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What Drives the Global "Land Rush"?

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What drives the global "land rush"?

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Abstract: We review evidence regarding the size and evolution of the "land rush" in the wake of the 2007-2008 boom in agricultural commodity prices and study determinants of foreign land acquisition for large-scale agricultural investment. Using data on bilateral investment relationships to estimate gravity models of transnational land-intensive investments confirms the central role of agro-ecological potential as a pull factor but contrasts with standard literature insofar as quality of the destination country's business climate is insignificant and weak tenure security is associated with increased interest for investors to acquire land in that country. Policy implications are discussed.

Keywords: Land Acquisition, Large-Scale Agriculture, Foreign Investments, Agro-Ecological Potential, Land Availability, Land Governance, Property Rights

JEL classification codes: F21, O13, Q15, Q34

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After decades of stagnant or declining commodity prices when agriculture was considered a "sunset industry", recent increases in the level and volatility of commodity prices and a concomitant rise in global demand for land have taken many observers by surprise. Anticipation of future commodity price spikes and lack of alternative assets for investments during the 2008 financial crisis led to marked increases in demand for agricultural land. Reactions to this phenomenon are mixed. Some, including many host-country governments, welcome it as an opportunity to overcome decades of under-investment in the sector, create employment, and bring access to financial services and technology. Others denounce as a "land grab" (Pearce 2012), and point to the irony of possibly large food exports from countries that may depend on food aid. A large body of case studies also highlights that many projects seem speculative, lack a sound technical and economic basis, and fail to properly consult or compensate local people. Still, while the nature and desirability of impacts is subject to debate, there is broad consensus that the wave of recent land acquisitions could have far-reaching implications on long-term food security, agricultural production patterns, and global stability. Better understanding and analysis of the factors underlying the wave of large-scale land deals is thus desirable.

Such analysis is relevant for a number of development issues. One is the debate on the most appropriate structure of agricultural production. The exceptionally large poverty elasticity of growth in smallholder agriculture (Ligon and Sadoulet 2011, Loayza and Raddatz 2010) as demonstrated in rapid recent poverty reduction in Asian economies such as China, and the fact that the majority of poor still live in rural areas led many to highlight the importance of a farm structure based on smallholders for poverty reduction (Lipton 2009, World Bank 2007). But disillusion with the limited success of smallholder-

based efforts to improve productivity in Sub-Saharan Africa and apparent export competitiveness of "mega-farms" in Latin America or Eastern Europe during the 2007/8 global food crisis have led many observers to suggest that, despite a mixed record, acquisition of land by large operators can be a path out of poverty and to development (Collier and Venables 2011). However, high inequality associated with concentration of land under large farms often negatively affected human and economic development as large farms used their locally dominant position to monopolize markets (Binswanger et al. 1995), subvert provision of public goods such as education (Nugent and Robinson 2010, Vollrath 2009), undermine financial sector development (Rajan and Ramcharan 2011), or restrict political participation (Baland and Robinson 2008).

While case studies are gradually being complemented by efforts to more systematically describe the scope of large land acquisitions (Anseeuw et al. 2012b), the data reported are often taken at face value without proper scrutiny (Rulli et al. 2013).[1] Our paper contributes to this debate in two ways. First, we compare estimates of large transnational land-based investment from three sources. With some important caveats, available data point towards a boom in the wake of the combination of the 2008 food price spike and financial crises, a focus of institutional investors on more mature segments of the market, and a dominant role of the state rather than private parties as supplier of land in Africa. At the same time we find that, even though they claim to focus on very different aspects of the phenomenon -expression of demand at the height of the commodity boom and signed or actually verified deals- quantities reported by these data sources are strikingly similar. Existing databases' scope to trace and differentiate distinct stages of the process of acquiring land and implementing investments seems thus very

limited and the ability to do so more clearly is likely to be a key criterion that reliable data sources will have to meet.

A second issue relates to the determinants of transnational land demand. Noting that, without better data, such analysis will have to be limited to demand rather than actual land transfers, we estimate unilateral regressions for land demand (expressed by number of projects) in a destination country as well as bilateral gravity models of it as a function of traditional demand shifters, newly developed data on potential land supply, and political and institutional variables. Results support the importance of supply (agro-ecological potential) and demand-side variables (population density and agricultural imports). Standard investment climate variables have les systematic effect than land governance which is consistently highly significant although, counter-intuitively, we find that countries with weak tenure security and governance have been most attractive for investors, a result that is robust across a range of estimators and controls.

The paper is organized as follows. Section 2 puts evidence on land demand and actual land transfers into context by drawing on the analysis of FDI in the macro-literature to suggest a methodological approach, and outline data needs. Section 3 presents cross-sectional data on land demand, discusses the econometric approach, and briefly presents relevant descriptive statistics. Key econometric results and robustness checks as discussed in section 4 support the importance of food import demand as a motivation for countries to seek out land abroad ("push factors") and of supply in the form of agro-ecological suitability as key determinants for the choice of destination ("pull factors"). They also highlight the extent to which weak land governance seems to

encourage rather than discourage transnational demand for land. Section 5 concludes by highlighting a number of implications for policy.

I. Conceptual Framework

While the recent nature of interest in large land deals implies that the agricultural economics literature analyzing this issue remains limited, methodological and substantive lessons can be drawn from studies on cross-country capital and investment flows. We briefly review conceptual considerations and econometric issues. This is followed by a discussion of ways to measure variables that may affect country-level supply of and demand for land as well as institutional factors in terms of overall investor protection and rule of law as well as specifically the security of property rights to land.

Insights from the literature on foreign investment flows

A large empirical literature demonstrates that, with the exception of a limited number of plantation crops, production of agricultural crops is characterized by constant or -once a certain minimum farm size that fully utilizes certain lumpy inputs such as machinery or managerial capacity has been reached- decreasing returns to scale. A key reason is that, if effort cannot be observed, salaried workers -in contrast to family members who are residual claimants to profits- will exert optimum levels of effort only if subject to costly supervision. This would reduce the competitiveness of large farms relying on wage-labor compared to owner-operated farms. The former may have advantages in acquiring capital needed to expand into frontier areas or overcoming market imperfections due to absence of public goods. The history of large land deals (Byerlee and Deininger 2013) suggests that, traditionally, large operators' advantages remained limited and transitory unless upheld by distortions (Binswanger *et al.* 1995,

Deininger 2003). In the recent past, developments in crop breeding, tillage, and information technology may make supervision of wage labor easier (Deininger and Byerlee 2012), possibly making large farms more competitive economically. In countries where financial systems do not work well, large farms' ability to reduce the cost of capital by accessing international equity markets can provide them with a distinct advantage (Deininger *et al.* 2013).

While there are no cross-country studies to empirically analyze large-scale foreign land acquisitions, the literature on foreign investment has explored methodologically similar issues. It suggests that the magnitude and distribution of capital flows to recipient countries are determined by pull and push factors (Calvo *et al.* 1996),[2] in addition to country-specific variables, e.g., cultural and geographical proximity or past bilateral ties (Benassy-Quere *et al.* 2007, Habib and Zurawicki 2002). Gravity models relating FDI between two countries to each partner's size, distance, and proxies for transaction cost are widely used in the literature to explain bilateral FDI (Wei 2000).[3] Results are by and large consistent with the theoretical literature on trade and capital flows (Markusen and Venables 1998) suggesting that demand and supply factors will complement sector-specific drivers of FDI such as a desire to be close to market or take advantage of lower production costs (Helpman 1984, Markusen and Venables 2000).

