Land Governance
POLICY BRIEF
WORLD BANK ✦ DEVELOPMENT RESEARCH GROUP
ISSUE 3 ✦ JANUARY 2018

Does large farm establishment create benefits for neighboring smallholders? Evidence from Ethiopia

✳ Daniel Ali, Klaus Deininger, and Anthony Harris

Quantifying the direction and magnitude of spillovers for small holders is an essential part of the policy dialogue surrounding large-scale agricultural investment. We use intertemporal variation in smallholders' proximity or intensity of exposure to large farms, while exploring the variation in large farm establishment over time and space, to analyze the presence and magnitude of spillovers between large and small farms. Findings show that between 2004 and 2014 new formation of commercial farms did not contribute to job creation and provided at best modest benefits for neighboring smallholders in terms of technology and access to inputs. This implies that in Ethiopia a more strategic approach may be required to maximize smallholder benefits from large farm formation. Our methodology has proven to be robust and can be applied to study spillover effects of large-scale commercial farming more generally. Avenues to do so are outlined.

Introduction

The 2007/08 food price spike, together with the recognition that some countries in Africa are endowed with large amounts of seemingly unoccupied or unclaimed land, triggered a marked increase in private sector demand for agricultural land to satisfy increasing demands for food, fuel, and fiber. Although often described as 'land grab', the expansion of large commercial farms also gave rise to expectations of private capital to complement public investment, making up for decades of underinvestment in agriculture. It prompted a lively policy debate regarding the direct or indirect effects from such investments towards more rapid rural development and poverty reduction for countries with ample land resources.

A key argument in the policy dialogue revolves around local spillover effects from private investment in agricultural production, which are likely to be quite different from those higher up the value chain. Spillovers can be positive or negative. Examples of the latter include land made available without proper valuation and compensation, or new investors monopolizing factor markets or encroaching on land or water resources.

Quantifying the direction and magnitude of local spillovers is therefore essential. Yet, despite this interest, efforts at systematic quantification for agricultural production, beyond individual case studies, have been rare. Careful empirical assessment based on a clear methodology, with a representative and rigorous quantification of the underlying processes, is key to providing clarity on spill overs.

This policy brief presents a methodology for quantifying spillovers for large-scale agricultural investments by analyzing spatial proximity as the main channel of transmission, while exploring variation in large farm establishment over time and space to identify causal impacts. Using detailed data on commercial farms and smallholders for Ethiopia, we estimate mean effects of establishing new large farms on key agricultural indicators for neighboring smallholders. Ethiopia was selected, as it has a long history of large farm establishment, availability of good data, and plays a preeminent role in recent debates on this topic.

Inventory of possible spillovers

High transaction costs or ignorance of potential benefits can discourage smallholders from using certain inputs or technologies, even if the benefits of doing so exceed the cost. If transport or other transaction costs are high, smallholders may be rationed out of input and output markets as quantities demanded may be too small to defray the costs, even without credit constraints.

The presence of large farms may assist neighboring smallholders to overcome these obstacles. To the extent that they use these, large farms can affect smallholders' use of technology and equipment, level and intensity of input use, factor market participation, and resilience to shocks.

In this study, we examine two types of spillovers (i) crop specific spillovers, where transmission occurs between smallholders and large farms growing the same crop, and (ii) generic spillovers arising between smallholders and large farms regardless of crops, which may capture improvements in input market access, marketing assistance or increased local labor demand.

For crop specific spillovers, we focus on maize, wheat, sorghum, and teff, four key cereals grown by many large and small farms across Ethiopia. Smallholders and large farms report clear differences in yields and input use intensities for these crops, except for teff. A sizable share of large farms growing these crops report providing technical support to their smallholder neighbors. Both facts suggest significant scope for spillovers.

Data sources

A first set of data is the Ethiopia's Central Statistical Agency (CSA) smallholder agricultural production survey conducted annually by resident enumerators for a sample of some 1,400 kebeles nation-wide and covers the period between 2003/4 and 2013/14. Data on input use is collected from a random sample of 20–40 farmers per kebele, i.e. a total sample of 28,000 to 56,000 farmers per year. However, data on yields is based on crop cuts of randomly selected fields in

each EA rather than of fields belonging to the sampled farmers. This makes it impossible to estimate farmer-specific production functions and forces us to analyze yields at kebele level instead. The survey also lacks data on farmer's use of labor, preventing us from using these surveys to explore this potentially important channel for large farms to affect smallholders. Instead, we use data on individual labor supply collected in the 2011/12 and 2013/14 LSMS-ISA panel to estimate local labor market effects from large farm establishment.

