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Would Small be More Beautiful in the South African Land Reform?

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4.1 Introduction

It was white people who, under Apartheid, were the owners and entrepreneurs of South African agriculture, while blacks were reduced to the status of serfs or were pushed into traditional farming on unproductive land in the black homelands. When the Apartheid regime was overthrown in 1994, the new government launched the ambitious plan of redistributing 30 percent of the agricultural land to black farmers. However, hindering this plan was the fact that hardly any black people had the agricultural experience, management capacity, or capital to run AQ1 the large-scale farms – part of the price of 80 years of systematic discrimination that no political intervention can undo in the short run.

Apart from addressing historical injustices, the main goals of the land AQ2 reform in South Africa are rural poverty alleviation, economic growth, and redistribution of income (DLA, 1997). But the reform has made little progress, in terms of both the amount of land redistributed and the success of those who have received land through the reform; the redistributed farms are to a large degree unproductive or have failed completely (Hall, 2008; Lahiff, 2008). Nevertheless, despite its lack of success, politicians still seem to be committed to reaching the redistribution target, and there is a call to speed up the process through radicalization of the reform (Lahiff, 2007b).

Land redistribution should lead to greater equality but is also, more importantly expected to increase agricultural productivity and employment. The Inverse Relationship (IR) between farm size and productivity is considered a stylized fact in development economics (Banerjee, 2005). Large farms, both privately and collectively run units, face the moral hazard of hired labor, while smaller farms tend to be worked

by families, who work harder and invest more as they retain the full return of their inputs.

Apartheid favored large, mechanized farms and restricted subdivision, creating an agricultural sector dominated by a white élite (van Zyl et al., 1995). Restrictions on subdivision are still in place on the land reform farms, due to perceived economy of scale (Hall, 2008; Lahiff, 2007a) – however, the beneficiaries have neither the resources nor the skills to run mechanized commercial farms, and beneficiaries in collectively owned farms find it hard to collaborate with one another (Lahiff, 2007b). Hence, splitting farms into family-size units might increase production, employment, and investments, potentially reducing the high rural poverty rate.

We tested the IR hypothesis on farms controlled by land reform beneficiaries using the Quality of Life Survey (QoL) from 2005. The estimated elasticity of value of crop production per land unit with respect to cultivable area, controlling for land value, irrigation, fallow land, and organizational form, is significant and negative – ranging in [–0.87, –0.49]. The results are supported and further interpreted by applying qualitative information from personal visits to 31 land reform farms in 2009. Our quantitative study supports critical reports based on case studies (du Toit, 2004; Lahiff, 2008), but of greater concern is the fact that our field visits show an even more negative effect over time. Several recorded large farm 'successes' in the QoL dataset from 2005 had in fact by 2009 ceased to produce due to internal conflicts of interest and mismanagement. Therefore, an updated dataset could give an even stronger IR effect. However, small farms are a conditional success, as they apply traditional technology and do not satisfy the South Africans politicians' own perception of efficient production.

4.2 Land reform policy in South Africa

4.2.1 Correcting historic injustice

In 1994, the first democratically elected government of South Africa inherited one of the most unequal land and income distributions in the world; a white minority, 10.9 percent of the population, controlled 86 percent of total agricultural land, while the African majority was confined to just 13 percent of the territory, known as the homelands (Lahiff, 2007b). The agricultural sector was, and still is, separated by means of production, as a highly mechanized commercial sector coexists with black small-scale subsistence-oriented farmers. The emergence of large-scale white farms was made possible by artificially depressing

the wages of black workers, the creation of marketing monopolies, direct transfers and output subsidies (Christiansen and van den Brink, 1995; Binswanger and Deininger, 1993; Bundy, 1988). In fact, during the nineteenth century the African tenant and owner-operated farms had been outcompeting large-scale farms operated by European settlers and dependent on hired labor (Christiansen and van den Brink, 1995; Binswanger and Deininger, 1993; Bundy, 1988). The main reason for the comparative advantage of the African farmer was the simple technology and the large amount of labor used in production (Christiansen and van den Brink, 1995). So the white large-scale farm owners argued that labor shortages made it impossible to compete, and lobbied for policies to curb competition from black farmers (Christiansen and van den Brink, 1995). As a result, the restrictions on farms owned by black Africans became more pronounced. Tenancy emerged as a response, and by the end of the nineteenth century 50 percent of African farmers were tenants on white-owned land (Christiansen and van den Brink, 1995). Concerns that the success of the African tenant farmers would make them difficult to govern, and the sharp increase in demand for labor from the emerging mining sector, led to an act that had a profound impact on South African history (Christiansen and van den Brink, 1995).

In 1913, the parliament of the then three-year-old Union of South Africa passed the Natives Land Act. The act formalized by law the borders of the African reserves, and declared that natives, defined as members of an aboriginal race or tribe of Africa, only had rights to conduct agricultural activities within these reserves (Feinberg, 1993). Two-thirds of the population would hence be obliged to farm on only 7.8 percent of the available agricultural land, which soon led to land degradation (Christiansen & van der Brink, 1995). The Africans could not own, rent, or lease land outside the homelands, which later became known as the Bantustans(Feinberg, 1993). Independent farmers had to give up, and become cheap labor in the mining industry or employees for white farmers. The black rural population lost their agricultural capital, farming skills and information base that had been accumulated over generations (Christiansen & van der Brink, 1995). In this way, the rural sector became dominated by highly mechanized white farms, despite the historically comparative advantage of labor-intensive production (Deininger & May, 2000).