A key stylized fact with regard to overall investment flows, commonly referred to as the Lucas paradox (Lucas 1990), is that the volume of such flows remains well below levels which neoclassical theory predicts would be needed to equalize returns to capital. This remained the case even after capital market liberalization vastly increased capital flows to developing countries (Prasad et al. 2008). Explanations focus on fundamental

differences in economic structure such as technology, missing production factors, policy, or the institutional environment, in particular sovereign risk asymmetric information, and the past track record (Fan *et al.* 2009). Countries with weak rule of law, high political or default risk, incipient financial markets, high transaction cost, or deficient governance, may attract limited investment even if they offer exceptionally high rates of return (Shleifer and Wolfenzon 2002). Cross sectional analysis supports the key role of institutional factors to explain magnitude and nature of capital flows towards developing and emerging economies (Alfaro *et al.* 2008). Panel techniques have been used to show not only that time invariant factors such as social norms, culture, geography, and trust, affect foreign capital flows but also that foreign investors tend to reward policy reforms by increasing bank lending once institutional reforms have been implemented (Papaioannou 2009). They also suggest that institutional variables rather than human capital or income are key factors underlying this relationship.

Investors have different vehicles at their disposal to realize any given level of investment. A key trade-off is between the length of commitment (and the ease of withdrawing funds) and the ability to exercise managerial control (Sawant 2010). The corporate finance literature suggests that a distinguishing feature of FDI vs. portfolio investment is the control investors enjoy over their assets. Asymmetric information, agency problems, and use of proprietary technologies all are likely to give rise to a preference for direct over portfolio investment (Albuquerque 2003). Greater control can alleviate the adverse consequences of limited ability to enforce investors' rights (Schnitzer 2002) so that direct investment may be preferred over other forms of investment. Thus, while weak governance may deter investments in absolute terms, the

share of FDI in total capital flows is likely to be higher in countries with weak governance because investors will demand ways of investing that provide them with greater control (Hausmann *et al.* 2007).

Empirical approach

As we are interested in explaining the number of planned or actual investments in country *j* by investors from country *i*, we use a bilateral Poisson regression to model occurrence and count of projects in an origin-destination pair. Indexing host countries by *j*, we let N_{ij} denote the number of investment projects received by host country *j* and originating in country *i*. Assuming that N_{ij} follows a Poisson distribution λ_{ij} , we can write

$$Prob(N_{ij}) = \frac{e^{-\lambda_{ij}} . \lambda_{ij}^{Nij}}{N_{ij}!}$$

Specifying λ_{ij} as a linear function of explanatory variables X_{ij}, allows us to express the expectation of N_{ij} conditionally on a set of explanatory variables X_{ij}. Denoting the conditional expectation by L_{ij}, we obtain

$$L_{ij} = E[N_{ij}|X_{ij}] = e^{X_{ij}.B_{ij}}$$

where X_{ij} is a row vector of explanatory variables and B_{ji} is a column vector of corresponding coefficients. Taking logs then allows us to formulate a model that can be estimated as

$$l_{ij} = X_{ij}.B_{ij}$$

where l_{ij} is the logarithm of L_{ij} and parameters B_{ij} are estimated by maximum likelihood under the assumption that different realization of the count variable L_{ij}, i.e. the number of

investment projects are independent from each other. As we estimate in logarithms, coefficients can be interpreted as elasticities or semi-elasticities (depending on the unit of the explanatory variable) and each element of the coefficient vector B_{ij} can then be interpreted as the change in the log of the conditional expectation of the planned or actual investments made in country *j* by investors from country *i* , resulting from a marginal increase in the value of the corresponding element of X_{ij}. In principle, X_{ij} can be partitioned into destination characteristics ($VarDest_j$), origin attributes ($VarOrig_i$), and bilateral variables ($VarBilat_{i,j}$) characterizing the specific origin-host pair. Formally, the bilateral count model (Poisson regression) is

$$l_{ij} = VarOrig_i.\alpha_i + VarDest_j.\beta_j + VarBilat_{ij}.\gamma_{ij}$$

where variables are defined as above. In our empirical application, $VarOrig_i$ includes food dependence and the population of the country of origin, $VarDest_j$ includes a country's amount of "available" land or the maximum potential value of agricultural production on this land, the yield gap, institutional variables (see below), and the strength of investment protection, and $VarBilat_{i,j}$ includes the physical distance between the two countries and the existence of a historic colonizer / colonized relationship.

Large numbers of zeros and heteroskedasticity of errors may imply that OLS results will be biased and inconsistent. The Poisson pseudo-maximum-likelihood estimator is suggested to deal with this (Silva and Tenreyro 2006), We follow this suggestion and, in addition, use tobit and zero inflated Poisson models to check the robustness of our estimates.

Specific determinants of cross-border farmland investment

Applying the above framework to explore determinants of interest in cross-border farmland deals,[4] while straightforward conceptually, requires information on key supply- and demand-side variables as well as institutional factors. We focus on availability of high potential 'uncultivated' that is not forested, not protected, and not populated and the 'yield gap' on the supply side, population growth and food import dependence on the demand side, and variables for land governance, investor protection, and law and order regarding the institutional environment.

The attractiveness of a country for farmland investment will depend on availability of land with high agro-ecological potential not yet used for intensive crop production. We rely on bio-physical modeling of potential crop yields to obtain an estimate of the value of potential output from any given piece of land even if not currently cultivated.[5] To avoid problems (Young 2000), we use agro-ecological potential for rainfed cultivation as defined by the global agro-ecological zoning project (Fischer et al. 2002). As wheat, maize sorghum, soybean, sugarcane, oil palm, and cassava account for the majority of global agricultural output and span a wide range of agro-ecological conditions, we use them as indicator crops and simulate output for each of them using location-specific climatic conditions. Results from doing so, with output valued at 2005 prices (i.e. pre-crisis), are then compared for each 5 arc-minute grid-cell of the GAEZ v3.0 resource inventory to choose the crop with the highest output value that then defines the output value for that grid-cell. Figure 1 in the online appendix graphically illustrates the resulting potential value of output per ha for all grid cells.

To make these data useful for our regressions, we overlay the map of potential output with information on actual land use and population density from a variety of databases.[6] This allows us to compute a measure of land supply as the potential output value from areas that are not forested, protected, already used for agricultural cultivation, or have a population density above 25 inhabitants per km^2.[7] The rationale is that, if potentially suitable land is forested or protected, it is likely to provide social or environmental benefits that would make their use by investors much more costly and risky than that of areas that are less densely populated and not forested or protected. We also compute the notional value of potential output on all areas that are currently covered with forest. If our hypothesis is correct, we would expect the first but not the second variable to be a significant driver of land demand. Furthermore, we aggregate the value of potential output on currently cultivated areas in this way at country level and compare it with data on actual output to obtain a measure of the "yield gap", i.e. the difference between observed and potential yields under existing technology that can be exploited by working with existing producers without bringing new area under cultivation. We note that, other things equal, a higher yield gap should increase interest by foreign investors interested in quickly establishing production.