The second data source is the 2014 round of the annual CSA census of all operational large farms. The category of large commercial producers is defined as all those with a size over 10 hectares. It is important to note that flower farms are not included in the sample of CSA's large and medium scale commercial farms survey. This second CSA survey covers a sample of all large farms in the 10–50 ha category and the universe of farms holding 50 ha or more. Farm level information is provided on input use, output, and year of establishment. GPS coordinates taken for every field allow us to map the universe of all farms above 50 ha that were operational in 2014.

Finally, to account for inter-temporal variability in climatic conditions, we use gridded 0.1' rainfall data publicly available from NOAA since 1980 to compute long-term mean and standard deviation of precipitation for each pixel.

Methodology for quantifying spillovers

As discussed, spillover channels rely on physical proximity. Our measure of proximity, constructed for each kebele and year, is the distance to the nearest large farm or the next large farm growing the same crop. Our alternative measure of exposure is the total large farm area in concentric circles or rings around the kebele with inner and outer radii of 0 to 25, 25 to 50 and 50 to 100 km.

Kebele centroids are used as a proxy for the location of households in the agricultural sample survey. For any kebele and year in the smallholder sample, we compute the distance from the kebele centroid to the centroid of the nearest large farm and the total area devoted to large farm cultivation of a specific crop within a certain radius of the kebele centroid.

As CSA redrew the sample of kebeles for the smallholder data only once (in 2007/08), we link survey rounds across years to obtain two kebele level panels for the 2004–2007 and the 2008–2014 period with about 500 and 2,000 kebeles, respectively.

We link each large farm's year of establishment to all rounds of the smallholder survey to generate kebele-specific measures of proximity and exposure to large farms in each year. The time variation in smallholder kebeles' proximity to large farms, overall or for specific crops, over the 2004–14 period is used to identify if smallholders' fertilizer use, yields, employment, or resilience are affected by large farm establishment.

Large-scale land based investment in Ethiopia

In Ethiopia, historic attempts at establishing large farms were mostly unsuccessful. Before 1974, subsidies were used to attract commercial investment in so-called 'model farms', whose establishment was often associated with tenant evictions, mediocre productive performance and little employment generation. These failures led to a decision in the 1990s to rely on smallholder agriculture as the main driver of development. This changed in the Government's 2010–2015 Growth and Transformation Plan, which views large farm investment as a strategic priority, asserting that capital intensive investment is the only way to bring such land to productive use and generate spillover benefits for smallholders.

The Ethiopia's CSA annual census of operational large farms suggests that, since the 1990s, about 1.3 mn. ha has been transferred to a total of 6,612 commercial farms, some 78% of which own more than 50 ha. The annual rate of farm establishment dropped from a peak of close to 800 in 2007/08 back to the pre-2007 level of some 250 in 2011/13.

More land may have been transferred as only operational farms are included in the CSA survey. A review of some 10,600 investment licenses by the Agricultural Investment Agency suggests that less than 20% of licensees ever established a farm.

By 2014, 95% of land transferred for commercial farms benefited Ethiopians or joint ventures rather than foreigners (see Table 1). Mean farm size is about 200 ha (172 ha for Ethiopians and 840 ha for foreigners). By respondents' own estimates, 55% of land transferred remains unutilized, largely due to technology and labor constraints.

Investments made focus on land clearing and machinery rather than public goods, and less than 20% of farms accessed credit themselves.

Measuring spillovers

Density functions for changes in distance between smallholder kebeles and the next large farm over time overall illustrate the rapid expansion of large farms over the study period, with a marked change over the 2004–2010 period, corresponding to new large farms establishment. Commercial maize farms spread from the center of the country leaving only kebeles in Gambella and Tigray at a distance of more than 150 km from the next large farm. In 2004, large

Table 1: Descriptive statistics for large farms above 50 ha

	Total
Size & establishment year	
Size cultivated (ha)	266.66
Before 91 (%)	4.68
1991–92 (%)	3.49
1992–2002 (%)	21.50
2002–2006 (%)	22.61
07–2008 (%)	24.98
09–2010 (%)	14.54
11–2013 (%)	8.20
Ownership type (%)	
Government	2.74
Private	92.39
Cooperative	4.61
Ethiopian	*96.62*
Foreign	*2.67*
Joint	*0.71*
Type of acquisition (%)	
Direct negotiation	6.83
Woreda	51.32
Region	37.17
Federal Government	4.68
Number of obs.	*3484*

Source: Own computation from 2013/4 CSA large farm surveys.

sorghum farms were clustered in Oromia, eastern Afar, and the northwest of Amhara spilling into Tigray. Although fewer than maize, their number expanded greatly by 2014. Large wheat farms expanded from southern Amhara and Oromia and northern SNNPR in 2004 to cover virtually the entire Oromia and considerable parts of SNNPR and Amhara. Teff which, in 2004, was grown mainly in the central highlands, also has expanded greatly.