At the end of Apartheid in 1994, a white paper of the new government introduced three concepts in the land reform program (DLA, 1997). *Restitution* implied that people that had been wrongfully evicted after the Natives Land Act (NLA) in 1913 (or their descendents) would get

their land back or a monetary compensation (Hall, 2008). *Tenure* aimed to secure property rights by issuing formal land titles to individuals as well as communities. *Redistribution* aimed to provide land for landless labor tenants and farm workers, as well as new entrants to agriculture. Redistribution is the most important component of the land reform, as it is expected to make the most substantial contribution and benefit the greatest number of people (Lahiff, 2007b). The redistribution is based on the principle of willing seller – willing buyer. This means that the seller and buyer engage in voluntary negotiations, and the role of the state is to provide grants to eligible beneficiaries to buy land on the market (Deininger, 1999). Until the year 2000, a one-time grant of maximum R1600 was made available for households earning less than R1500 per month (Lahiff, 2007b). Restrictions on subdivision, as discussed below, and the relatively large holdings available on the market as a consequence of the policies described above, forced beneficiaries to pool their resources to be able to buy land under the Settlement Land Acquisition Grant (SLAG) program and then farm collectively (Hall, 2008). The lack of success of the land reform projects led to restructuring of the grant system to make it more focused on targeting emerging black commercial farmers and smaller groups, under the new Land Redistribution for Agricultural Development Grant (LRAD) program in year 2000. The income ceiling was abandoned, and own contributions from the beneficiaries were (and still are) required either in cash or in kind. The grants are given on a sliding scale, depending on the size of the contribution made by the beneficiaries. This has raised the concern that the land reform is leaving the poor behind; as the grant system depends on the beneficiaries' own contribution, it will target people with a previously strong asset base (Hall, 2008).

4.2.2 Restrictions on subdivision

The lack of small farms on the market is a consequence of the Subdivision of Agricultural Land Act (SALA) of 1970 that restricted the fragmentation of agricultural land (Hall, 2008). The land reform projects are formally exempted from the act; however, a market for small parcels consisting only of potential land reform beneficiaries is too small to be profitable for large landowners to bear the cost of subdividing their land and selling it in multiple parcels (Lahiff, 2007b). In this way, the act indirectly restricts the opportunities for beneficiaries to buy small and medium-sized farms. This is a crucial obstacle, since small-scale farms are the ones most sought after by the rural poor and landless (Lahiff, 2007b). The reasons for restricting the subdivision of agricultural land were to prevent the rise of

black small-scale farmers and secure a minimum income level for white farmers (van Zyl et al., 1995); SALA was repealed in 1998, but the repeal has still not been signed into law by the President – it has never yet officially been brought into effect (Hall, 2008).

Furthermore, institutional and ideological obstacles have prevented subdivision of land reform projects after they have been acquired in the market (Hall, 2008). The major obstacle is the general skepticism among officials in central positions towards restructuring the agricultural sector. Land reform projects that propose subdividing existing farm units or applying for grants to start small-scale production stand little chance of being accepted, even though the largest demand is for small-scale production (Lahiff, 2007b). Our own qualitative interviews also demonstrate that beneficiaries fear governmental revenge in one form or another if they subdivide. This skepticism is based on the belief that productive farming can only be conducted on large-scale farms, and this stems from the fact that a large part of the rural population has never seen a successful and productive small farm because of the distortions imposed under apartheid (Deininger, 1999). As argued by Lahiff (2007b), beneficiaries have numerous problems accessing credit markets, and lack of credit makes many of these land reform projects unworkable.

The large-scale commercial agricultural sector is highly mechanized and a substantial employer, while the current small-scale sector is relatively unproductive. The wish to keep the large-scale commercial sector intact is therefore understandable. However, as discussed above, decades of discrimination against the black rural population has led to the loss of agricultural skills and capital, and it may therefore be over-optimistic to expect that beneficiaries can turn into commercial farmers overnight. Small-scale and medium-scale production may be a more efficient and productive approach, at least in the short run. Van den Brink et al. (1995) point out that it would be unfair to compare the productivity of the commercial sector with the traditional sector because of the discriminatory policies against the latter. It has also been impossible to do so due to the general lack of data on the traditional sector. However, the authors referred to some case studies where black small-scale producers were not facing severe discrimination, and these studies concluded that small-scale farms were more efficient. Van Zyl et al. (1995) analyze the relationship between farm size and total factor productivity within each of the sectors, instead of analyzing between sectors; they find that smaller farms in the commercial sector are generally more efficient, and that they use a relatively more labor-intensive production technique. However, they find that farms in the former homelands seems to be scale-

inefficient, although the results should be treated with caution because all those farms are relatively small. This result is not surprising, as part of the Apartheid system was to make small-scale farmers in the homelands unable to be self-sufficient so that they were forced to seek outside work (Deininger and May, 2000). Recognizing the problem of the relatively unproductive small-scale sector has led to a shift of focus to emerging commercial black farmers and businessmen, perhaps moving the land reform away from its goal of rural poverty reduction (Hall, 2008). The continuation of the focus on large-scale farming is likely to benefit a small, privileged group and may not be labor-absorbing, which is crucial for combating rural poverty.

4.3 Theory and literature

The IR between farm size and yield became a stylized fact in development economics after numerous studies had found a negative relationship between farm size and the value of output per land unit. Berry and Cline (1979) was one of the first studies to analyze the IR econometrically; they found a significant negative relationship in two land-abundant Latin American countries and four land-scarce countries in Asia. (See also Bhalla, 1979; Carter, 1984 and Cornia, 1985 for similar studies and results.) Consequently, this empirical observation became a major argument for efficiency of land redistribution reforms.