The literature suggests that much of the immediate demand for land in the wake of the 2008 crisis was driven by fears of political instability due to dependence on volatile food imports (Woertz 2013). To account for this, we complement standard bilateral information on physical, cultural, or geo-political proximity (a past colonial relationship) with information on origin countries' population and past net food imports. We use three indicators to explore links between foreign land acquisition and

governance. First, data on regulatory quality, rule of law, from the World Governance Indicators database (Kaufmann *et al.* 2004) serves as a proxy of general regulatory quality.[8] Second, a measure of investor protection from the 'Doing Business' database provides information on the firm-specific regulatory environment.[9] Finally, as agricultural investment is more land-intensive than other FDI, land governance and land rights security are likely to be of great relevance.[10] We draw on a recent cross-country database on this issue (de Crombrugghe et al. 2009) to construct an indicator of tenure security for local users by using the first component from a principal component analysis on a set of key land governance variables.[11]

How good land governance and strong protection of property rights affect a country's attractiveness for land-intensive investment is an empirical issue. On the one hand, the long time horizon of some agricultural production cycles, in particular for perennials, is likely to make investors reluctant to tie up large resources in an environment where weak governance increases dangers of conflict with local users or of opportunistic government behavior and creeping expropriation (Schnitzer 1999). On the other hand, inexperienced investors may find it easier to establish property rights if (land) governance is weak, especially if they believe that it is easier and more 'secure' to acquire land directly from governments rather than engage in a dialogue with local populations.[12]

II. Data on cross-border large scale land acquisition

We document problems with data and how they constrain the ability to analyze the 'land rush'. As all databases include few very large deals that did not materialize, analysis is limited to proposed projects at country level and any further analysis is likely

to require 'primary' data from government registries. With this caveat, we note that interest in large scale agricultural investment of the type considered here did hardly exist before a very rapid peak in 2008/9. Focus was on Africa where most proposed deals involve firms interested in acquiring land from government rather than private parties, in marked contrast to a predominant role of funds and prevalence of market-based land transfers in more mature environments.

Global evidence

In principle, information on cross-border large scale land acquisitions should be from national registries, backed by periodically updated records tracking implementation, economic performance, and investors' compliance with contractual obligations.[13] In practice, destination countries' limited institutional capacity and weak regulatory framework often imply that such information is not systematically gathered or analyzed (Deininger *et al.* 2011b).[14] As a consequence, much of the data underpinning conclusions in the literature on large scale land acquisitions originates from secondary sources such as press reports. To explore data quality and conduct descriptive analysis, we draw on three distinct data sets that purport to refer to interest in land acquisition, signed deals, and transfers verified on the ground.

Our first dataset is based on media reports published at the height of the commodity price boom, i.e. between Oct. 2008, and Aug. 2009 by the NGO GRAIN.[15] In light of the limited time period covered by these data, the widely reported fact that only a small fraction of intended land acquisitions led to actual transfers, and the possibility that, without geo-referencing intended locations, efforts to eliminate double counting by eliminating reports that refer to the same piece of physical land may not always have

been fully successful, this is likely to provide an upper bound estimate of the immediate response triggered by the 2007/8 boom. The second data set, referred to as A&C below, is based on an algorithm of systematic automated web searches that has been used successfully as the basis of a commercial subscription service to document closures of industrials plants in France.[16] These data are limited to 'signed deals' until 2012 (Alomar and Cousquer 2012). Both of these may be biased if systematic cross-country differences in press freedom or internet access affect the reporting of deals. Our third source of data, the 'land matrix', reports deals that have gone through ground verification by NGOs affiliated with the International Land Coalition (Anseeuw *et al.* 2012a) and will thus not be affected by such concerns.

Differences in the variables covered across databases, together with data gaps and missing values for many of the variables, create challenges for efforts to distil simple stylized facts about the 'land rush' (see table 1 in the online appendix). For example, the size of the (proposed) land transfer is missing in about 57% of observations in the 2008/9 demand assessment. Also, in the land matrix data close to 80% of transfers lack information on transaction dates, making it impossible to assess whether such transfers accelerated recently. Information on type of seller/investor and projected amounts of investment or jobs to be created is absent virtually everywhere. More consistent data gathering, with proper quality control procedures, could have large benefits for analysts and policy makers presently are largely unable to compare their country to others in terms of the 'quality' and expected local benefits from such investments.

Although our three sources refer to very different concepts, they provide very similar estimates of the phenomenon (table 1). With some 56 mn. ha in 390 projects and

54 mn. ha in 848 projects, respectively, A&C and the land matrix arrive at higher estimates for the amount of land involved in signed or verified deals than the 45 mn. ha in 453 projects for which, based on Grain data, interest had been expressed at the height of the boom. This is unexpected as many intended deals are known to have either never materialized or been implemented at much smaller scale than originally envisaged (Schoneveld 2011).

We also note that, in all datasets, a few 'mega'-projects above 1 mn ha (9 with a total size of 23 mn. ha in Grain and 7 with 24 and 12 mn. ha, respectively, in A&C and the Matrix) affect estimates of total area. Eliminating these reduces the estimated size of land deals, consistent with the notion that large parts of early demand may have been speculative, dominated by few very ambitious projects. Surprisingly though, if transactions greater than 1 million ha are eliminated, the size of 'ground-verified' deals as reported by the matrix (42 mn. ha in total) amounts to almost double the demand articulated in 2008/9 (22 mn ha) and significantly exceeds even the amount of supposedly signed deals during the 2008-12 period based on A&C (32 mn. ha). Tis suggests weaknesses in field verification procedures applied by the land matrix, though the paucity of variables reported makes it impossible to verify these systematically.[17] The number of target countries also varies across data sources -with 82 it is largest in Grain data, followed by 67 in A&C and 55 in the land matrix. All data sources coincide in suggesting that there has been a disproportionate focus on Africa which consistently accounts for some 50% of the area involved.[18]

{Table 1 about here}

Subject to caveats regarding consistency of reporting and data quality, comparison of A&C and Grain allows us to identify few regularities of land investment (table 2). Direct involvement by governments or SWFs appears to have been limited. In line with the literature on corporate finance, direct rather than portfolio investment predominates in Africa (where it makes up 75% of projects) while funds focus on more 'mature' market segments including North America, Europe, and Australia. Although joint ventures had limited relevance throughout, the share of purchases in total acquisitions seems proportional to the level of institutional development; almost 90% of reported transactions were purchases in the US, Europe, and Australia compared to only about a third in Africa. Africa also stands out in that, for almost 90% of the known cases, the 'seller' is the Government rather than a private party or user group, in line with the notion that in Africa state usurpation of communal land rights is a key risk (Alden-Wily 2010).

{Table 2 about here}

Although only one of our databases has information on time of acquisition, it provides interesting insights (table 3). First, while there was little activity before 2008 (total transfers of only 2 Mn ha), the volume of reported signed deals increased to 6 mn. ha in 2008 and 30 mn. in 2009, followed by a drop to 9 and 10 mn. thereafter. This boom-bust cycle is more pronounced for biofuels (which account for 11%, 37%, and around 10-15% of acquisitions before, during, and after 2008, respectively) and in Africa (53% in 2008 reduced to less than 20% in 2009 and less than 10% in 2011). Possibly as a result of limited alternative investment opportunities, funds' involvement also peaked in

2008. Governments had not acted as buyers at all in the period before 2008 and, although they were most active in 2008, their presence continued.