Our data confirm a clear decrease in distance to the next commercial farm, from 78 km in 2004 to 41 km in 2014 and an increase of the number of large farms within a 0–25, 25–50, and 50–100 km radius. As a result, the scope for interaction between large and small farms expanded.

Table 2 provides data on large farms overall and the four crops considered. Mean area for the farms considered here is 267 ha, with wheat farms largest and sorghum and teff farms smallest. About 25% of farms were established during 2007/08 alone. With 55 ha per permanent employee, the average farm employs less than 5 permanent workers. Employment intensity varies by crop, with wheat farms least and teff farms most employment intensive. Overall, 37% of farms report paying lease fees, ranging from 73% of wheat farms to 30% of sorghum farms. With only 6% reporting current outstanding loans, access to formal credit by commercial farms seems modest. Provision of advice and technical assistance as a channel for spillovers is supported by reports from large farmers who state that they provide advice to smallholders on a range of topics, topped by 20% on fertilizer or seed varieties.

Table 3 provides information on area cultivated, yield and fertilizer use by crop for smallholders as well as commercial farms of different sizes. The relationship between yields and farm size is non-linear; yields are highest for farms in the 10–20 ha range while those above 20 ha often obtain yields 20% below those attained by the top performing group in each crop. For all crops except teff, smallholders' yields amount to 75% or less of those attained by commercial farms, creating prima facie potential for spillovers, either through adoption of better technology or more intensive input use on the part of smallholders.

We used the data to test if and to what extent large farm formation in Ethiopia benefited or harmed neighboring smallholders by affecting (i) their use of fertilizer; (ii) labor demand and job creation; and (iii) crop yields. We assume the main transmission channels are transfer of knowledge, provision of access to markets for inputs and outputs, or implicit credit and insurance, the former being particularly relevant if there are gap in yields or input use between large and small producers.

Improved seeds and fertilizer have been identified as key to smallholder productivity in Ethiopia. Although our data suggest that the use of improved seeds is significantly higher in commercial than smallholder farming, the difficulty of unambiguously identifying improved seed types in standard surveys leads us to focus our empirical analysis only on fertilizer.

For fertilizer use, a marginally significant positive effects of large farm establishment was found for maize but not for other crops. For smallholders producing maize, a reduction in mean distance to the next commercial farm, would be predicted to increase the share of producers applying fertilizer by 0.7 percentage points with a further decrease from 40 km to 2 km predicted to increase fertilizer use by an additional 4.6 percentage points. Effects are more pronounced for distance to the next large farm growing maize where equivalent shifts would be predicted to be associated with increases of 2.5 or 3.9 percentage points, respectively, in the propensity to use fertilizer. Results suggest that spillover effects are limited to farms in very close proximity; estimated coefficients on area beyond 25 km are not significantly different from zero while those on both total and maize area in the 0–25 km range are highly significant.

Results for other crops suggest no increases in incidence of fertilizer use due to spillovers from large farm establishment. For teff, fertilizer use by small producers is only slightly below that of commercial farms while their yields are some 50% above those of the latter (table 3), suggesting the potential or spillovers is low to begin with.

While the above effects of commercial farms establishment on incidence of chemical fertilizer use may be driven predominantly by improved market access, impacts on neighboring smallholders' yields would reflect knowledge transfer or technology more directly. For maize and wheat, results suggest that having a large farm area with the same crop close to smallholders can have yield-enhancing impacts. For teff and sorghum coefficients are all insignificant.

Table 2: Descriptive statistics for large farms above 50 ha for selected crops

	Total	Maize	Sorghum	Wheat	Teff
Size & establishment year					
Size cultivated (ha)	266.66	377.90	234.56	551.74	237.60
Before 2002 (%)	29.67	18.4	32.26	46.87	13.1
2002–2006 (%)	22.61	19.70	27.26	8.52	18.70
07–2010 (%)	39.52	54.31	34.35	39.78	57.92
11–2013 (%)	8.20	7.59	6.15	4.83	10.28
Employment					
Hectares per perm. worker	56	55	83	254	32
Temp. workers/ha	3.56	2.82	3.70	1.32	1.70
Fees, investment, credit					
Lease fee reported (%)	36.74	58.54	29.96	73.31	37.24
… if yes Birr/ha	530	327	274	1518	203
Other payments. (%)	11.37	24.09	9.11	19.01	12.53
… if yes Birr/ha	376	464	218	180	170
Any investment (%)	93.11	90.18	98.71	80.45	89.43
Any loan last 5 years (%)	20.68	17.10	24.62	14.92	16.98
.. if yes Birr/ha	18,195	16,548	17,039	39,997	12,099
Provided advice in 2015 to smallholders on…					
Fertilizer	0.204	0.372	0.202	0.294	0.452
Irrigation	0.071	0.154	0.045	0.066	0.173
New seed varieties	0.202	0.376	0.163	0.257	0.422
Pests	0.146	0.258	0.166	0.125	0.341
Soil problems	0.115	0.213	0.106	0.118	0.286
General cropping problems	0.177	0.297	0.171	0.191	0.351
Water issues	0.101	0.162	0.092	0.092	0.265
Animal services	0.103	0.175	0.126	0.099	0.232
Marketing	0.106	0.192	0.111	0.072	0.255
Number of obs.	3484	822	1659	194	323

