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LARGE SCALE LAND INVESTMENTS AND FORESTS IN AFRICA

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Large scale land investments and forests in Africa

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Abstract

Recent years have witnessed an increasing interest in land-based investments for food, feed, fuel and fiber, driven by volatility in commodity prices, economic growth of emerging economies, policy drivers of biofuel demand and investor strategies in the wake of the global economic crisis. This has led to a surge of foreign and local investments in developing countries, where land can be obtained at lower cost, and has led to fears of land grabbing. In this paper we consider the problem of identifying the determinants of large scale land acquisitions in Africa, and employ unilateral beta regression to explore the link between investments and a number of indicators related both to land supply and to institutional features. The results on the resource seeking nature of investments and on the impact of the land governance indicators are mostly in line with the findings of other studies; on the contrary, the results on forest land being a driver for large scale land acquisitions in Africa differ from previous findings, and indicate commercial pressure on African forests that may lead to accelerating degradation and deforestation.

Keywords: beta regression, foreign direct investments, land grabbing, large scale land acquisitions

JEL Classification: F210, O130

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1. Introduction

The last few years have seen a surge of foreign acquisitions of land in developing countries, especially in Africa, which has triggered considerable policy debate and many empirical studies. The rise in commodity and energy prices, the perception of a likely increase in the demand for food, low interest rates in financial activities, water scarcity and the biofuels policy of the EU are known to be the potential factors that have increased the acquisition of land. This wave of land investments, the majority of which has been for agricultural use, has led to fears of land grabbing (Anseeuw et al., 2012 a and b; Cuffaro, Giovannetti, Monni, 2013; Deininger and Byerlee, 2011).

The literature on large scale land acquisitions (LSLA) has concentrated attention essentially on deals by international investors targeting developing countries, i.e. on foreign direct investments (FDI) in land and on the concern that investments are taking place in contexts where many people have only insecure land rights. A case study literature (Anseeuw et al., 2012a; Cotula et al., 2009; Deininger and Byerlee, 2011; FAO, 2009; GTZ, 2009; Oxfam, 2011) points out that there may be substantial negative implications, essentially because existing land uses and claims may go unrecognized. On the other hand, because of neglected users rights, land may appear more abundant, i.e. empty, than it actually is. In fact, in one of the first studies focusing on the recent wave of FDI in Sub-Saharan Africa, Cotula et al. (2009) observe that most if not all productive land targeted for potential investment was likely to be already claimed by farmers, herders, hunters or foragers.

In this paper we analyze the determinants of large-scale land deals in Africa, and employ unilateral beta regression (Ferrari and Cribari-Neto, 2004) to explore the link between investments and a number of indicators related both to land supply and to institutional features. Results show that the agro-potential of land and forest land are attractive factors, and that land investments are more directed to countries with a high share of rural land under traditional systems and high diversity of land tenure system, confirming that these systems with complex structure of property rights and widespread insecurity of land tenure are under strong commercial pressure. Notice that the results on the impact of the land governance indicators is mostly in line with the findings of other studies on the determinants of LSLA; on the contrary, the results on forest lands as an attractor of LSLA in Africa does not emerge from other studies, and indicates commercial pressure on African forests that may lead to accelerating degradation or deforestation.

The paper is organized as follows. In Section 2 we briefly review the problem of large scale land acquisitions and focus in particular on LSLA in Africa. In Section 3 we explain in details the different response variables and the different explanatory variables that we have employed in our analysis, with indications about the data sources. In Section 4 we introduce several models in order to find the determinants of both the number of deals and the size of the deals in Africa. The results of the econometric analysis differ from previous findings mainly as for the role of forests as a driver of land demand. The role of forests is examined in more details in Section 5.

2. Large scale land acquisitions

2.1 Overview

Reliable and uncontroversial recent data on investment in agriculture and land are hard to find for several reasons. First, there are investments in agriculture which do not go through multinational enterprises (MNEs), and are therefore more difficult to trace. Indeed, as the 2009 World Investment Report (UNCTAD, 2009) remarked, recent investors in agriculture are new for a number of reasons including the emergence of non-MNEs actors, often private equity or State-owned funds, sometimes specifically established for investing in land. Second, since a transaction appears in FDI data only when it has been fully paid, a recent trend such as land grabbing may not be reflected in FDI data for a substantial length of time (UNCTAD, 2009). Other limitations are that deals may not be reported if host governments see them as politically sensitive and that existing reports and databases have very different coverage. For these reasons, the phenomenon of land acquisitions by foreign investors emerged mainly through media reports since the 2007-8 commodity price boom. Since then, the efforts of collecting data systematically, especially by GRAIN (2010) and International Land Coalition (Anseeuw et al., 2012b) in partnership with several other centers, have improved the availability of data. As will be discussed in details in Section 3, here we use data mainly from the Land Matrix database¹, which includes large deals made since the year 2000 for agricultural production, timber extraction, carbon trading, industry, renewable energy production, conservation, and tourism in low and middle-income countries.

Figure 1 illustrates the geographical distribution of land deals, showing that Sub Saharan Africa has been the most targeted region, followed by East Asia and Latin America. Figure 2 shows that while some

¹ International Land Coalition in partnership with several research centers (CDE, CIRAC, GIZ, GIGA) has published Land Matrix (Anseeuw et al., 2012b and <http://landportal.info/landmatrix>). Land Matrix includes deals (purchase, lease or concession), at different stage of negotiation (intended, concluded, failed); transnational and domestic, initiated since the year 2000 and covering an area of 200 hectares or more.

regions are only investors and others mostly target (mainly Africa), land deals occurred within and between regions, with a strong tendency to intra regional flows in Asia and South America and South-South deals becoming increasingly common.

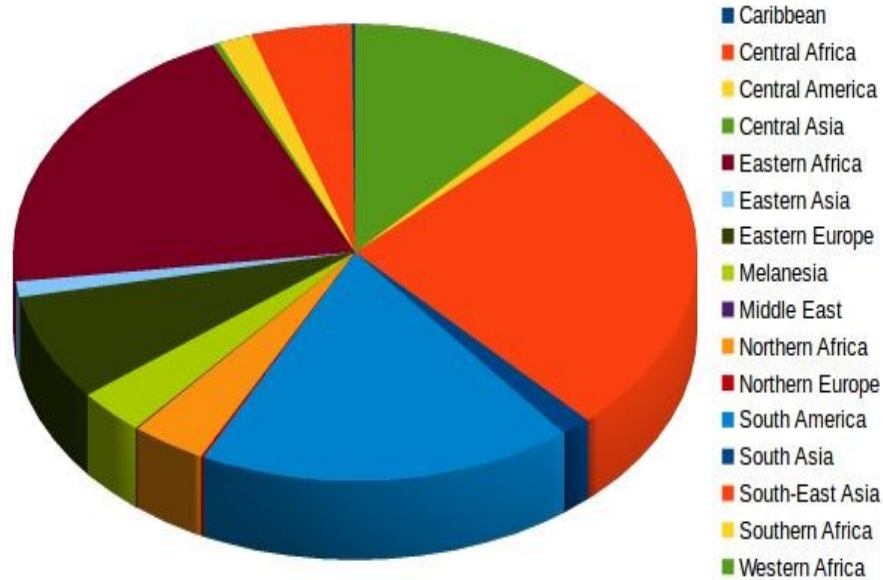


Figure 1: Total acquisitions by region (Land Matrix, last accessed December 2016)

