016***	0.016***	0.015***	0.015***
	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)
Neighbor compound		0.014***	0.009***		0.014***	0.009***
		(0.004)	(0.003)		(0.004)	(0.003)
Neighbor plot			0.025***			0.025***
			(0.006)			(0.006)
Additional expl. variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,574	24,574	24,574	24,574	24,574	24,574

Note: Dependent variable: amount of labor i send to j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

Table A7: Efficiency and social proximity

	(1)	(2)	(3)	(4)
A^*_{ij}	-0.000	-0.000		
	(0.000)	(0.000)		
A^{*v}_{ij}			0.000	0.000
			(0.001)	(0.001)
Kin tie	0.053***		0.053***	
	(0.010)		(0.010)	
Kin of head		0.057***		0.057***
		(0.013)		(0.012)
Kin of wife		0.021***		0.022***
		(0.007)		(0.007)
Marriage kin		0.015**		0.014**
		(0.006)		(0.006)
A^*_{ij}* kin tie		0.001		
		(0.002)		
A^{*v}_{ij} * kin tie		-0.002		
		(0.002)		
A^*_{ij}* kin of head		0.001		
		(0.002)		
A^*_{ij}* kin of wife				0.001
				(0.002)
A^*_{ij}* marriage kin				-0.001
				(0.002)
A^{*v}_{ij}* kin of head				-0.006
				(0.006)
A^{*v}_{ij}* kin of wife	-0.000			
	(0.001)			
A^{*v}_{ij}* marriage kin			-0.000	
			(0.002)	
Additional expl. variables	Yes	Yes	Yes	Yes
Observations	59,797	59,797	59,797	59,797

Note: Note: Dependent variable: amount of labor i send to j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.

Table A8: Efficiency and geographical proximity

	(1)	(2)
A^*_{ij}	-0.000	
	(0.000)	
A^{*v}_{ij}		-0.001
		(0.002)
Kin of head	0.026***	0.026***
	(0.008)	(0.008)
Kin of wife	0.019***	0.019***
	(0.007)	(0.007)
Marriage kin	0.016***	0.015***
	(0.004)	(0.004)
Neighbor compound	0.009***	0.009***
	(0.003)	(0.003)
Neighbor plot	0.025***	0.024***
	(0.006)	(0.006)
A^*_{ij}* neighbor compound	-0.000	
	(0.001)	
A^*_{ij}* neighbor plot	-0.000	
	(0.000)	
A^{*v}_{ij}* neighbor compound		-0.005
		(0.003)
A^{*v}_{ij}* neighbor plot		0.002
		(0.003)
Additional expl. variables	Yes	Yes
Observations	24,574	24,574

Note: Note: Dependent variable: amount of labor i send to j. A^*_{ij} denotes the predicted household level efficiency accomplishing transaction. A^{*v}_{ij} denotes the predicted village level efficiency accomplishing transaction. All regressions include village fixed effects. Standard errors are clustered on the village level. ***, **, * indicate significance on a 1 pct., 5 pct. and 10 pct. level.