The theoretical explanations of the IR focus on the labor, capital and land market imperfections that lead factor prices to be dependent on farm size, causing input use per land unit, and hence yield, to be different on large and small farms. This is because there is widespread evidence on constant return to scale (CRS) technology in agricultural production (Berry and Cline, 1979; Bhalla, 1979; Heltberg, 1998; van Zyl et al., 1995).[1] Given CRS technology, input ratios and yield should be constant across farm scale, but if factor prices depend on farm size, the input ratios will be distorted and this would lead to a relationship between yield and farm size. Large farms face higher labor costs, due to higher supervision cost of hired labor. Family labor is the residual claimant of the farm's output and will thus have an incentive to apply an optimal level of effort. Hired labor, on the other hand, who do not receive even the marginal value of their effort, have an incentive to shirk, leading to high costs for low productivity, and, further, supervision costs arise on larger farms. Ceteris paribus, the small-scale farms will have higher output per land unit than large-scale farms because they employ more people due to lower labor costs (Bhalla, 1979;

Binswanger and Rosenzweig, 1986). This effect on productivity might be offset by lower capital costs for large-scale farmers who have access to cheaper credit. The total effect will depend on the output per land unit compared to small farms. This depends on the relative decrease of land and capital prices as farm size increases, the substitution between capital and land, and the substitution between capital and labor (Berry and Cline, 1979). There can also be economy of scale in marketing, control of product quality, and the introduction of innovative technologies, irrigation etc.

The presence of an IR remains highly controversial and contested. The main objection is the failure to control for unobservable factors that are correlated with farm size and yield. For instance, Benjamin (1995) asserts that the empirical results are biased when land quality is unobservable. To control for land quality, Bhalla and Roy (1988) use data from India with detailed information on soil fertility; Heltberg (1998) uses village and household fixed effects; and Benjamin (1995) instruments farm size, using data from Java with various measures of population density. The two former studies find a smaller IR effect when taking land quality into account, and in the latter study, the IR disappears altogether when instrumenting for farm size. However, the instruments used are weak and the sample contains mostly small farms, as pointed out by Heltberg (1998).

4.4 Data and descriptive statistics

The cross-sectional Quality of Life (QoL) survey is described in May et al. (2009). Data was collected at the household and the project (defined as community) level. Our purpose is to analyze whether there is an inverse relationship between output per hectare and farm size on farms that are run by 2002 beneficiary households and their corresponding 207 land reform projects.[2] The sample selection probability for a project is proportional to its size, that is, households in larger projects have an equal probability of being surveyed to households in smaller projects. Twelve households were then randomly selected within each project (May et al. 2009).

There are four categories of land in the survey:

(i) private land outside the project;
(ii) individually farmed project land;
(iii) collectively farmed project land with individual output; and
(iv) collectively farmed land with collective output.

Beneficiaries receive part of the profit in the last category, while in the third category the participants actually split the physical production volume between them. We then introduce the concept 'farm' as our analytical unit by aggregating parcels within each category. We consider all parcels of private land in category (i) in the household survey for a given household as one farm, and equally for all parcels registered under category (ii). This implies that the same household might have two 'farms'; one close to their house and one individual farm on the project land. For collectively farmed land, we prefer to use information given in the project manager/leader questionnaire for the whole land reform project as a unit.[3] However, it is then impossible to split between (iii) and (iv), and hence we aggregate into a single farm all parcels reported to be collectively run in the project questionnaire. Missing information is a considerable problem in the QoL data base. We exclude the household if information on size and production of land 'mostly used' for farming is missing for one of its parcels, for example, dryland crops, gardens, or irrigated land. Reported zero production is regarded as valid information. We also regress the models excluding zero observations, and these results do not alter the conclusion.

The resulting dataset has 545 farm observations, of which 47 percent is private land, 46 percent is individually used land on land reform projects and 7 percent is collectively farmed land on land reform projects. There is some overlap in size between the three categories, but individual parcels tend to be small and collective farms large, as shown in the kernel densities of farm area for the three categories in Figure 4.1, below. Private farms are generally smaller than the project farms, which illustrates the restrictions on subdivision as discussed in Section 4.2. We introduce the variable 'organization form' in the empirical model to control for this effect. as it correlates with cultivable land size (which might still be lying fallow, even though it is cultivable).

The majority of the farms in our dataset are small, that is, 75 percent are smaller than 1 ha, 12 percent are between 1 and 10 ha, 6 percent are between 10 and 100 ha, 5 percent are between 100 and 1000 ha, and 1 percent of them are above 1000 ha. See Appendix 4.1.

The value of crop production (Y) is calculated by multiplying the crop production volume[4] by the median crop prices in each of the three regions.[5] The figure is reported in South African rands. Farm areas are denoted in hectares. Cultivable area (CL) only includes the relevant uses, that is, it excludes non-relevant uses like housing, grazing, etc.

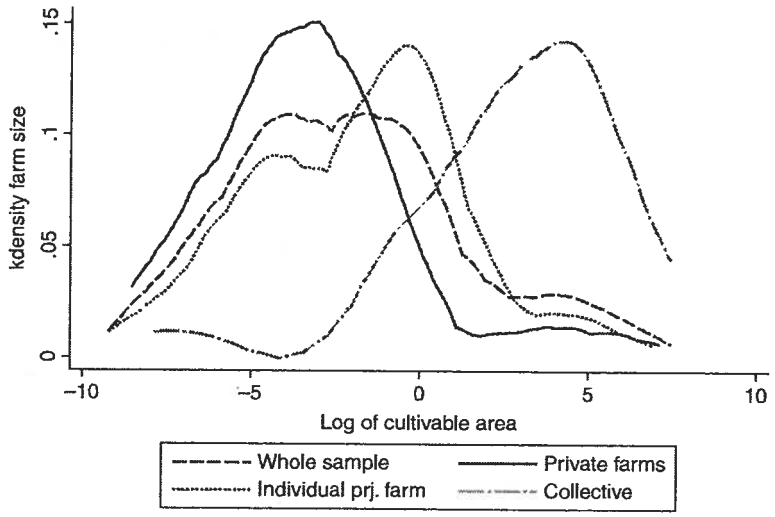

Figure 4.1 K-density function of the three farm categories: private, individual project, and collective farms

Source: Quality of Life dataset.