A variety of actors are involved in FDI in land, both from the private and public sector. Agribusiness accounts for the largest share of investors in land acquisitions but governments and sovereign wealth funds (SWFs) are also involved. In search for food (and water) security and in the wake of the food price surge of the late 2000s and the increasing scarcity of water, several countries fully depending on food imports, such as the Gulf countries, have substantially increased their investments (though mainly to few countries). The number of private-public partnerships has also been increasing in the last few years. As for private sector finance, there seems to be sufficient empirical evidence that confirms a trend of increasing interest, with a wide array of institutional investors involved in developing countries agriculture and specifically in land acquisitions. SWFs have been buying/leasing large tracts of farmland in the developing world; international private equity groups which operate raising capital primarily from other institutional investors, mostly to invest into, or to acquire, an operating company are investing more and

more in the agricultural sector; international pension funds have also been expanding and diversifying their portfolios to include more developing world agriculture exposure. More generally the financializing of commodities has brought new potentials for profit making to the primary sector thus stimulating speculative investments in land (Anseeuw et al., 2012 a and b; Cuffaro, Giovannetti, Monni, 2013; Deininger and Byerlee, 2011).

Table 1 reports some basic data on deals in Africa, including the magnitude of transnational and domestic deals in terms of area acquired, the sectors of investment for transnational and domestic, and the average sizes of investments in terms of area. Table 1 shows that wood and fiber are the intended purpose of about one third of total land acquired followed by food crops and biofuels; the latter, as expected, have a larger role for transnational than domestic acquisitions. Moreover, the average size of reported acquisitions is very large, and the average scale of transnational acquisitions for the most important sectors exceeds that of domestic acquisition.

Table 1: Land deals in Africa, transnational and domestic

Intention of investment	Area (ha) Transnational	Area (ha) domestic	Share of sectors		Average size (ha)		
			Transnational	Domestic	Transnational	Domestic	Transnational/ domestic
Biofuels	2833264	360042	14,7	9,7	172915	136243	1.3
Food crops	3299036	709936	17,1	19,1	120558	56694	2.1
Renewable energy	835063	114185	4,3	3,1	255192	166005	1.5
Agri unspecified	1493217	221434	7,7	6,0	117479	58742	2.0
Non-food agricultural commodities	849591	155778	4,4	4,2	155965	189944	0.8
For wood and fibre	5609518	1142415	29,1	30,8	400934	216527	1.9
Conservation	1347841	158977	7,0	4,3	1191822	438152	2.7
Forest unspecified	17300	190173	0,1	5,1	16741	24065	0.7
Livestock	307845	254868	1,6	6,9	78383	205479	0.4
For carbon sequestration/REDD	1147733	400100	6,0	10,8	840768	243400	3.5
Tourism	1369850	0	7,1	0,0	1899400	n.a.	_
Industry	159917	125	0,8	0,0	159917	250	639.7

Source Land Matrix accessed July 2016

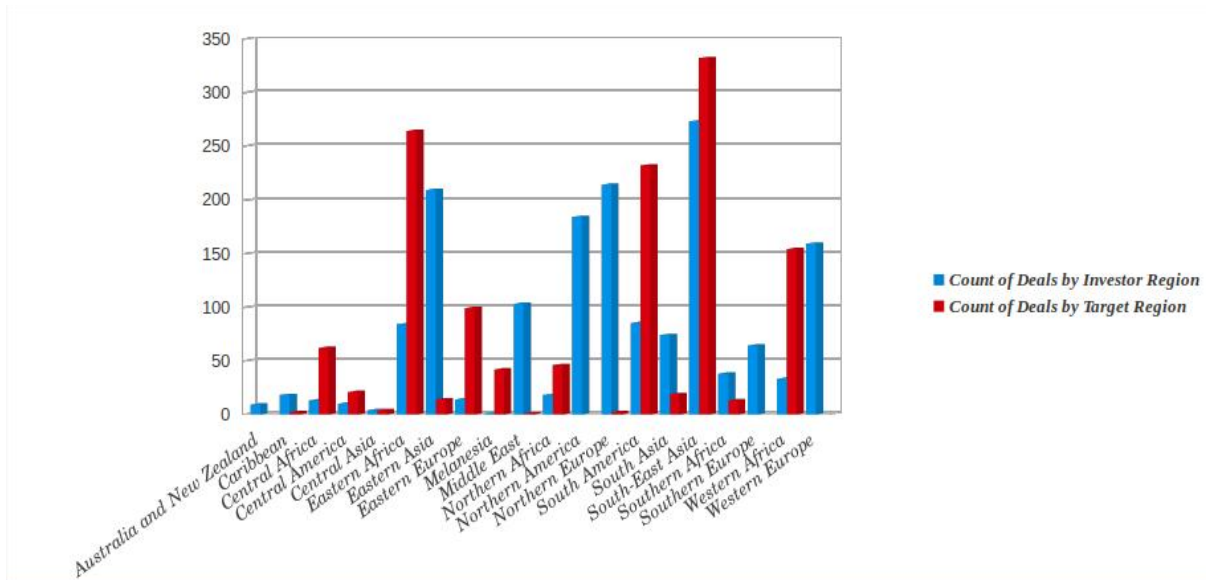


Figure 2: Land deals by investor/target region (Land Matrix, accessed December 2016)

2.2 The determinants of LSLA in the literature

The literature on the determinants of recent large scale land acquisitions has concentrated mainly on FDI. The variables explaining recent flows of FDI in land include price trends and the profitability of investments in agriculture, the increasing value of agricultural land, the increasing involvement in land acquisitions of new investors, i.e. financial actors and investors from countries heavily dependent upon food imports. With regard to the choice of location, land acquisitions have privileged land abundant, low income countries, indicating that investments are mainly resource seeking.

A number of studies have analyzed recent LSLA using unilateral regressions and gravity models to explain the count of international investments (number of projects reported in target country). As explanatory variables they mostly use some proxy of the extensive and intensive margins for agriculture, as well as measures of investment protection and land tenure security. Studies on bilateral FDI have included food dependence and population size in the country of origin, as well as bilateral variables such as the physical distance between the countries and the existence of a historic colonizer/colonized relationship. In this sense, it is particularly interesting to consider in details the work of Arezki et al.