{Table 3 about here}

Disaggregating country-level data for Africa points towards differences across databases (table 4). Top destinations in terms of number of investments are Ethiopia, Sudan, Mozambique and Tanzania (22%, 15%, 13%, and 12%, respectively) for A&C, Mozambique, Ethiopia, Tanzania, Madagascar (25%, 20%, 15%, and 11%) for the Matrix, and Sudan, Ethiopia, Nigeria, and Ghana (19%, 15%, 11% and 11%) for Grain. Regarding investors' region of origin, all databases attribute a significant role to investors from Western Europe who account for between 40 and 43 percent of total investment. They do diverge on the rest, though, with the second most important origin region the Middle East according to Grain (29%), Africa (27%) according to the matrix, and East Asia or North America (17% each) as per A&C.

Descriptive statistics for key dependent variables

Means of dependent variables for 'origin' or 'destination' countries based on the three databases, distinguishing for whether or not a project is reported as having started in the Grain and A&C databases, are displayed in table 5 for the. Between 0.9% (in A&C) and 5.7% (based on the matrix) of country pairs share a colonial heritage, with a mean distance of 5,500 to 7,500 km between them. Size of cultivated area is about double in origin as compared to destination countries throughout. The non-forested wich, according to our criteria, could be available for expansion is between two three times larger in destination as compared to origin countries although potential output per ha is slightly

lower in destination countries. With between 65% and 72% in destination vs. 30% to 36% in target countries, the yield gap is about double in the former vs. the latter.

On the demand side, origin countries are net importers of food and significantly more populous than destinations which are much smaller characterized by small net exports. Values of our governance indices consistently point towards lower protection of investors' interests, less robust law and order, and weaker land governance in destination as compared to origin countries.[19] This suggests that the pull of supply-side factors (i.e. ample land availability) may outweigh concerns about limited institutional capacity.

{Table 5 about here}

The bottom panel of table 5 also highlights the share of countries targeted in each of the regions together with the average number of projects per country in each of them, highlighting that, according to the Grain data, 37% of countries with an average of 2.11 investments per country (or 5.7 for each country with non-zero investment) were targeted and 31% (with 1.4 projects) had actually some activity overall but that the share was almost 70% among African countries (with an average of 4.4 projects per country) but only 8% (with 0.64 projects per country) in East Asia and the Pacific. These shares are slightly lower for the A&C and the matrix data.

III. Econometric results

While our analysis is limited to demand rather than actual investment, in a scenario of high commodity prices such demand may well be realized. Unilateral and bilateral models suggests that (i) availability of suitable but uncultivated land for expansion is a key driver of land demand; (ii) the difference between potential and actual

yield on land already cultivated (the 'yield gap'), a key predictor of the ability to quickly increase production, has no consistent impact; and (iii) quality of land governance and in some cases law and order, are highly significant throughout, suggesting that land demand has been higher where protection for such rights and security of property remain weak.

Results from unilateral regressions

Results from a Poisson regression with the count of large-scale land acquisition projects in the country of destination as dependent variable are reported in Table 6 for information on all projects and projects with some activity from Grain (cols. 1 and 2) and A&C (cols. 3 and 4) and total projects from the Matrix (col. 5). The point estimate of potential output on non-forested area is positive and significant throughout while that for potential on forested area is negative in all but 2 regressions (where it lacks significance). In terms of magnitude, coefficients for potential output on non-forest and for forested area suggest that, other things equal, a 10% increase of potential output value on non-forest or forest land would increase the number of projects by 5-11% or reduce it b up to 10%, respectively. Surprisingly, the 'yield gap' is not significant throughout for the total number of projects, consistent with the notion that a desire to better utilize potential on land that is already cultivated was not a main driver of the 'land rush'.

{Table 6 about here}

To facilitate comparison, we normalize land governance variables to have zero mean and unit variance. The coefficient on land governance is negative and significant throughout while coefficients on other governance variables are rarely significant. This supports the notion that, instead of land acquisition being contingent on strong protection of rights, weak tenure security for existing occupants at country level has been associated

with higher investor interest in land-related investment. *Prima facie*, this would imply that civil society concerns about extractive or speculative motives with little concern about benefits to local populations may not be entirely misplaced. The association with land governance is large enough to be economically meaningful: a reduction in the land governance index by one standard deviation, equivalent to the difference between Brazil and Angola, would be predicted to be associated with a total number of projects that is lower by between 36% (Matrix) and 18% (A&C) and a number of started projects that is lower by 7% to 16%.

Results from bilateral regressions

Bilateral models provide a richer way of exploring determinants of the 'land rush'. Poisson regressions of the number of projects for any bilateral investor/host pair are thus estimated (see Table 7 where the coefficient of the land governance indicator from an equivalent regression including regional dummies is reported in the bottom). We note that distance (negative effect) and a former colonial relationship (positive effect) are strong predictors of an investment relationship consistently across databases. In terms of supply-side characteristics, regressions suggest that, as in the unilateral case, higher potential output from non-forested land are associated with higher attractiveness of a country to investors. According to these results, a 10% increase of potentially cultivable land would be associated with an increase in the number of projects in a host country by between 3.5 and 5.55%. The value of potential output from forest land is significant in some cases. The coefficient on the yield gap, though positive, is insignificant or of marginal significance in all regressions except those for the matrix and started projects in A&C where it has a positive coefficient. Low yields and the associated opportunity to

catch up or even leapfrog to the technology frontier seem to have been less important in terms of increasing a country's attractiveness as a target for land acquisition than the availability of high-potential land that is not yet under cultivation.

{Table 7 about here}

In terms of demand factors, higher population levels and per capita food imports in origin countries are strongly positively associated with higher demand for land investment.[20] This may indicate that a desire to acquire land may increasingly complement traditional means of dealing with imbalances in food supply through markets and storage. With the exception of land governance, coefficients on institutional variables are at most weakly significant, suggesting that even once other factors are accounted for, high levels of institutional maturity are not a precondition for large amounts of land-related investment. To the contrary, the coefficient on host countries' quality of land governance, which accounts for the extent to which local rights are recognized, is highly significant and negative. Consistent with the bilateral results, weak land governance thus seems associated with higher attractiveness to investors at country level. From a substantive point of view, this resonates with evidence that, unless well-governed institutions to manage these resources exist, resource booms may fuel rent-seeking and corruption (Bhattacharyya and Hodler 2010) instead of development (Oechslin 2010). In the context of land-related investment, transparency and disclosure, a proper regulatory framework, and the lack of market mechanisms to liquidate non-performing ventures have been of particular concern.