4.5 The farm size–productivity relationship in the South African land reform

4.5.1 Empirical specification

The conventional approach to empirically test the IR is to use ordinary least squares (OLS) estimation on the following econometric model (Bhalla and Roy, 1988; Carter, 1984; Heltberg, 1998):

$$ln\frac{Y_i}{FS_i} = \beta_0 + \beta_1 lnFS_i + \varepsilon_i \quad (1)$$

The main parameter of interest β_1 is equal to the elasticity of value of output per land unit (Y/FS) with respect to farm size (FS). The OLS estimators will be unbiased if the error term ε_i, representing all residual variation in the dependent variable, is uncorrelated with FS. The impact of farm size in yield is seen as an indirect test for the market imperfections explained above. If capital market imperfections dominate, we will have high capital/land ratios on large farms dominating over the labor market imperfections, and we should expect β_1 to be positive. If labor

Appendix 4.1 Summary of variables

	#Obs.	Unit	Mean	Std. dev.	Min.	Max.
Cultivable land						
Whole sample	545	HA	27.5	137.2	0.0001	1713
Individual private	251	HA	18.8	119.0	0.0002	1200
Individual project	249	HA	13.3	76.2	0.0001	1024
Collective	45	HA	154.9	318.4	0.0004	1713
Farms with pos. production	514	HA	25.6	131.9	0.0001	1713
Regions: Cape	129	HA	56.1	189.5	0.0002	1024
Inland	144	HA	26.7	151.3	0.0003	1713
Coast	178	HA	12.8	64.0	0.0001	684
Crop production						
Whole sample	545	Rand	70,200	594,616.9	0	8587592
Individual private	251	Rand	35771.6	390,509.2	0	6000.000
Individual project	249	Rand	44,613.2	509054.6	0	7743600
Collective	45	Rand	403814.8	1385661	0	8587592
Farms with pos. production	514	Rand	74433.9	612061.5	1.56	8587592
Regions: Cape	129	Rand	39315.9	1574221	0	1403666
Inland	144	Rand	49234.4	49234.4	0	6000000
Coast	178	Rand	121564.6	895147	0	8587592
Crop production per hectare						
Whole sample	545	Rand/HA	1.52e7	3.41e8	0	7.97e9
Individual private	251	Rand/HA	757,888.5	5274949	0	7.5e7
Individual project	249	Rand/HA	465735.7	2597077	0	2.81e7
Collective	40	Rand/HA	1.77e8	1.19e9	0	7.97e9
Farms with pos. production	514	Rand/HA	1.61e7	3.51e8	0.06	7.97e9
Regions: Cape	129	Rand/HA	222311.6	1574221	0	1.76e7
Inland	144	Rand/HA	609671.8	6251226	0	7.5e7
Coast	178	Rand/HA	4.56e7	5.97e8	0	7.97e9
Crop inputs per hectare:						
Whole sample	545	Rand/HA	31039.9	272112	0	4175000
If crop input is positive	231	Rand/HA	73232.8	414763.8	0.217	4175000
Land value per hectare (if >0)						
Whole sample	451	Rand/HA	120488	570320.6	60	7000000
Regions: Cape	129	Rand/HA	224615.2	809831	100	7000000
Inland	144	Rand/HA	66781.1	288505.4	60	2900000
Coast	178	Rand/HA	88473.3	523593.7	200	6000000
Irrigated farms	36		|Farms with	fruits trees		| 42

and land market imperfections are dominant, there will be a tendency towards labor-intensive small-scale farms. Such will use more of the available cultivable land and more labor on each hectare than will large-scale farms. In this case, we should expect β_1 to be negative, and we have an IR (Bhalla, 1979).

The main objection to Equation (1) is that farm size (FS) is correlated with the error term. That is, if there is a non-random relationship between farm size and other variables explaining the value of output per land unit, the results will be biased, and an observed IR could, at least in part, be attributed to an omitted variable. In an attempt to control for this endogeneity problem, we include variables that explain variation in value of output per land unit and that are potentially correlated with farm size.

Land unsuitable for cultivation

A concern is that the existence of large farms is due to the fact that they are situated in remote areas where there is no real basis for agricultural production.[6] One hypothesis is that areas with a high proportion of land that is unsuitable for agricultural production would experience low population growth and less pressure to subdivide land holdings (Carter, 1984). If the proportion of unusable land increases with farm size, then β_1 will have a downward bias. The best way to control for this potential bias would be to exclude from our analysis the share of the farm size that is non-arable. However, we do not have information on the share of farm that is actually non-arable; therefore, in Equation (1) we replace FS with land 'mostly used for' cultivation (CL).

Land quality

The main objection to Equation (1) is that larger farms are characterized by systematically lower land quality, because more productive land tends to be split into smaller units than less productive land. The best method to control for land quality would be to have information on soil type, color, and depth; variables that directly explain land quality. According to Berry and Cline (1979), the price of land is the principal indicator of land quality, and should reflect both inherent land quality differences and the location of the land. Our respondents assess the sales value of their land, and we use the value of cultivable area (FV) as a control for land quality.

But there are two problems with using land price as a proxy for land quality. First, the land price also reflects expected output based on previous realized yields; the land price will then depend on the expected

yield, and this would lead to correlation between the error term and land price. Secondly, the land price as a quality term may be biased in favor of small farms;[7] if there are more potential buyers for small holdings, the land price per hectare will be higher for small farms than for large farms, creating an illusion of higher quality land on small farms. However, leaving out a control variable for land quality can bias the results. Therefore, we use the price per cultivable land unit as an indicator of productivity, with the implicit assumption that the assessed price mainly reflects land quality differences.