(2015) and of Giovannetti and Ticci (2016), because in the following it will be used extensively for comparison with our results.

Consider first the paper by Arezki et al. (2015). The authors examine large transnational land investment worldwide from three data sources (Land Matrix, Grain and A& C), and notice a boom of land investments after the 2008 food price spike and financial crises, highlighting the prevailing role of the state rather than private parties as supplier of land in Africa. Their study however explains only the count of LSLA (number of contracts, regardless of their size in terms of area acquired), through a unilateral cross-countries Poisson regression and a bilateral gravity model. The authors compute two land supply variables: the potential output value from areas that are not forested, not protected, not already used for agricultural cultivation and that have a population density below 25 inhabitants per km², and the notional value of potential output on all areas that are currently covered with forests. Furthermore, they consider the intensive margin and variables for the institutional environment (land governance, investor protection, and law and order). For the bilateral gravity model, they take into account physical, cultural, and geopolitical proximity (e.g. a past colonial relationship), with information on origin countries population and net food imports. Their results, both from the unilateral and the bilateral models, suggests that (i) the availability of suitable but uncultivated land for expansion is a key driver of land demand, while the value of potential output from forest land is significant only in some cases for bilateral regression; (ii) the difference between potential and actual yield on land already cultivated (yield gap), a predictor of the ability to quickly increase production, i.e. the intensive margin, has no consistent impact; and (iii) the quality of land governance is highly significant throughout, suggesting that land demand has been higher where protection for land rights and security of property remain weak. However, the pseudo R-squared in these models is on average rather low.

The paper by Giovannetti and Ticci (2016) examines the relationship between investment in land and biofuel development in Sub Saharan Africa. The authors adapt the analysis of FDI flows in land to the gravity model framework. They apply a Poisson pseudo-maximum likelihood model (PPML) and follow specifications similar to those used by Arezki et al. (2015), but with important differences. First, the choice of the variables is conditioned by their focus on land deals for biofuel productions; in fact, their dependent variable is the bilateral number of international large-scale land deals concluded since 2000, in which at least one crop is potentially used as biofuel feedstock. Second, Arezki et al. (2015) use the first version of the Land Matrix dataset, while Giovannetti and Ticci's estimates are based on data from the second version that improves data reliability. Third, they investigate the role of institutional

conditions by adding institutional dimensions. Fourth, as well as the standard gravity model including country-specific variables both for the origin and the destination, they also consider a second specification that involves a benchmark model and a quasi-fixed effect model with country dummies for the purpose of capturing the impact of all origin-specific push factors that may affect the size of FDIs in land.

The results of Giovannetti and Ticci (2016) show that high-income OECD countries and emerging economies, such as Brazil, China, South Korea, Malaysia, are more likely to acquire overseas lands for biofuel purposes, while Gulf States are not significantly involved in acquisitions for cultivation of biofuel crops. In fact, countries who are short of fertile lands, are more likely to be interested in land investments for cultivating food crops. Moreover, the dummy variable for biofuel producers has a positive and significant coefficient, suggesting that investors from countries already active in the biofuel markets are the most interested in transnational land investments to expand their access to biofuel feed-stocks. Furthermore, countries identified by better institutional quality are more likely to attract a higher number of biofuel land deals. This evidence partially diverges from that of Arezki et al. (2015). A possible explanation of this is the different focus, and the fact that biofuel production is a relatively new sector that, compared with traditional agricultural investments, implies a higher risk; for this reason biofuel investors tend to prefer countries with better institutional conditions. Finally, from the land governance point of view, Giovannetti and Ticci (2016) find that countries with weak protection of land tenure rights of local population are more targeted by biofuel-related land acquisitions.

In summary Giovannetti and Ticci (2016) find that foreign investors tend to select countries with (i) better institutional environments, (ii) higher endowments of land and water resources, and (iii) weaker protection of land rights. Notice that these findings are consistent with a resource-seeking attitude behind large-scale land demand for biofuel crops. Even in this study however, the pseudo R-squared in the bilateral model is rather low on average.

3. Data sources and variables

The Land Matrix² has published data on over a thousand contracts at different stages of negotiation concluded, under negotiation, intended - worldwide for a total area of around 40Mn ha. We searched the database for contracts concluded and described as documented by official sources, which resulted

2 *Accessed February 2015*

in 336 contracts in Africa from a total of 466. This led to the computation of the number of contracts per country, which in analogy with the work of Arezki et al. (2015) and of Giovannetti and Ticci (2016), was assumed as the response variable in the first stage of our analysis in Section 4.

In the second stage of our analysis, for each country we computed what we refer to as an index of investment in Africa, namely the ratio between the overall actual size of the deals in that country (concluded, documented by official sources of information and reported in the Land Matrix dataset) and the sum of cultivated land, grassland, woodland and forest land for the country. With respect to the number of deals per country, the index of investment has the advantage of taking into account also the size of the various contracts. Notice that the analysis of the determinants of the index of investment can be done both at a country level and at a single deal level, by comparing the actual size of each deal to the country land as defined. However it is important to stress that the two variables represents fairly different matters: while the analysis of the index of investment at a country level enables to find the determinants of the share of the country land obtained by international and domestic investors, at a single deal level (for which the data set is rather large) it permits to find the determinants of the size of the individual deals. Both approaches will be considered in Section 4.

Notice that, in both stages of our analysis, as explanatory variables we assumed different indicators of institutional quality, of land governance, of land use and of land suitability, which are described in details in Table 2. Data sources for the explanatory variables have been: (i) the Institutional Profiles Database, which is the result of a collaboration between the French Development Agency (AFD) and the Directorate General of the Treasury, and is based on a survey completed by country/regional Economic Services of the Ministry for the Economy and Finance and the country AFDs offices, (ii) the World Bank, (iii) the Worldwide Governance Indicators (WGI) project, which is produced by the World Bank and by the Natural Resource Governance Institute (NRGI) and Brookings Institution. (iv) the Global Agro-Ecological Zones (GAEZ) (Fischer et al., 2011), from which³ we built land use indicators such as shares of cultivated, grassland and forest⁴ and share of land in different agronomic categories of nutrient availability and workability.

3 The GAEZ, combining soil, terrain and climate characteristics with crop production requirements, estimates suitability for crop production of each land grid cell at the 5-arc-minute-level, at four technology and management levels (low, intermediate, high and mixed; see Box 4.3). The suitability assessments provide extents for a range of suitability classes (Fischer, G., et al. 2011) condensed into three, (i) prime land, (ii) good land and (iii) marginal and not suitable land.