With growing population and limited absorptive capacity in the non-agricultural sector, the ability to create gainful employment is a key concern for policy makers and considerable hopes are pinned on employment creation from large farms being integrated into agro-processing value chains. Using large farm area cultivated within different distance bands as the independent variable, our analysis supports the notion of large farms having no impact on local labor markets. Data suggests that in marked contrast to, for example, flower farms, large farms fail to significantly contribute to generation of paid jobs and, even in their immediate vicinity, such farms have no perceptible effect on casual labor demand.

Conclusion and policy implications

Exploring size and direction of spillovers from large farm establishment in Ethiopia, contributes to the debate on commercial farming in Africa. During the 2004–14 period, a rather uncoordinated process of commercial farm establishment provided neighboring smallholders with at best modest spillover effects in technology, input market access, and resilience, but no job creation benefits. Spillover effects are largely limited to maize, a crop where technology is similar across farm sizes and large farm density sufficiently high to facilitate interaction with small farmers.

These findings are subject to a few caveats. First, our large farm data exclude flower and horticultural farms, so spillovers estimated here are only for field crops. Second, as data on commercial farms below 50 ha is collected only on a sample basis, estimated spillovers are from farms above 50 ha. Third, the benefits we compute can be interpreted as social gains if the land now used by large farms was earlier unutilized. Survey data suggest this was not the case in about 30% of cases. Fourth, while our methodology can in principle be applied to any outcome variable, lack of data on socio-economic outcomes precludes us from making inferences on broader welfare effects.

Modest investments in additional data collection would allow to address these issues and enhance the policy relevance of these findings for Ethiopia by (i) comparing size of impacts of investing in large-scale farming to those of other investments (irrigation, establishment of agro-processing facilities, direct technology transfer) to enhance smallholder integration into value chains; (ii) exploring heterogeneity of effects by nature of contractual provisions, investor type, or farm size class, in particular for farms in the 10–20 ha group; and (iii) assessing spillover effects on measures of welfare.

Methodologically, our paper demonstrates that linking information on start date and location of large farms to georeferenced household or farm survey data and using inter-temporal variation in large farm presence for identification allows to rigorously assess spillovers from commercial farm establishment in ways that transcend the limitations of case studies. In many countries where commercial farming has become a policy priority, the data required to estimate spillovers in this way are available or could easily be generated for analysis at rather low cost. This is a worthwhile investment to inform policy given the far-reaching impact of large farm expansion on agricultural structure and local livelihoods, reputational risk, and the possibility of shaping private sector investment decisions by adapting and fine-tuning the regulatory framework in light of actual outcomes.

Table 3: Productive performance of smallholders vs. commercial farms in different farm size classes

	Maize	Sorghum	Teff	Wheat
Yield (Q/ha)				
Smallholder	27.07	21.29	13.62	21.85
Commercial farmers	37.69	27.01	8.29	25.58
Use fertilizer (%)				
Smallholder farmers	38.76	15.40	65.24	73.18
Commercial farmers	67.73	23.48	73.52	65.25
Observations				
Smallholder kebeles	1,368	910	955	634
Commercial farmers	1,659	3,077	826	464

Source: Own computation from 2013/4 CSA large farm and smallholder farm surveys

This policy brief is based on Ali, Daniel Ayalew; Deininger, Klaus W.; Harris, Charles Anthony Philip. 2016. ***Large Farm Establishment, Smallholder Productivity, Labor Market Participation, and Resilience: Evidence from Ethiopia*** . World Bank Policy Research Working Paper; No. 7576. http://bit.ly/2DThF4G

Daniel Ali is a senior economist and **Klaus Deininger** a lead economist at the World Bank, Washington DC; **Anthony Harris** works at Mathematica Policy Research, Cambridge MA.

✦ CONTACT: **kdeininger@worldbank.org.**