Another factor determining yield and soil quality is the availability of irrigation. Irrigation makes it possible to have higher cropping intensity and also to have production during the dry season, so an observed IR can be the result of a higher share of irrigated area on small farms if small farms have a higher proportion of irrigated land than large farms. Previous studies have used the proportion of arable land that is irrigated; however, we preferred to construct a dummy variable for the existence of irrigation (I). Only 7 percent have irrigation, but those actually irrigate most of the land.

To further control for differences in land quality, we divided the sample into geographical regions with more homogenous soil quality. Due to data scarcity, it is not possible to divide the sample into provinces, so we disaggregated the observations into Cape (Northern, Western and Eastern Cape); Inland (Limpopo, Mpumalanga, North West, Gauteng, and Free State); and Coast (KwaZulu–Natal).

Product mix

Another feature that may cause a downward bias in the relationship between yield value and farm size is if large farms systematically cultivate low-value crops that need more land and less of the relatively expensive labor per unit of output. One way to control for a supposed shift in product mix as farm size increases is to regress the above models within a crop sector, for example to analyze the models only for farms producing maize. The data used here is not suitable for separating farms into different sectors, as 67 percent of all households have reported producing more than two crops (May et al., 2009). Even if it were possible to separate farms into different sectors, this might not be the best approach since crop mix itself can be a response to the discussed market imperfections (Benjamin, 1995). Holding the product mix constant will neutralize the inefficiencies caused by large farms shifting to crops that need less labor and more land, which gives low values of output per land unit.

Berry and Cline (1979) argue that Equation (1) is a more accurate way to control for the shifting of product mix. The argument is that evaluating the output achieved relative to available land and controlling for land quality leaves no reason to believe that there should be a systematic difference in cropping patterns between large-scale and small-scale farms. Keeping unusable land and land quality constant will choose the product mix that maximizes the value of output per land unit independent of scale. If market imperfections make large farms shift to crops that are less intensive in the relatively more expensive inputs and give a low value of output per land unit, the land will not be used to its full potential. This is an inefficiency that should be captured in the model.

Organization

Restrictions on the subdivision of relatively large farms supplied on the market and the relatively small grants forced beneficiaries to form groups in order to be able to acquire farms as a result of the land reform. The indications from our farm visits are that these groups seemed to have major management problems and internal conflicts relating to investment decisions and division of workload. As larger farms are more expensive, there is a chance that a higher proportion of large farms will be organized as collectives, and this correlation can cause a bias on the estimated elasticity in the models presented above. Deininger (1995) argues that agricultural collectives are far less efficient than independent family farms, because members of collectives will not reap the full reward of their actions, leading to undersupply of effort and investment. If this is true, and a higher proportion of large farms in the sample are organized as collectives, then this could lead to downward-biased results in our models. On the other hand, Platteau (1995) claims that some forms of cooperative land management are superior to private farms in Sub-Saharan Africa. Communities perceived as indigenous and gaining property rights to land that is historically viewed as communal land may have well developed community institutions, organizational policies, and trust amongst community members. This may enable them to pool their resources, efficiently divide the workload, and have a greater scope of labor specialization. To control for organizational form, we have included dummies for individual project land and collective project land. The complete model estimated is therefore:

$$\ln\frac{Y_i}{CL_i}=\beta_o+\beta_1\ln CL_i+\frac{\beta_2\ln FV_i}{CL_i}+\beta_3 I_i+\beta_4 Dind_i+\beta_5 Dcoll_i+\varepsilon_i \qquad (2)$$

Where Y is the value of output for farm i. CL is the size of cultivable area. The parameter of interest, β_1, measures the elasticity of value of output per land unit with respect to cultivable area. FV/CL is equal to the value of cultivated land per hectare. I is a dummy for the existence of irrigation on farm i. *Dind* is the dummy variable for land that is individually farmed on the land reform project farms, and *Dcoll* is likewise for collectively farmed land on the same farms. The reference category is hence individual farmed land that is not on the land reform project, for example 'at home'. Equation (2) also gives a formal test of the claim given in Deininger (1995), that large farms, organized either privately or collectively, will face the same problems that lead to an inverse relationship, since β_1 now reflects the land elasticity with respect to operational area, keeping organizational form constant. The results of the econometric analysis are presented in the next section.

4.5.2 Results and discussion

The results are presented in Table 4.1 below. The estimated elasticity of value of crop production per hectare with respect to farm size is substantial, –0.867 in the simplest model – that is, a 1 percent increase in farm size is associated with a 0.867 percent reduction in the value of crops produced per hectare. The effects drop when we control for land quality, using land value as indicator, irrigation as production input, organizational form, and geographical region. The coefficient for the IR effect is still –0.486 in our preferred Model 5, in Table 4.1 below, and different from zero at a 1 percent significance level. However, we regard these results as partial correlations rather than causal relations, since simultaneity and omitted variable biases are potential problems in such cross-section estimations. The result, however, is quite clear; the larger the farm, the lower the gross income per hectare.

Land value as an indicator of land productivity is highly significant, while the positive effect of access to irrigation turns out to be insignificant. Introducing a control variable for land quality should, as explained above, control for shifts in product mix and a non-random relationship between farm size and land quality. The elasticity drops to –0.588, and the consequent shift in product mix and lower land quality can hence explain some of the observed IR effects in Model 1 in Table 4.1.