4 These indicators represent the estimated share of land cover with the greatest extent in each grid-cell. Various land cover maps were combined to produce a quantification of the main land use/land use share based on a 5 arc-minute grid-cell in the spatial raster. The resulting categories that we use to obtain our variable land are, indeed, Cultivated Land, sum of rain-fed land and irrigated land, forest land and grassland and woodland, excluding barren land and very sparsely vegetated land.

Table 2: Explanatory variables

Institutional Indicators (The Worldwide Governance Indicator project)	<i>Regulatory quality</i>	Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
	<i>Rule of law</i>	Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
	<i>Control of corruption</i>	Reflects perceptions of the extent to which public power is not exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.
Land governance indicators (Institutional Profiles Database)	<i>Diversity</i>	Represents the diversity of the land tenure system (communal ownership, usage rights, customary rights, religious rights, "modern" rights etc.) across the country in practice (0 = no diversity, 4 = high diversity).
	<i>Traditional System</i>	Represents the share of rural land under the traditional rights system (use, grazing, transhumance, exploitation etc.; 0 = no land under traditional system, 4 = very large share).
	<i>Procedures</i>	Represents the existence and efficiency of procedures for land tenure formalization and registration (0 = no instrument, 4 = instrument efficient)
Land use indicators (GAEZ)	<i>Cultivated Land</i>	Share of land allocated to cultivated land.
	<i>Forest Land</i>	Share of land allocated to forest land.
	<i>Grassland and Woodland</i>	Share of land allocated to grassland and woodland
Land suitability indicators (GAEZ)	<i>Nutrient</i>	Share of suitable land with moderate constraints on soil fertility, particularly important for low input.
	<i>Workability</i>	Share of suitable land with moderate constraints on soil workability (that comprise conditions that may cause physical hindrance to cultivation, or cause limitations to cultivation imposed by soil texture/clay mineralogy and soil bulk-density).
Other (World Bank)	<i>Price</i>	Average land price
	<i>Ease (of Doing Business)</i>	The ranking on the ease of doing business index is an unweighted average of the country's percentile rankings on ten topics: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts and resolving insolvency.

Before moving to the analysis of the determinants of LSLA, it is interesting to summarise the similarities and the differences among the various target countries in terms of land grabbing. For this reason, we have conducted a cluster analysis taking into account three variables: the number the deals for each country, the average size of the deals for each country, and the corresponding index of investment. The results are summarised in Table 3 and Figure 3, and show that there are at least four groups of target countries. In the first cluster we find Congo alone, that is characterized by the largest average size of the deals; the index of investment in Congo, however, is not particularly large. In the second cluster we find 18 countries that have very limited average size of the deals and also small index of investment; no countries in that group exceed 18000 ha for the average size of the deals, and only Egypt has an index of investment greater than 0.01. In the fourth cluster we find three countries, Gabon, Liberia and Sierra Leone, who have rather large average size of the deals and an equally large index of investment; only Sierra Leone in this group has an average size smaller than 90000 ha and only Gabon has an index of investment smaller than 0.16. The remaining countries are in the third cluster, with an intermediate value of both the average size of the deals and the index of investment. Notice that Congo, Gabon, Sierra Leone and Liberia have a larger share of forest land compared to other countries.

Table 3: Features of the country groups identified by the cluster analysis

Cluster	1	2	3	4
Average number of deals	5	9.89	15	13
Average size of the deals	404400	8911.13	38606.69	93503.02
Average index of investment	0.0596	0.0033	0.0121	0.1221

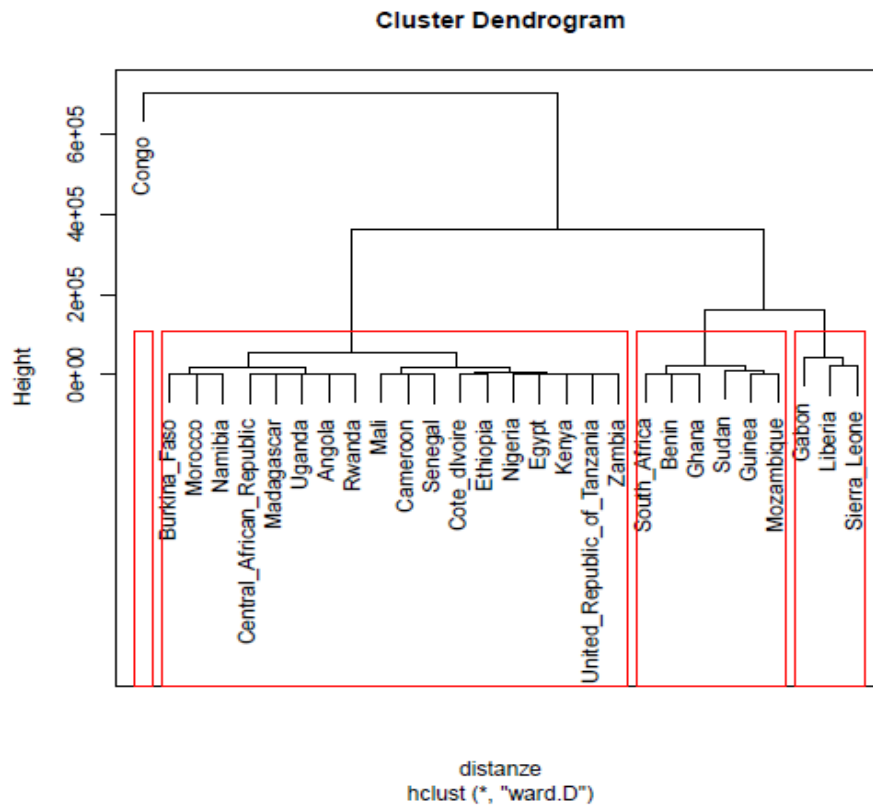


Figure 3: Cluster analysis

4. Modelling the number of deals and modelling the index of investment: econometric results

We are now going to consider, through the analysis of appropriate econometric models, the problem of identifying the determinants of large-scale land deals in Africa, both transnational and national.

First, for purposes of comparison with the work of Arezki et al. (2015) and of Giovannetti and Ticci (2016), we focus on the number of deals, and estimate a unilateral zero-truncated count regression model to explore the relationship between this response variable and the explanatory variables illustrated in the previous section. Notice that the zero-truncated model here might be more suitable than a standard regression model for count data, given that our data set includes only countries who have received at least one contract. Moreover, note that here we explore the behaviour of both the Poisson model and the Negative Binomial model, which is more appropriate in case of over dispersion.

The results are shown in Table 4 and Table 5, and at least for the Poisson model are partially in agreement with the findings of Arzeki et al. (2015) and of Giovannetti and Ticci (2016) in the sense that better institutions are not necessarily an attractor (contrary to what should be expected) and forest land is not significant. Specifically, under the Poisson model we find that foreign investors tend to select countries in Africa with (i) large share of suitable land allocated to grassland and woodland and with moderate constraints on soil fertility, (ii) low land price, (iii) no diversity of the land tenure system and weak procedures for land tenure formalization and registration, (iv) better institutional environment from the point of view of respecting the law, but worse institutional environment with respect to the quality of policies that promote private sector development.