Robustness checks

Methodologically, our use of the Poisson pseudo-maximum-likelihood estimator follows the literature that suggests this estimator as the most appropriate for the case at hand (Silva and Tenreyro 2006). Others have argued that in trade/investment models, large numbers of zeros may pose greater challenges than the heteroskedasticity of errors so that, under certain conditions, it may be preferable to use tobit or even OLS (Martin and Pham 2011) or modified Poisson fixed-effects estimators such as the zero inflated Poisson (Burger *et al.* 2009).[21] To check the robustness of our results, we complement Poisson regressions with tobit, zero inflated Poisson, and OLS regressions. Results, reported in table 2 in the online appendix, are in line with what had been reported earlier, allaying fears that our findings are driven by the choice of estimator. Coefficients for the main variables of interest are comparable to the ones obtained earlier, supporting the importance of bilateral factors, such as distance or colonial relationships, supply factors linked to agro-ecological potential and to some extent food exports, demand shifters such as net food imports and population, and land governance rather than investor protection or a general rule-of law index as a key institutional factor.

IV. Conclusion and policy implications

Higher commodity prices and concerns about food security, a history of under-investment in agriculture, and wide variation of land scarcity and productivity across countries, have considerably increased interest by investors in agricultural land. Conceptually, it seems desirable for countries subject to such interest to adopt policies that encourage 'pioneer' investors but keep out speculators (Collier and Venables 2011). However, little systematic evidence or data exists to concretize such guidance.

To advance on this, we document available data, noting that limitations allow only crude inferences of interest in the number of projects involving land acquisitions at country level rather than actual transfers. Use of different databases allows us to discern a boom-bust cycle associated with the 2007/08 commodity price spike, a strong focus of new interest on Africa, and distinct differences in the profile of transactions across regions –with much greater state involvement in Africa than elsewhere. Yet, available databases suffer from common gaps and weaknesses that will have to be addressed on a priority basis to make reliable inferences on land sizes, proposed investment volumes and jobs creation, business models (outgrower or nucleus, greenfield or takeover of an existing farm), and implementation progress in a consistent and meaningful way. Without this, it will be difficult not only to dispel the air of secrecy currently surrounding this topic but also to allow countries and investors to draw lessons from successful (and unsuccessful) experiences so as to develop appropriate business models and approaches over time.

Combining evidence on land demand by outsiders with country-level endowments allows econometric analysis to identify drivers of such demand. Beyond bilateral links (distance, cultural proximity), potential availability of hitherto uncultivated land and a history/infrastructure of food exports are relevant, as are food import dependence and population as demand factors. Insignificance of the 'yield gap' and the consistent association of weak land governance with higher investor interest come as surprises but are in line with the notion that, in our study period, which is dominated by the immediate post-2008 peak, interest may have been more focused on acquisition of 'vacant' land rather than helping improve agricultural productivity by integrating existing producers

better into value chains. This is in line with anecdotal evidence of countries that attracted large amounts of investor interest at the peak but found it hard to translate investors' promises into production or benefits on the ground. It suggests that attracting high levels of diffuse interest by players who lack familiarity with the sector may not be conducive to quickly advancing agricultural productivity for the benefit of broader development and, if it leads to tracts of land being occupied without utilization, may actually be detrimental to this goal.

While our data are too weak to make inferences on actual production, our evidence implies that better land governance,[22] increased transparency, and a more consistent global and national effort at monitoring could be conducive to attracting capable investors in a number of ways, in particular by (i) improving the ability to identify responsible and qualified investors *ex ante* and effectively negotiate with them to maximize local benefits by integrating existing producers into value chains; (ii) ensuring that land occupied by non-viable ventures can be transferred to more efficient producers quickly; (iii) allowing responsible investors to distinguish themselves to reduce risk -and ideally their cost of capital; and (iv) providing a basis for learning from experience to develop successful business models. The recent slow-down of the 'land rush' provides an opportunity for countries to act on this agenda now to be in a better position to distinguish discern pioneers from speculators and thus turn mere interest into real progress for the agricultural sector if and when another commodity price boom hits.

Endnotes

[1] Problems with existing data are documented at http://ruralmodernity.wordpress.com/2012/04/27/the-land-matrix-much-ado-about-nothing/, http://oilforfood.info/?p=423, and http://www.chinaafricarealstory.com/2012/04/zombie-chinese-land-grabs-in-africa.html.

[2] Push factors (e.g. business cycle in industrialized countries) explain the magnitude of capital flows. Pull factors relate to domestic country characteristics (e.g. economic performance) that help explain the distribution of capital flows across potential recipient countries.

[3] The OECD defines FDI as "an activity in which an investor resident in one country obtains a lasting interest in, and a significant influence on the management of, an entity resident in another country. This may involve either creating an entirely new

enterprise (“greenfield” investment) or, more typically, changing the ownership of existing enterprises via mergers and acquisitions." A takeover by a foreign firm is considered FDI if the foreign firm holds at least 10% of the voting rights on the board.

[4] Note that in many countries, urban settlements have expanded rapidly in past decades and that policies had an important role in shaping the nature of such expansion (Angel *et al.* 2012). While this is an important area for future research, it is beyond the scope of this paper.

[5] Note that our approach thus excludes consideration of potential investment to establish irrigation which would require more intensive modeling of hydrological flows and, furthermore, encounter issues related to riparian rights and seasonal availability of water.

[6] Our measure of agricultural land outside the forest and protected areas is constructed from various bases, including Global Land Cover 2000 (http://www-gem.jrc.it/glc2000) PAGE Global Agricultural Extent (http://www.ifpri.org/dataset/pilot-analysis-global-Ecosystems-page), Global Forest Resources Assessment 2000 (http://www.fao.org/forestry/32203/en) and World Database on Protected Areas 2009 (http://www.wdpa.org / download.aspx). Population data is from LandScan 2003 Global Population (http://www .ornl.gov /Landscan/).

[7] Based on this definition, total land for potential expansion is 445 million ha, compared to about 1.5 billion ha already under cultivation. Most of this land (201, 123, and 52 million ha, respectively) is in Sub-Saharan Africa, Latin America, and Eastern Europe (Deininger *et al.* 2011a).

[8] Variables included measure security and enforceability of property rights,

security of contracts, judicial independence, judicial accountability, and prevalence of the rule of law.

[9] The index consists of a weighted average of indices measuring the transparency of transactions, the liability of company directors and shareholders, and the power of administrators to hold directors accountable for misconduct. Our variable is defined as the country's percentile in the ordered distribution of ranks regarding investor protection in the *Doing Business* database.

[10] Key relevant aspects for us are the clarity of land rights and the way state land is managed, disposed of, and acquired, as these elements have an important impact on land tenure security. For more details on land governance, see (Deininger *et al.* 2011b).

[11] The main contributing variables are (contributions under brackets): "land tenure security" (16%), "public policies addressing land rights" (15%), "land ownership rights security" (14%), "diversity of tenure situations" (11%), "recognition by the State of the diversity of tenure situations" (10%), "scarcity of land-related conflicts" (10%), "traditional collective use and ownership" (9%), "significance of land use policies" (6%). This first axis captures 40% of variance. Low values of the index imply low levels of tenure security.

[12] Weak protection of property rights by the state would imply a greater need for private enforcement, an issue that often proved problematic in the past. For an interesting perspective, see the story of Jarch capital in Southern Sudan (Funk 2010).

[13] Although inventory data suggest that a large share of large land acquisitions may be by domestic rather than foreign buyers, existing databases fail to provide

information on this. The implicit assumption seems to be that even a minority stake by a foreigner qualifies a deal as cross-border.