We further find that beneficiaries considered to be individual owners of their land had a significant higher productivity, as the dummy coefficient is 1.327, which is significantly higher than the reference category *Private non-LR farm land*. One possible explanation is that the latter suffers from soil mining. Another is the more secure property rights to *Private non-LR*

Table 4.1 Estimation of relationship between crop yield and cultivation area

	Model 1	Model 2	Model 3	Model 4	Model 5
	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)
Cultivable area (lnCL)	–0.867***	–0.588**	–0.592***	–0.499***	–0.486***
Land value (ln(FV/CL))		0.357**	0.354**	0.453***	0.462***
Irrigation (Dummy)			0.142	0.571	0.684
Ind. project land (Dummy)				1.618***	1.327*
Collective land (Dummy)				–1.106	–1.220
Coast (Dummy)					0.464
Cape (Dummy)					–0.121 (0.768)
Constant	5.057***	1.841	1.853	0.352	0.260
R^2	0.194	0.192	0.192	0.209	0.211
Adj. R^2	0.192	0.189	0.187	0.201	0.198
#Obs.	545	451	451	451	451

Note: Dependent variable is the logarithmic value of production per hectare of cultivable land (lnY/CL). Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

land, which will make the owners report unused land as well – as long as it belongs to them. Weak property rights on collective farms, however, imply that the farmers would only report the plots they actually farm individually. Our visits also showed that the remaining beneficiaries had grabbed the better part of failing collective run farms, leaving the less productive parts idle, that is, a 'tenderloin' effect. However, the QoL does not have any information on the share of cultivable land actually farmed, and hence we are not able to test this hypothesis quantitatively. The coefficient for *Collective land* is negative, although not significantly different from the *Private non-LR land* category. The significantly lower productivity compared to individual project land is an argument for allowing subdivision in the South African land reform.

Land productivity might be linked to regional differences within the enormous South African continent. The dummy coefficient for the *Cape* and *Coast* provinces compared to the reference category *Inland* are not significant, implying that our chosen regions show no differences in productivity levels (Models 6–11, Appendix 4.2). The

Appendix 4.2 Extending Model (5) with estimated crop inputs, Model (6) uses scale, Model (7) dummy for any crop input and (8) includes regional dummies

	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11
Dep. Var.	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)
Cultivable area (lnCL)	−0.531***	−0.472***	−0.568***	−0.542**	−0.576***	−0.203
Cultivable area squared	−0.017				−0.011	
Land value (ln(FV/CL))	0.470***	0.462***	0.369**	0.373**	0.378**	0.445***
Irrigation (I) (Dummy)	0.734	0.691	1.127	1.294	1.299	0.659
Ind. project land (Dummy)	1.332*	1.286*	1.275*	1.303*	1.312	1.216
Collective land (Dummy)	−0.932	−1.316	−1.557	−0.676	−0.601	−1.541
Cape (Dummy)	−0.079	−0.136	−0.429	−0.436	−0.404	−1.002
Coast (Dummy)	0.469	0.432	−0.122	−0.134	−0.128	−0.463
Crop input (per hectare)		0.075	0.067	0.069	−0.081	
Fruit trees (Dummy)			−3.819***	−3.801***	−3.768***	
Collective land* Cultivable area				−0.369	−0.319	
Ind. project land* Cultivable area				0.025	0.029	
Coast*CL						−0.399*
Cape*CL						−0.385*
Constant	0.419	0.306	1.749	1.783	1.805	1.247
R^2	0.212	0.212	0.233	0.235	0.236	0.218
Adj. R^2	0.198	0.197	0.217	0.216	0.215	0.203
#Obs.	451	451	451	451	451	451

Note: Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

alternative specification, with interaction between region and cultivable land, shows a significantly stronger IR effect in the *Coast* and *Cape* than in the reference category *Inland*; the IR coefficient for the latter is now −0.203 and insignificant, while the interaction coefficient is negative and significant for *Cape* and *Coast* in Model 11 in Appendix 4.2. The regional differences in the IR effect are also apparent in separate regional regression Models 12–17 in Appendix 4.3; the IR effect is

Appendix 4.3 Model 3 and 5 run on regional sub-samples

Region	Coast		Inland		Cape	
	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17
Dep. Var.	ln(Y/OP)	ln(Y/OP)	ln(Y/OP)	ln(Y/OP)	ln(Y/OP)	ln(Y/OP)
Cultivable area (lnOP)	−0.606***	−0.347	−0.151	−0.211	−0.902***	−0.635**
Land value (ln(FV/OP))	0.442*	0.779***	0.614**	0.597**	0.083	0.255
Irrigation (I) (Dummy)		−3.025		3.036		1.366
Ind. project land (Dummy)		3.078***		−0.217		0.239
Collective land (Dummy)		0.284		−0.269		−4.150*
Constant	1.633	−3.676	−0.241	−0.427	4.013	2.772
R^2	0.231	0.274	0.102	0.108	0.265	0.290
Adj. R^2	0.223	0.253	0.087	0.076	0.253	0.261
#Obs.	178	178	144	144	129	129

Note: Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

strongest in the *Cape* provinces, and the effect is less significant in the *Coast* region, while there is no significant effect in the *Inland* region.

We include a dummy for the existence of fruit trees as productive capital; these tend to be more common on smaller farms and hence a potential source of estimation bias in the IR effect. However, the effect is significantly negative rather than, as expected, positive. Two potential explanations for this counterintuitive result appeared during the farm visits: fruit farms that had become unprofitable were sold as LR farms, and the new owners had problems finding buyers since product quality in fruit plays a more important role than it does for crops such as maize and vegetables. So some farms had started to cut down fruit and citrus trees to start arable farming. In Models 7–10 in Appendix 4.2, we find no significant effect for the value of inputs for crop production like fertilizers, pesticides, and seeds, as control variables.[8] This implies that the IR effect is mostly due to labor market imperfections and not capital/input market imperfections. Van Zyl et al. (1995) stress that total factor productivity (TFP) would be the relevant measure of efficiency, but such calculation is beyond the quality of our dataset.