However we can see from Table 5 that the preferred model is the Zero-truncated Negative Binomial model, with an Akaike Information Criterion (AIC) equal to 186.4; noticed for the Negative Binomial model (but not for the Poisson) a chi-square test of goodness of fit failed to reject the null hypothesis with a p-value equal to 0.23. And under the Zero-truncated Negative Binomial model, only three explanatory variables are significant for the number of deals, namely Diversity, Traditional rights and Nutrient, with neither of them being highly significant. This seem to suggest that in the analysis of the determinants of large-scale land deals it would be more convenient to focus on a different response variable, for instance the index of investment in Africa defined in the previous section.

Table 4: Results from unilateral Zero-truncated Poisson regression for the number of deals

Coefficients	Estimate	Std. Error	z value	Pr(> z)	
(Intercept)	2.3895424	0.4200629	5.689	1.28e-08	***
Regulatory quality	-0.0530059	0.0084629	-6.263	3.77e-10	***
Rule of law	0.0343924	0.0081268	4.232	2.32e-05	***
Diversity	-0.1356821	0.0715219	-1.897	0.057819	.
Procedures	-0.6213237	0.1347599	-4.611	4.02e-06	***
Cultivated land	0.0297519	0.0084605	3.517	0.000437	***
Grassland	0.0362046	0.0066418	5.451	5.01e-08	***
Nutrient	1.4743801	0.4776387	3.087	0.002023	**
Workability	-1.8244164	0.9185609	-1.986	0.047015	*
Price	-0.0002896	0.0001603	-1.806	0.070844	.

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Log-likelihood: -144.8539 on 18 degrees of freedom

AIC: 309.7079

Non significant: Forest land, Control of corruption, Ease, Traditional rights

Table 5: Results from unilateral Zero-truncated Negative Binomial regression for the number of deals

Coefficients	Estimate	Std. Error	z value	Pr(> z)
(Intercept):1	0.76959	1.12762	0.682	0.4949
(Intercept):2	0.01154	0.45919	0.025	0.9799
Diversity	-0.40678	0.18492	-2.200	0.0278 *
Traditional rights	0.48161	0.28683	1.679	0.0931 .
Nutrient	2.89465	1.32079	2.192	0.0284 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Log-likelihood: -88.1982 on 51 degrees of freedom

AIC: 186.3963

Non significant: Forest land, Control of corruption, Price, Ease, Rule of law, Workability, Grassland, Procedures, Cultivated land, Regulatory quality

Notice that because of the nature of the index of investment, that assumes values in the interval $[0, 1]$, in order to explore its relationship with the different explanatory variables of Table 2, we find appropriate to employ a Beta regression model. This was firstly proposed by Ferrari and Cribari-Neto in 2004 for modelling continuous variates that assume values in the standard unit interval, e.g., rates and proportions, and has the feature of being naturally heteroskedastic and easily fit asymmetric data. In fact, the key motivation for the Beta regression model lies precisely in the flexibility of the Beta distribution that assumes for the response variable.

More in details, given a sample y_1, \dots, y_n , the Beta regression model assumes that y_i is a $\text{Beta}(\mu_i; \phi)$ random variable ($i = 1, \dots, n$), where μ_i is the expected value of y_i ($0 < \mu_i < 1$) and ϕ is a precision parameter such that $\text{var}(y_i) = \mu_i(1 - \mu_i)/(1 + \phi)$. Moreover, the model assumes that, using standard regression notation, $g(\mu_i) = x_i^T \beta$, where x_i is a vector of k covariates, β is a vector of unknown parameters, and $g(\cdot)$ is a link function (for instance the logit function) that makes both terms of the regression equation defined on the real line. Notice that parameter estimation for this model can be obtained via Maximum Likelihood.

The results are shown in Table 6 with respect to the index of investment computed at a country level, and in Table 7 with respect to the index of investment computed at a single deal level; in both cases most of the explanatory variables are significant, and the pseudo R-squares indicates a substantial improvement in the goodness of fit with respect to that obtained for the regression models for count data in Arezki et al. (2015) and of Giovannetti and Ticci (2016), especially for the model at a country level. In particular, in both models the agro-potential of land (and in particular its fertility) and the share of suitable

land allocated to forest land are attractive factors, while the share of land allocated to cultivated land is not. Moreover, land investments are more directed to countries with a high share of rural land under traditional systems and high diversity of land tenure system, confirming that these systems with complex structure of property rights and widespread insecurity of land tenure are under strong commercial pressure. Other attractive factors are a low land price, a high ranking on the ease of doing business index, a better institutional environment from the point of view of respecting the law and controlling corruption, but worse institutional environment with respect to the quality of policies that promote private sector development.

Table 6: Results from unilateral Beta regression for the index of investment (at a country level)

Coefficients	Estimate	Std. Error	z value	Pr(> z)	
(Intercept)	-1.677e+01	2.027e+00	-8.272	< 2e-16	***
Regulatory quality	-1.115e-01	2.366e-02	-4.710	2.48e-06	***
Rule of law	1.252e-01	2.724e-02	4.598	4.27e-06	***
Control of corruption	2.947e-02	1.348e-02	2.186	0.028786	*
Diversity	4.071e-01	1.746e-01	2.332	0.019722	*
Traditional rights	1.027e+00	2.274e-01	4.516	6.30e-06	***
Procedures	-4.425e-01	2.175e-01	-2.034	0.041944	*
Grassland	-1.960e-02	1.104e-02	-1.775	0.075899	.
Forest land	5.284e-02	8.264e-03	6.394	1.62e-10	***
Nutrient	5.828e+00	8.608e-01	6.771	1.28e-11	***
Workability	6.714e+00	1.260e+00	5.327	1.00e-07	***
Price	-4.601e-04	1.152e-04	-3.993	6.52e-05	***
Ease	2.785e-02	8.068e-03	3.453	0.000555	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Log-likelihood: 122 on 14 Df

Pseudo R-squared: 0.689

AIC: -216.0177

Non significant: Cultivated land

Table 7: Results from unilateral Beta regression for the index of investment (at a single deal level)