[14] Reasons include the nature of a country's land administration system (e.g. role of chiefs in the case of Ghana), the balance between market and non-market transfers, gaps in capacity and resources with agencies often overwhelmed by unanticipated demand, overlaps in responsibility whereby 'approvals' are often given at different levels in the hierarchy or by institutions not authorized to do so.

[15] All media reports can be accessed at www.farmlandgrab.org.

[16] The ultimate goal is to continue collecting these data and make them available to subscribers on a commercial basis. We thank R. Alomar and D. Cousquer for kindly making historical data available to us for analysis.

[17] Together with weak documentation and the fact that the database made available publicly is updated on a continuing basis without keeping track of previous versions, this reinforces the notion that the land matrix seems be more of an advocacy tool than a rigorous scientific effort, As the matrix does not include information on the timing of transactions, cross-checking is virtually impossible.

[18] Beyond the focus on Africa, different databases differ regarding the relative importance of other regions; while Grain and the Matrix coincide in pointing towards EAP, A&C has EAP as a distant fifth after UEA, ECA, and LAC, partly due to a stronger focus on 'market' transactions.

[19] With correlation coefficients of -0.44 and 0.63 between land governance and investor protection and law and order, respectively, institutional variables are highly correlated.

[20] Note that we do not include a measure of overall income in our regressions. One reason is that we want to focus on the effect of some specific characteristics of the agricultural sector rather than on the effect of overall economic performance on attracting investment. Another reason is that income *per capita* is often seen as an outcome of institutions and governance structure (Acemoglu *et al.* 2001) which are already included in our regressions. As indicated in table 3 in the online appendix, the main results presented in this paper are robust to the inclusion of both income indicators and regional dummies.

[21] The zero inflated models assumes existence of two latent groups within the population: one with zero counts and one with only positive counts. They are then estimated in two steps; a first step uses a logit regression to estimate the probability that there is no bilateral investment at all and a second step is a Poisson regression of the probability of each count for the group with a non-zero probability.

[22] In line with international agreements (Food and Agricultural Organization of the UN 2012), these could include recognition of local rights, education of right holders, and allowing voluntary and transparent transfers of land.

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Table 1: Comparing total and regional extent of land transfers in three key databases

	Total	AFR	EAP	ECA	LAC	MNA	UEA
1. DEMAND IN 2008/9 (Grain)							
Total area (mn ha)	45.179	27.232	8.562	4.556	3.181	1.420	0.228
Projects (#)	453	216	95	47	47	25	23
Countries affected (#)	82	35	7	12	11	6	11
Projects > 1 mn ha (#)	9	4	2	1	1	1	0
Projects > 250kha (#)	30	15	8	6	1	0	0
Area < 1 mn ha	22.109	11.132	5.322	3.326	1.981	0.120	0.228
Area < 250k ha	7.134	3.548	1.270	0.886	1.081	0.120	0.228
2. SIGNED AFTER 2008 (A&C)							
Total area (mn ha)	56.223	34.202	2.528	6.482	4.121	1.527	7.363
Projects (#)	390	192	36	56	57	8	41
Countries affected (#)	67	28	5	9	11	5	9
Projects > 1 mn ha (#)	7	5	0	1	0	0	1
Projects > 250kha (#)	34	19	2	4	4	2	3
Area < 1 mn ha	32.303	17.102	2.528	5.262	4.121	1.527	1.763
Area < 250k ha	17.344	8.393	1.704	3.390	2.818	0.327	0.711
3. GROUND VERIFIED (Matrix)							
Total area (mn ha)	54.054	23.334	23.372	1.776	5.166	0.005	0.401
Projects (#)	848	439	270	18	117	1	3
Countries affected (#)	55	27	4	9	4	0	11
Projects > 1 mn ha (#)	7	2	5	0	0	0	0
Projects > 250kha (#)	37	14	15	1	6	0	1
Area < 1 mn ha	42.715	20.354	15.013	1.776	5.166	0.005	0.401
Area < 250k ha	25.059	13.906	7.024	1.453	2.659	0.005	0.012

Note: AFR=Sub-Saharan Africa, EAP = East Asia and Pacific, ECA = Eastern and Central Europe, LAC = Latin America and Caribbean, MNA = Middle East and North Africa, UEA = United States, Europe, and Australia.
Source: Own computation from the relevant databases as explained in the text.

Table 2: Key characteristics of land deals according to the three databases, total and by region

	Total	AFR	EAP	ECA	LAC	MNA	UEA
1. DEMAND IN 2008/9 (Grain)							
Acquisition type (%s)							
Lease	44.6	59.1	55.4	43.3	15.6	33.3	11.1
Purchase	46.8	32.6	23.4	56.7	81.3	66.7	83.4
Concession	8.6	8.3	21.2	0.0	3.1	0.0	5.5
Intended use (%s)							
Biofuels	20.8	28.0	15.9	6.7	26.2	0.0	15.8
Food	37.8	34.4	52.3	48.9	11.9	70.0	0.0
Industrial/Plantation	22.0	21.7	20.4	20.0	35.7	15.0	15.8
Livestock	19.3	15.9	11.4	24.5	26.2	15.0	68.5
Type of buyer (%s)							
Public agency	25.8	25.7	33.3	27.8	26.3	21.1	0.0
Private firm	36.1	44.2	30.4	24.9	28.9	26.3	31.6
Private fund	38.1	30.1	36.2	47.3	44.7	52.6	68.4
2. SIGNED AFTER 2008 (A&C)							
Acquisition type (%s)							
Purchase	51.8	28.4	29.0	78.6	75.0	50.0	87.8
Lease	43.1	66.1	54.8	19.6	21.2	50.0	9.8
Joint venture	5.1	5.4	16.1	1.8	3.8	0.0	2.4
Type of seller (%s)							
Seller Gov't	54.8	88.1	70.9	11.9	18.0	57.1	2.8
Seller Private	45.2	11.9	29.1	88.1	82.0	42.9	97.2
Type of buyer (%s)							
Buyer private firm	67.3	75.3	82.8	49.1	68.4	50.0	42.5
Private fund	25.4	15.3	5.8	45.4	31.6	37.5	52.5
Gov't/SWF	7.3	9.5	11.4	5.5	0.0	12.5	5.0
Intended use (%s)							
Crop biofuel	22.8	39.1	16.7	0.0	12.3	12.5	0.0
Food	58.7	48.4	63.9	94.6	66.7	75.0	39.0
Other	18.5	12.5	19.4	5.4	21.1	12.5	61.0
Investment amount							
Info non-missing (%)	23.3	14.6	25.0	14.3	29.8	25.0	65.9
Investment/ha (US$)	9,071	13,910	5,699	1,602	3,283	2,069	11,000
3. GROUND VERIFIED (Matrix)							
Intended use (%s)							
Biofuels	20.0	26.9	17.4	0.0	5.6		0.0
Food	18.5	21.1	12.6	66.7	15.7		0.0
Industry/plantation	38.0	32.0	44.9	5.6	47.2		100.0
Other	23.5	20.0	25.1	27.8	31.5		0.0

Note: AFR=Sub-Saharan Africa, EAP = East Asia and Pacific, ECA = Eastern and Central Europe, LAC = Latin America and Caribbean, MNA = Middle East and North Africa, UEA = United States, Europe, and Australia.
Source: Own computation from relevant databases as explained in the text. Only cases with information reported are considered, i.e. 'not known' is coded as missing throughout.