Of the 545 farm observations included, 31 have zero production. We prefer to include those in the regression models by adding a small

Appendix 4.4 Corresponding to Models 1–5 without zero production observations

	Mode l1*	Mode l2*	Mode l3*	Mode l4*	Mode l5*
Dep. Var.	**ln(Y/CL)**	**ln(Y/CL)**	**ln(Y/CL)**	**ln(Y/CL)**	**ln(Y/CL)**
Cultivable area (lnOP)	−0.781***	−0.555***	−0.603***	−0.698***	−0.676***
Land value (ln(FV/CL))		0.286***	0.257***	0.228***	0.241***
Irrigation (Dummy)			1.805***	1.188**	1.394***
Ind. project land (Dummy)				0.433*	−0.126
Collective land (Dummy)				2.448***	2.247
Coast (Dummy)					0.949***
Cape (Dummy)					−0.091
Constant	6.620***	4.102***	4.214***	3.986***	3.785***
R^2	0.530	0.553	0.567	0.590	0.603
Adj. R^2	0.529	0.551	0.563	0.585	0.596
#Obs.	514	425	425	425	425

Note: Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

number to all observations.[9] The IR effect is stronger when zero production farms are excluded in the core Models 1*–5*, given in Appendix 4.4. Large farms often produce something and are hence included, while smaller farms more often do not produce anything and are hence excluded.[10]

The summary statistics in Appendix 4.1 disclose that some outlying observations of production per hectare, as reported through the mean in summary statistics of Appendix 4.1, potentially drive our results. However, our log–log model will put less weight on these outliers. We re-estimate models in Table 4.1, leaving out 5 percent of the observations with the highest value of production per hectare. The elasticity of value of production per hectare with respect to cultivable area is still significantly negative for this alternative dataset, reported in Models 1**–5** in Appendix 4.5 – although it is also weaker, with an IR coefficient value of −0.353. The effect is in accordance with expectations, as some observations with unrealistically high yield figures appear on some collectively run farms due to reported small land size.

Appendix 4.5 Corresponding to Models 1–5 without 5 percent highest yield outliers

	Mode l1**	Mode l2**	Mode l3**	Mode l4**	Mode l5**
Dep. Var.	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)	ln(Y/CL)
Cultivable area (lnCL)	−0.761***	−0.510***	−0.506***	−0.365**	−0.353**
Land value (ln(FV/CL))		0.324**	0.326**	0.432***	0.440***
Irrigation (Dummy)			−0.118	0.708	0.766
Ind. project land (Dummy)				−2.487*	−2.534*
Collective land (Dummy)				1.238*	1.245
Coast (Dummy)					−0.151
Cape (Dummy)					−0.297
Constant	4.977***	2.056	2.045	0.831	0.900
Adj. R^2	0.146	0.144	0.142	0.159	0.156
#Obs.	517	427	427	427	427

Note: Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

4.5.3 Qualitative insights from farm visits

The IR effect in the QoL cross-section dataset was partly confirmed in our visit to 31 land reform farms all over the country in 2009. The informal prohibition of subdivision implied that most farms became collective property, while the transition from SLAG to LRAD programs did not imply a major change in the policy on the ground. Few black capitalists actually want to buy farms in spite of the subsidy. However, groups of people united in order to raise the necessary funds to buy the large farms: small businessmen, retrenched workers, or poor who paid their contribution in 'sweat equities'. The large numbers of beneficiaries gave rise to several problems: for example, sleeping partners who had never participated in farm work might actually make claims on the production of the active members; and beneficiaries with a short time horizon actually led several farms into non-sustainable strategies, such as selling off machinery, small animals, seeds, etc., and in order to maximize short-run payoffs sold whatever existed of capital and distributed financial support between them.

The land reform farms in general lacked machinery and crop inputs like fertilizers, seeds, etc. When investments took place, there was often

a mismatch between type of machinery purchased and needs; the beneficiaries could have a biased perception of need, perhaps buying fancy tractors rather than seeds. Furthermore, they often felt forced to accept what turned out to be bad advice from consultants hired by the agricultural authorities, for fear of losing financial support.

The sustainability of the larger LRAD projects is also questionable when they were owned by a group of small-scale commercial interests. They were often split between people genuinely interested in farming and mere investors. If the former strived and became efficient farmers, for example through out-grower schemes for the national and international food industry (the government had set up a program forcing the food industry to buy a certain amount of input from black farmers), co-owners might still demand the sale of the farm when land prices had risen due to urban sprawl or tourism.[11] Such farms are recorded as productive in the QoL data, but the land is now lying fallow. This partial effect of increased probability of failure over time contradicts Keswell et al. (2010), who find a positive income effect over time on the LRAD subsample of the QoL dataset.

The normal presumption is that farms do better over time due to experience, while these examples show, in contrast, that the probability of infighting and hence project failure increases.

The few individual LRAD projects visited were normally involved in chicken production. The black entrepreneurs we visited were more or less bankrupt, in spite of huge transfers of governmental money; they lacked either the necessary experience and the birds died unproductively, or the long-term market connections needed to get a good price for their products.

Joint ventures between groups of black – normally former farm workers – and white consultants or farmers took place, mostly under the restitution program. But some of these large farms are now bankrupt; the black farmers could seldom put up their counterpart for new investments, and they would, furthermore, lose interest if dividends were not paid regularly (in addition to a normal salary for farm workers). Their main interest would actually be to construct individual housing to prevent dependency on the white farmers. The sustainability of these projects was also questionable due to lack of investment, tension and lack of trust between the partners.