Coefficients	Estimate	Std. Error	z value	Pr(> z)	
(Intercept)	-1.170e+01	8.983e-01	-13.019	< 2e-16	***
Regulatory quality	-1.992e-02	8.493e-03	-2.345	0.019024	*
Rule of law	2.386e-02	1.164e-02	2.050	0.040412	*
Control of corruption	2.764e-02	7.547e-03	3.662	0.000250	***
Diversity	3.182e-01	9.206e-02	3.457	0.000546	***
Traditional rights	4.300e-01	1.186e-01	3.626	0.000288	***
Cultivated land	-1.007e-02	6.089e-03	-1.653	0.098335	.
Grassland	-1.540e-02	5.193e-03	-2.966	0.003015	**
Forest land	1.551e-02	4.216e-03	3.679	0.000234	***
Nutrient	2.382e+00	5.201e-01	4.579	4.67e-06	***
Price	-1.868e-04	6.972e-05	-2.680	0.007371	**
Ease	1.503e-02	3.643e-03	4.125	3.71e-05	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
 Log-likelihood: 1970 on 13 Df
 Pseudo R-squared: 0.413
 AIC: -3913.486
 Non significant: Workability, Procedures

It is interesting to notice that our results on forests differ from previous findings. In fact, some studies do not consider forest land (see for instance Giovannetti and Ticci, 2016 who employ only the data on agricultural land, i.e. land area that is arable, under permanent crops, and under permanent pastures). Arezki, et al. (2015), as we already noticed, use more complex indicators of land supply: the potential output value from areas that are not forested, not protected, not already used for agricultural cultivation and that have a population density below 25 inhabitants per km, and the notional value of potential output on all areas that are currently covered with forest. The authors state that they expect the first variable, but not the second, to be a significant driver of land demand on the basis of the hypothesis that if potentially suitable land is forested (or protected), it is likely to provide social or environmental benefits that would make its use by investors very costly and risky. Their econometric results for the unilateral regressions show that the potential output on the non-forested area is positive and significant throughout, whereas the point estimate for potential on forested area is negative in all but two regressions (where it lacks significance). Results for the bilateral regressions show that, as in the unilateral case, higher potential output from non-forested land is associated with the higher attractiveness of a country to investors. The value of the potential output from forest land is significant (but negative) in some cases.

In our model, on the contrary, we introduce explicitly among the explanatory variable the share of land allocated to forest land, and find that at least as far as the index of investment is concerned, forests are a driver. The reasons for these different results could lie in the fact that (i) our study focuses on Africa only, and (ii) our response variable is related to the size of the deals and not just to their count.

In summary the share of forest land in a country has been an attractor of land acquisitions for agricultural production, wood and fibre, carbon trading, industry, renewable energy production, conservation, and tourism. The size of acquisitions is also related to forests. Forest land in Africa is under commercial pressure for causes that include agriculture but also timber extraction.

5. The Role of Forests

According to the FAO database, forest cover worldwide went from 4128 million of ha in 1990 to 3999 million of ha in 2015. As shown in Table 8 and Figure 4, the largest losses of forests have occurred in Central America, followed by East-Southern Africa and West central Africa, therefore tree cover loss seems to be concentrated in the tropics (World Resources Institute, 2016).

Hosonuma et al. (2012) provide an assessment of proximate drivers of deforestation and forest degradation⁵ by synthesizing empirical data reported by countries as part of their REDD+ readiness activities, Center for International Forestry Research (CIFOR) country profiles, UNFCCC national communications and scientific literature⁶. Based on deforestation rate and remaining forest cover, 100 (sub)tropical non-Annex I countries⁷ were grouped into four forest transition phases: (i) pre-transition (high forest cover and low deforestation rates), (ii) early-transition (forest cover is lost at an increasingly

5 Deforestation denotes the (complete) removal of trees and the conversion from forest into other land uses such as agriculture, mining etc, with the assumption that forest vegetation is not expected to naturally regrow in that area. Forest degradation denotes thinning of the canopy and loss of carbon in remaining forests, where damage is not associated with a change in land use and where, if not hindered, the forest is expected to regrow (Hosonuma, et al. 2012).

6 Reducing emissions from deforestation and forest degradation (REDD+) is a mechanism developed by parties to the United Nations Framework Convention on Climate Change (UNFCCC). It creates a financial value for the carbon stored in forests by offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. Developing countries would receive results-based payments for results-based actions. REDD+ goes beyond simply deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. <http://www.unredd.net/about/what-is-redd-plus.html>

7 The Convention divides countries into three main groups according to differing commitments. Non Annex 1 are mostly developing countries recognized by the Convention as being especially vulnerable to the adverse impacts of climate change or to the potential economic impacts of climate change response measures http://unfccc.int/parties_and_observers/items/2704.php

rapid rate), (iii) late-transition (small fraction of remaining forests exhibit a slowing of the deforestation rate), (iv) post-transition phase (the forest area change rate becomes positive and forest cover increases through reforestation). According to the assessment, the deforestation drivers are similar in Africa and Asia, while degradation drivers are more similar in Latin America and Asia. It is interesting to note, as shown in Figure 5, that most countries in the continent are in the early transition phase; moreover, Table 8 shows that all African regions were still net losers in terms of forest cover between 1990 and 2015.

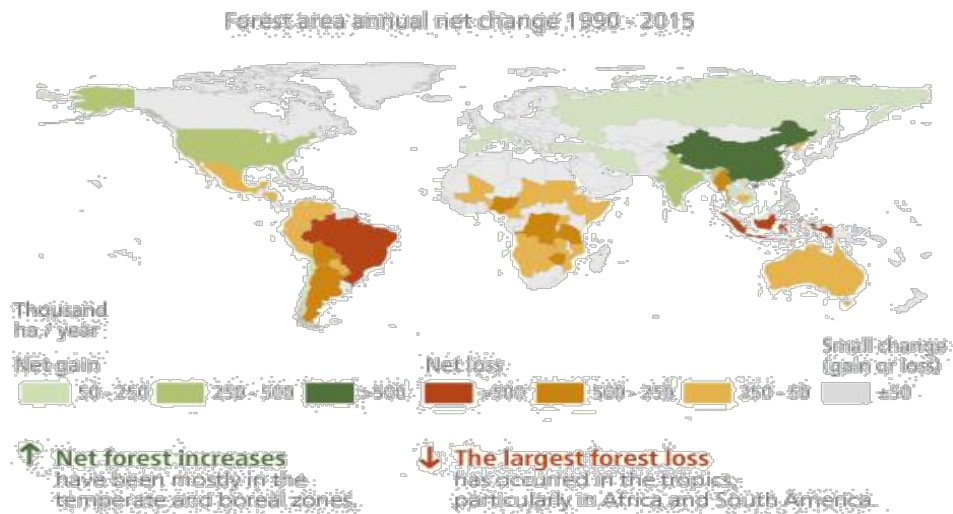


Figure 4: Forest cover annual net change 1990-2015 (FAO, 2015)