Table 3: Time variation in the nature of signed land deals

Year	Type	Total	AFR	UEA	EAP	ECA	MNA	LAC
Total	Area total (Mn ha)	56.990	34.404	7.518	2.914	6.790	1.623	3.741
	Biofuel (%)	16.9	23.1	0.0	23.9	0.0	30.8	12.7
	Buyer fund (%)	24.2	4.4	82.7	11.2	45.2	49.7	49.6
	Buyer Gov't (%)	7.8	9.5	4.0	15.5	6.0	1.2	0.0
	Seller gov't (%)	52.5	75.0	3.8	54.9	6.3	57.5	22.3
Before	Area total (Mn. ha)	2.047	0.859	0.154	0.386	0.308	0.096	0.243
2007	Biofuel (%)	11.3	23.2	0.0	8.5	0.0	0.0	0.0
	Buyer fund (%)	11.4	2.3	0.0	0.0	12.0	100.0	33.0
	Buyer Gov't (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Seller gov't (%)	45.6	39.5	96.7	86.3	0.0	100.0	6.6
2008	Area total (Mn ha)	5.932	3.806	0.202	0.593	0.844	0.002	0.485
	Biofuel (%)	36.7	53.0	0.0	16.9	0.0	0.0	12.4
	Buyer fund (%)	15.6	1.8	14.0	55.0	12.4	100.0	81.7
	Buyer Gov't (%)	11.9	18.6	0.0	0.0	0.0	0.0	0.0
	Seller gov't (%)	39.6	54.6	69.4	20.2	0.0	100.0	1.7
2009	Area total (Mn ha)	30.408	20.261	5.608	0.844	2.399	0.772	0.524
	Biofuel (%)	15.4	19.2	0.0	62.2	0.0	0.0	50.9
	Buyer fund (%)	31.5	4.3	99.9	0.0	87.3	92.0	57.6
	Buyer Gov't (%)	8.1	10.5	0.0	24.4	4.2	2.6	0.0
	Seller gov't (%)	59.9	81.4	0.0	100.0	4.2	96.1	4.8
2010	Area total (Mn ha)	8.514	3.251	0.201	0.790	2.141	0.754	1.378
	Biofuel (%)	22.6	39.6	0.0	3.5	0.0	66.4	7.6
	Buyer fund (%)	22.8	4.8	45.9	0.0	37.4	0.0	64.8
	Buyer Gov't (%)	1.5	3.9	1.8	0.0	0.0	0.0	0.0
	Seller gov't (%)	32.4	70.3	0.0	4.3	4.2	12.5	18.3
2011	Area total (Mn ha)	10.090	6.226	1.353	0.302	1.099	0.000	1.111
	Biofuel (%)	6.0	8.9	0.0	3.6	0.0	0.0	3.9
	Buyer fund (%)	11.0	6.4	37.0	0.0	2.9	0.0	16.6
	Buyer Gov't (%)	11.3	4.6	22.2	81.2	28.2	0.0	0.0
	Seller gov't (%)	56.6	74.9	0.0	89.6	21.8	0.0	48.0

Note: AFR=Sub-Saharan Africa, EAP = East Asia and Pacific, ECA = Eastern and Central Europe, LAC = Latin America and Caribbean, MNA = Middle East and North Africa, UEA = United States, Europe, and Australia.
Source: Own computation based on all signed transfers from A&C database. Percentages are weighted by area.

Table 4: Estimates at country level according to different sources

	Area (mn ha)	Projects		Origin of investor				
		No	%	Africa	East Asia	M. East	N America	W. Europe
1. DEMAND IN 2008/9 (Grain)								
Total Africa	27.23	216		14.9	13.9	28.7	3.1	39.5
Ethiopia	0.81	21	15.0	27.8	5.6	44.5	0.0	22.2
Ghana	0.53	15	10.7	14.2	7.2	7.2	0.0	71.4
Madagascar	1.94	14	10.0	9.0	18.2	18.2	0.0	54.6
Mali	0.60	9	6.4	11.1	0.0	33.3	11.1	44.4
Mozambique	0.18	14	10.0	33.4	8.3	8.3	8.3	41.7
Nigeria	0.03	16	11.4	43.8	12.5	18.8	0.0	25.0
Sudan	3.88	26	18.6	7.7	15.4	69.3	3.8	3.8
Sierra Leone	0.00	3	2.1	0.0	33.3	0.0	0.0	66.7
Tanzania	1.78	12	8.6	0.0	9.1	27.3	0.0	63.6
DRC	12.87	4	2.9	25.0	25.0	0.0	25.0	25.0
Zambia	2.00	6	4.3	0.0	50.0	33.3	0.0	16.7
Other	2.64	76		9.2	15.4	23.0	3.0	49.2
2. SIGNED AFTER 2008 (A&C)								
Total Africa	34.20	192		10.5	17.2	15.9	16.6	39.9
Ethiopia	2.19	32	22.2	17.7	5.8	29.4	17.7	29.4
Ghana	0.68	10	6.9	0.0	10.0	20.0	20.0	50.0
Madagascar	0.74	3	2.1	0.0	33.3	0.0	0.0	66.7
Mali	0.37	11	7.6	11.1	11.1	11.1	44.4	22.2
Mozambique	1.85	18	12.5	6.3	0.0	0.0	18.8	74.9
Nigeria	0.53	5	3.5	0.0	0.0	25.0	25.0	50.0
Sudan	6.12	22	15.3	15.0	15.0	50.1	20.0	0.0
Sierra Leone	0.49	11	7.6	0.0	30.0	10.0	0.0	60.0
Tanzania	1.32	17	11.8	0.0	25.0	6.3	18.7	50.1
DRC	15.04	10	6.9	30.0	30.0	0.0	20.0	20.0
Zambia	0.09	5	3.5	20.0	0.0	20.0	0.0	60.0
Other	4.78	48		11.6	25.6	9.3	11.6	41.9
3. GROUND VERIFIED (Matrix)								
Total Africa	23.33	439		26.9	7.2	11.5	11.5	42.9
Ethiopia	4.77	71	20.1	22.5	4.1	24.5	18.4	30.6
Ghana	0.67	9	2.5	11.1	0.0	11.1	11.1	66.7
Madagascar	3.78	38	10.8	22.5	9.7	6.5	9.7	51.6
Mali	0.58	27	7.6	42.9	9.5	19.0	14.3	14.3
Mozambique	1.97	89	25.2	22.0	0.0	3.1	3.1	71.9
Nigeria	0.36	20	5.7	40.0	0.0	0.0	0.0	60.0
Sudan	3.92	18	5.1	5.9	0.0	52.9	23.5	17.7
Sierra Leone	0.72	13	3.7	14.3	0.0	0.0	28.6	57.1
Tanzania	1.38	54	15.3	24.2	9.2	0.0	12.1	54.5
DRC	0.24	6	1.7	0.0	0.0	0.0	0.0	0.0
Zambia	0.27	8	2.3	33.3	0.0	16.7	0.0	50.0
Other	4.66	86		37.7	14.5	2.9	7.2	37.7

Source: Own computation from the relevant databases

Table 5: Descriptive statistics for origin and destination in different databases