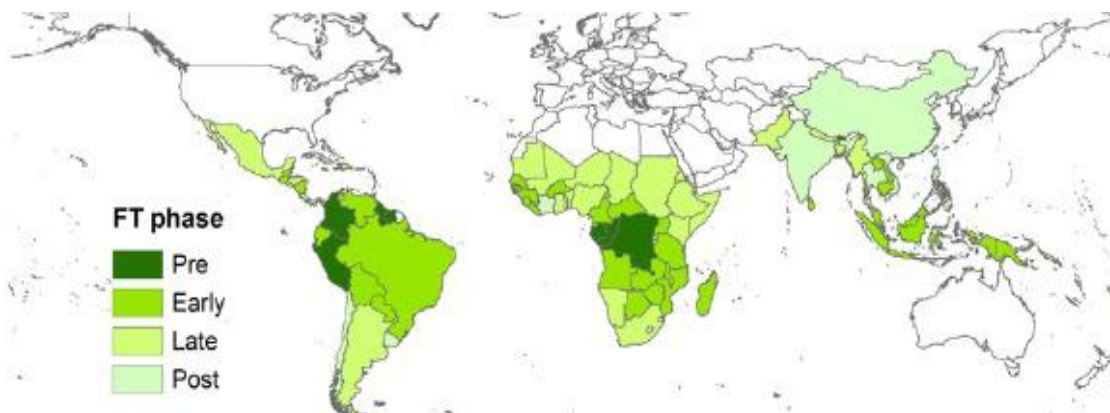


Figure 5: Spatial distribution of national FT phases (Hosonuma et al., 2012)

Table 8: The trend in forest cover, 1990-2015, by sub-region; units are 1000 hectares (Keenan et al., 2015)

Sub-region	1990	2000	2005	2010	2015	change in %
Central America	26995	23448	22193	21010	20250	-25%
Caribbean	5017	5913	6341	6745	7195	43%
East Asia	209198	226815	241841	250504	257047	23%
East-Southern Africa	319785	300273	291712	282519	274886	-14%
Europe	994271	1002302	1004147	1013572	1015482	2%
North Africa	39374	37693	37221	37055	36217	-8%
North America	720487	719197	719419	722523	723207	0%
Oceania	176825	177641	176485	172002	173524	-2%
South America	930814	890817	868611	852133	842011	-10%
South-South east Asia	319615	298645	296600	295958	292804	-8%
West-Central Africa	346581	332407	325746	318708	313000	-10%
West-Central Asia	39309	40452	42427	42944	43511	11%
Total	4128269	4055602	4032743	4015673	3999134	-3%

In particular, Table 9 shows that deforestation occurred in the Congo Basin as a result of the rise in the price of minerals and agricultural products in the international market place in the early 2000s. Small-scale agriculture and to a lesser extent the harvest of fuel wood are considered the main drivers of deforestation, but projects for large scale agribusiness plants, such as palm oil expansion, timber extraction, are developing in various countries and may become more and more important in the future.

Moreover it is interesting to notice that, as far as LSLA are concerned (see for instance Table 1), biofuels are a relatively new and important sector of investment, and there is a wide literature on the impact of biofuel feedstock expansion on forests in developing countries. Koh and Wilcove (2008), for instance, suggest that between 1990 and 2005, an estimated 55% to 59% of oil palm expansion occurred in Malaysia and at least 56% in Indonesia, at the expense of natural forest cover (Fitzherbert et al. 2008, Danielsen et al. 2009). The literature on the Brazilian Amazon has often pointed to indirect mechanisms of land use change, i.e. cattle ranching displaced by soy cultivation leads to deforestation (Margulis, 2004, Meloni Nassar et al., 2008, Lapola et al., 2010). In the case of Africa, however, as German, Schoneveld, and Pacheco (2011) have pointed out, evidence is limited and largely anecdotal.

Table 9: Congo Basin countries deforestation trend, 1990- 2015, by sub-region; units are 1000 hectares (Forest Resources Assessment, FAO, 2015)

Country	1990	2000	2005	2010	2015	change	change in %
Angola	60976	59728	59104	58480	57856	-3120	-5%
Burundi	289	198	181	253	276	-13	-4%
Cameroon	24316	22116	21016	19916	18816	-5500	-23%
Central African Republic	22560	22404	22326	22248	22170	-390	-2%
Democratic Republic of Congo	160363	157249	155692	154135	152578	-7785	-5%
Congo	22726	22556	22471	22411	22334	-392	-2%
Tanzania	55920	51920	49920	47920	46060	-9860	-18%
Zambia	52800	51134	50301	49468	48635	-4165	-8%
Total	399950	387305	381011	374831	368725	-31225	-8%

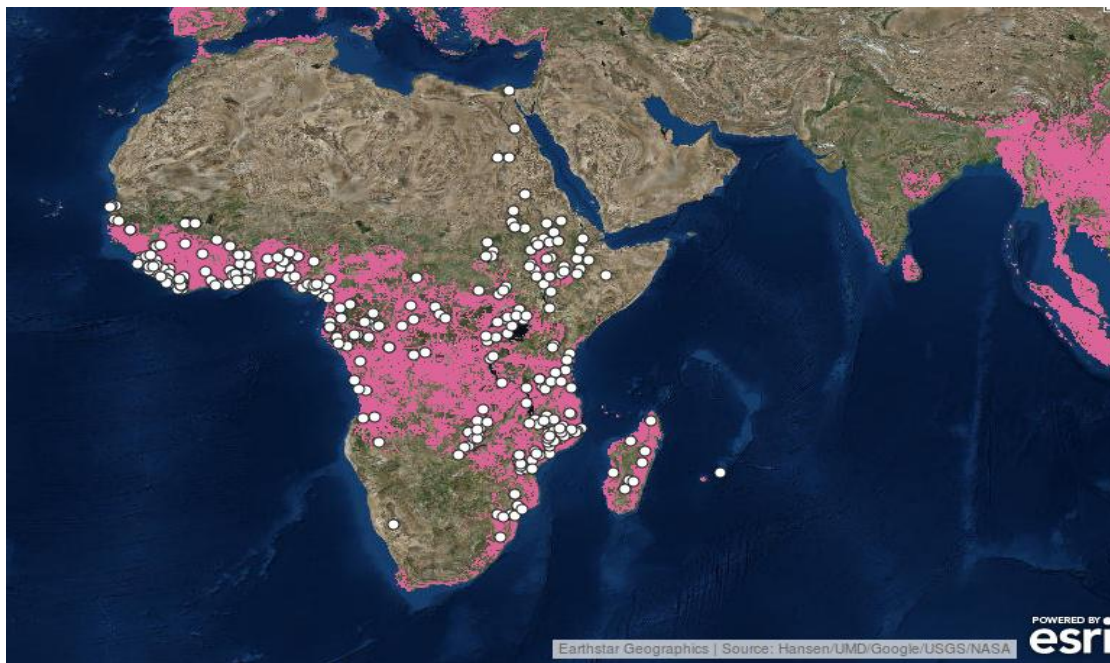


Figure 6: Map of Investments. and tree cover loss 200-2014. The pink area depicts tree cover Loss during 2000-2014, the white circles depict the investments according to Land Matrix data 2000-2014. Source: Authors' elaboration from Hansen/UMD/Google/USGS/NASA, accessed through Global Forest Watch.