	Grain				A&C				ILC	
	Total		Started		Total		Started		Total	
	Origin	Dest	Origin	Dest	Origin	Dest	Origin	Dest	Origin	Dest
					Descriptive statistics					
Distance	5979.87		6024.46		7403.6		6828.7		5642.09	
Former colonial relation	0.023		0.017		0.009		0.014		0.057	
Supply factors										
Cult. area (mn ha)	40.13	21.9	43.22	25.86	46.67	17.08	43.32	24.74	34.6	15.51
Non-forest land suit. (mn ha)	3.95	13.45	5.03	14.65	4.45	16	5.58	16.65	5.42	14
Max. poss. output non -forest	21474	38009	24866	39894	26401	38911	28691	44434	25300	25312
Forest land suit. (mn ha)	10.52	18.34	12.74	21.55	14.62	17.97	17.72	25.26	14.73	12.54
Max. poss. output forest	43889	78084	51144	84053	58497	76449	67297	95009	12099	12108
Yield Gap (%)	0.35	0.68	0.32	0.65	0.3	0.68	0.3	0.67	0.36	0.72
Demand factors										
Total population (000)	26300	9500	28900	10600	29600	6660	20100	7430	15900	7120
Net food exports	-3.23	1.33	-3.51	1.73	-1.61	1.33	-0.60	2.52	0.11	1.11
Food exports	12.36	4.40	14.93	5.50	15.08	3.82	18.40	6.21	15.74	3.17
Institutional environment										
Land governance	1.02	-1.22	1.10	-1.15	0.97	-1.18	1.81	-0.90	1.02	-1.42
Investor Protection	58.07	88.73	59.72	86.79	59.55	81.56	45.98	86.6	54	94.78
Law and order	4.55	3.24	4.6	3.36	4.53	3.17	4.71	3.35	4.56	3.1
					Share of countries targeted (%)					
Total		37.4		31.1		30.6		18.9		24.3
Africa		69.1		58.2		58.2		36.4		47.3
America		26.0		24.0		22.0		14.0		22.0
Asia		46.9		34.7		24.5		18.4		24.5
Europe		16.3		14.0		23.3		7.0		4.7
Pacific		8.0		8.0		12.0		12.0		12.0
					Average number of projects per country					
Total		2.11		1.35		1.99		0.63		2.68
Africa		4.36		2.69		3.98		1.38		5.53
America		1.08		0.82		1.40		0.36		1.78
Asia		2.84		1.84		1.53		0.71		3.84
Europe		0.47		0.28		0.88		0.09		0.19
Pacific		0.64		0.36		1.56		0.28		0.20

Notes: The table shows unweighted averages of country characteristics based on a total of 215 countries.
Source: Own computation from the relevant databases.

Table 6: Results from unilateral regressions

	Grain		A&C		Matrix
	Total	**Started**	**Total**	**Started**	
Max potential outp. non-forest	1.1538***	1.1255***	1.7200***	0.8008***	0.4742***
	[0.186]	[0.150]	[0.302]	[0.144]	[0.123]
Max potential outp. forest	-0.6333***	-0.6404***	-1.0907***	-0.0797	0.1301
	[0.173]	[0.139]	[0.277]	[0.133]	[0.114]
Landlocked	-0.5110***	-0.4004***	-0.9878***	-0.1257	-0.0769
	[0.188]	[0.146]	[0.320]	[0.142]	[0.122]
Yield gap	-0.1367	0.1328	0.4108	1.0241***	0.1505
	[0.445]	[0.361]	[0.669]	[0.365]	[0.334]
Land governance (norm.)	-0.4042***	-0.3947***	-0.3972***	-0.2081***	-0.6566***
	[0.094]	[0.075]	[0.137]	[0.076]	[0.069]
Law and order (norm.)	-0.0117	-0.0099	-0.0360	0.2959***	0.1382**
	[0.083]	[0.067]	[0.122]	[0.065]	[0.058]
Investor protection (norm.)	-0.0465	-0.1099*	-0.2145*	0.0508	-0.0673
	[0.075]	[0.060]	[0.110]	[0.066]	[0.058]
Observations	97	97	97	97	97
Pseudo R-squared	0.336	0.361	0.334	0.447	0.385
With region dummies					
Land governance	-0.2592**	-0.2378***	-0.1598	-0.3437***	-0.2928***
	[0.111]	[0.088]	[0.162]	[0.094]	[0.079]

Source: Authors' analysis based on data as explained in the text.
Note: The dependent variable is the number of projects reported in a country. A constant is included throughout but not reported.

Table 7: Results from bilateral regressions of the number of projects according to different databases

	Grain		A&C		Matrix
	Total	**Started**	**Total**	**Started**	
Bilateral variables					
Distance (log)	-0.6758***	-0.5954***	-0.2025*	-0.4108***	-0.9163***
	[0.057]	[0.050]	[0.122]	[0.056]	[0.032]
Former colonial relation	0.5746*	0.9642***	1.2569***	1.4614***	1.5348***
	[0.312]	[0.214]	[0.356]	[0.188]	[0.170]
Origin country variables					
Value net food imports	2.8002***	3.3382***	3.0151***	1.1044***	0.3883
	[0.239]	[0.186]	[0.381]	[0.259]	[0.256]
Population (log)	0.7041***	0.7669***	0.8364***	0.6875***	0.6863***
	[0.038]	[0.031]	[0.056]	[0.029]	[0.027]
Destination country variables					
Landlocked	-0.4007**	-0.3887**	-1.0754***	0.0281	0.2128*
	[0.195]	[0.156]	[0.329]	[0.146]	[0.127]
Max potential outp. non-forest	0.6740***	0.6588***	0.8970***	0.6355***	0.5723***
	[0.081]	[0.066]	[0.128]	[0.069]	[0.064]
Net food import value	0.1761***	0.1035***	0.0012	0.1224***	0.2084***
	[0.048]	[0.037]	[0.063]	[0.037]	[0.034]
Max potential outp. forest	-0.1644***	-0.1534***	-0.2684***	0.0589	0.0598
	[0.055]	[0.044]	[0.084]	[0.046]	[0.042]
Yield gap	0.7860	0.7568*	0.5882	1.6923***	1.1934***
	[0.531]	[0.432]	[0.796]	[0.440]	[0.420]
Land governance (normalized)	-0.5066***	-0.4574***	-0.4258***	-0.3200***	-0.7597***
	[0.096]	[0.079]	[0.144]	[0.078]	[0.069]
Law and order (normalized)	-0.1089	-0.0812	-0.0306	0.2209***	0.0039
	[0.085]	[0.070]	[0.122]	[0.065]	[0.060]
Investor protection (normalized)	-0.0537	-0.1140*	-0.2455**	0.0487	-0.0802
	[0.077]	[0.063]	[0.113]	[0.068]	[0.060]
	18,333	18,333	18,333	18,333	18,333
Pseudo R-squared	0.243	0.276	0.275	0.276	0.350
With region dummies					
Land governance	-0.2308*	-0.2152**	-0.1052	-0.3498***	0.0018
	[0.118]	[0.096]	[0.172]	[0.099]	[0.088]

Source: Authors' analysis based on data as explained in the text.
Note: The dependent variable is the number of projects in a country pair. A constant is included throughout but not reported.