In Figure 6 we have mapped the large scale land investments according to Land Matrix (accessed February 2015) and Global Forest Watch Map (accessed December 2015). The investments considered for the map⁸ are the same considered for the econometric analysis of Section 4, namely investments that have official sources and are concluded, as described in Section 3.

In this sense, our model and database may contribute to investigate the pressure for deforestation in Africa arising from recent LSLA. In fact, we can repeat the analysis of Section 4 not including acquisitions explicitly intended for wood and fiber, for REDD, and for conservation; this leaves 266 contracts out of 366. By doing so, we can model land investments exclusively aimed at agricultural production, industry, renewable energy production, and tourism as a function of the different indicators of Section 3, which include shares of different land types, and in particular forest land. The results are presented in Table 10, and show that forest land in Africa remain an attractor of investments also when we exclude from the data base the contracts whose purpose is explicitly related to forests. We take this as an indirect indication that land use change, i.e. deforestation, may ensue because of these investments.

Table 10: Results from unilateral Beta regression for the index of investment (at a country level) - excluding contracts explicitly aimed at wood and fibre, REDD, conservation.

Coefficients	Estimate	Std. Error	z value	Pr(> z)	
(Intercept)	-8.093792	0.879739	-9.200	< 2e-16	***
Regulatory quality	-0.102917	0.017072	-6.028	1.66e-09	***
Rule of law	0.075991	0.015955	4.763	1.91e-06	***
Traditional rights	0.690219	0.202130	3.415	0.000638	***
Procedures	-1.138188	0.160354	-7.098	1.27e-12	***
Forest land	0.017107	0.006043	2.831	0.004641	**
Nutrient	4.747861	0.685164	6.930	4.22e-12	***
Workability	8.144017	1.173188	6.942	3.87e-12	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Log-likelihood: 132.5 on 9 Df

Pseudo R-squared: 0.5893

AIC: -247.0843

Non significant: Control of corruption, Grassland, Price, Ease, Cultivated land, Diversity

8 The map is a collaboration between the [GLAD] (<http://glad.geog.umd.edu/>) (Global Land Analysis & Discovery) lab at the University of Maryland, Google, USGS, and NASA (<http://gfw.maps.arcgis.com/home/item.html?id=63f9425c45404c36a23495ed7bef1314>), and measures areas of tree cover loss across all global land (except Antarctica and other Arctic islands) at approximately 30 × 30 meter resolution. In this data set, "tree cover" is defined as all vegetation greater than 5 meters in height, and may take the form of natural forests or plantations across a range of canopy densities. Tree cover loss is defined as "stand replacement disturbance," or the complete removal of tree cover canopy at the Landsat pixel scale. Tree cover loss may be the result of human activities, including forestry practices such as timber harvesting or deforestation (the conversion of natural forest to other land uses), as well as natural causes such as disease or storm damage.

6. Conclusions

Recent years have witnessed an increasing interest in land-based investments for food, feed, fuel and fibre, driven by volatility in commodity prices, economic growth of emerging economies, policy drivers of biofuel demand and investor strategies in the wake of the global economic crisis. This has led to a surge of foreign and local investments in developing countries – Sub Saharan Africa has been the most targeted region followed by East Asia and Latin America - where land can be obtained at lower cost, and has led to fears of “land grabbing”.

This concern is motivated by several reasons, the most studied in the literature being that the deals involve at least one crucial asset, land, usually on a very large scale and predominantly in the context of complex and often unclear structures of property rights. Moreover, traditional policy and institutional variables, such as the strength of the legal and regulatory systems, the protection of property rights, and so on, that in general tend to enhance investments, are not necessarily drives for LSLA. Hence the current wave of FDI flows and land acquisitions is often taking place in contexts where many people have only insecure land rights, which makes them vulnerable to dispossession.

In this paper we consider the problem of identifying the determinants of large scale land acquisitions in Africa. First, for purposes of comparison with the work of other authors, we have focussed on the number of deals per country, and estimated a unilateral zero-truncated Negative Binomial regression model to explore the relationship between this response variable and different indicators of institutional quality, of land governance, of land use, and of land suitability. Notice that the zero-truncated model here is more appropriate than a standard regression model for count data, given that our data set includes only countries who have received at least one contract. Moreover, for the Negative Binomial model (but not for instance for a Poisson model, that is widely used in the literature on the determinants of LSLA) a chi-square test of goodness of fit failed to reject the null hypothesis, showing that the data present over dispersion. However under the Zero-truncated Negative Binomial model only three explanatory variables are significant for the number of deals, with neither of them being highly significant. This led us to focus on a different response variable, namely the index of investment in Africa, defined as the ratio between the overall size of the deals in a country (concluded, documented by official sources of information and reported in the Land Matrix dataset) and the country land. With respect to the number of deals per country, the index of investment has the advantage of taking into account also the size of the various contracts. Notice that because of the nature of the index of investment, that assumes values in the interval $[0, 1]$, in order to explore its relationship with the different explanatory variables related both to land supply and to institutional features, we have employed a Beta regression model.

The results on the resource seeking nature of investments and on the impact of the land governance indicators are mostly in line with the findings of other studies. Foreign investors tend to select countries with higher endowments of land resources, but with weaker protection of individual land rights, which might facilitate acquisition of land at favourable conditions. These findings are in line with a resource-seeking approach behind large-scale land acquisitions.

On the contrary, the results on forest land being a driver for large scale land acquisitions in Africa differ from previous findings, and indicate commercial pressure on African forests that may lead to accelerating degradation and deforestation. The share of forest land in a country has been an attractor of land acquisitions for agricultural production, wood and fibre, carbon trading, industry, renewable energy production, conservation, and tourism. The size of acquisitions is also related to forests. Forest land in Africa is under commercial pressure, for causes that include agriculture but also timber extraction.

Furthermore our model and database can contribute to investigate the pressure for deforestation in Africa arising from recent LSLA by studying the determinants of the index of investment when excluding acquisitions intended for wood and fibre, for REDD, and for conservation, i.e. by including only investments that imply land use change. The finding that forest land in Africa remains an attractor of investments also in this model is an indirect indication that land use change, i.e. deforestation, may indeed occur.

Knowing how and why forest area changes over time is crucial to achieve sustainable development, but in the case of Africa, evidence is limited and largely anecdotal. Our findings in this study, focused on the recent wave of large scale land acquisition, contribute to the appraisal of recent trends and their possible impact on forests.

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