None of the large-scale farms came close to their productivity potential. In some cases, highly efficient neighboring white farmers simply rented the land for a minor payment. Then if collective farming did not work out, subdivision would be the reasonable option to take.[12] Only some

cases existed, however, as the politicians had signaled that such division would not be tolerated, and hence the beneficiaries were afraid of retaliation in the form of the ministry holding back funds designated for the project. Few beneficiaries would also risk investing money and labor in subdivided parcels, as they feared other beneficiaries would make claims on the harvest – a real risk, as many beneficiaries did indeed perceive the land reform as an act to build society rather than create individual benefits. Such perception is especially prevalent amongst the majority of older beneficiaries, making young people unwilling to invest labor and money.

However, subdivision did take place on some land reform farms. Constructing affordable housing in semi-urban areas could be the real motive, with fairly large, highly productive kitchen gardens around each house. In other cases, most beneficiaries had left the project and the remainder agreed to divide between them the most fertile land and vital inputs like irrigation water. They would normally practise traditional farming techniques, and then, if they had the money available, hire outsiders to plough. This resulted in fairly high productivity on the small part of the whole farm that was actually cultivated, leaving farmland with less potentially fallow land; for example just four families with outdated equipment could farm only a small part of the holding originally given to 80 beneficiaries.

The most successful farmers seemed to be small household units employing mostly their own members as laborers and designating their products for less demanding markets, for example, selling goats and milk to the poorer black townships close by. Geographical location can be crucial to success; beneficiaries mostly come from densely populated areas, and it is questionable if they would relocate to remote places to practise small-scale farming. So proximity to population centers might be just as vital a success factor of the land reform as the creation of the small farm size itself. Respondents indicated no need for more individual parcels, as they already had enough land for subsistence production in their home towns, and they did not intend to move their family to sparsely populated areas with few public services.

4.6 Conclusion and policy recommendations

We find a robustly significant and substantial inverse relationship between farm size and value of crop production per hectare using the QoL survey data. Taken at face value, the results indicate that small-scale beneficiaries are more productive than large-scale ones. This further indicates that it would be favorable for the land reform in South Africa to take

a new direction and equalize land distribution. Possible explanations of the results are that the factors that can lead to external economies of scale in agricultural production – skill, access to credit, and markets – are to a certain degree absent in the population that the land reform is trying to target, and this makes small- and medium-scale farms more successful.

The qualitative results from the farm visits tend to confirm the empirical results. We observed that smaller land reform projects, which were controlled by small groups of beneficiaries, were relatively more successful – relatively successful in the sense that smaller land reform projects cultivate and harvest a larger proportion of the available land than do large-scale land reform projects; however, none of the farms we visited were producing at their full potential. Our interpretation of this observation is that the average beneficiary lacks agricultural management skills, has problems accessing markets, and lacks credit (because of bureaucratic problems and lack of trust in farmers), which implies they were not able to make the necessary (and correct) investments in machinery and infrastructure to run a large-scale commercial farm.

The empirical results should be treated with caution. Due to data quality, we were unable to isolate the causal effect between production scale and productivity. Nevertheless, the empirical results and the qualitative robustness check indicate the presence of an IR. Hence we repeat the pre-land reform policy recommendation given in Binswanger and Deininger (1993):

> By (the beneficiary group) having the freedom to choose their farms, internal management schemes, and subdivisions, they can select locations and farming systems most appropriate to the capital and skill endowments of their members.

Thus far, South Africa's land reform has been far from successful. Radicalizing the process to reach the target of redistributing 30 percent of white agricultural land without the ability of the redistributed projects to engage in production that is actually productive could be devastating for the rural economy and the economy as a whole. Recognizing the political and emotional importance of the redistribution of land in South Africa, as well as its economic importance for the rural poor, makes it important to evaluate the reform and identify criteria for success. Much can be done to improve the efficiency of the program itself and increase productivity on the land reform farms.

So, since cooperation enforced top-down by the financing system often fails, the most obvious step is to allow subdivision. Both our qualitative

and quantitative data indicate that smaller farms do at least farm using traditional cultivation methods to achieve moderate yields. However, allowing subdivision alone is not a sufficient condition for success, due to low demand for such units in distant areas, where the income potential is low. Intermediate farm size, suited to traditional entrepreneurs serving informal markets in poor settlements in highly populated areas, is probably a more viable strategy to make land reform projects more successful. To speed up the process, the government could consider buying farms, splitting them into several sections, and drawing up land titles in accordance with the preferences and skills of the beneficiaries.

Notes

1. See especially van Zyl et al. (1995) for economies of scale in South African agricultural production.
2. The survey applies a quasi-experimental approach, interviewing both beneficiary and non-beneficiary households. However, we used the former, since our interest was to analyze whether there is an inverse relationship on farms that are run by households and communities that have received land through the land reform.
3. We regard information about the collective land in the household survey as less reliable, since the numbers differ between informants in the project.
4. There are 25 different crops cultivated by the beneficiaries. 67 percent of households report growing more than two crop types, and 20 percent grow more than four (May et al., 2009). The variable of interest here is the total value of crops harvested, so the composition of Y will not be of interest.
5. We chose median crop prices, since the mean would be heavily influenced by unrealistic outliers.
6. For example, a 258 ha land reform project interviewed on the field trip has only 4 ha of cultivable land.
7. Small farms may be a sign of land scarcity, due to higher population density which implies higher prices. Higher prices may also be associated with market access, but this should also be reflected in the prices. However, we do not possess data to correct for these possible effects.
8. Unreported regression models with crop inputs as dependent variables show that smaller farms are more likely to apply inputs as well as more inputs per hectare of cultivable land. Collective farms tend to apply more fertilizers compared to larger collective farms. The same applies to collectively run farms compared to the individual categories, while significantly fewer farms in *Coast* and *Cape* spend money on crop inputs. The inclusion of crop inputs reduces the IR effect in Model 7 in Appendix 4.2 in spite of not being significant, while the change in our preferred Model, 5, is much smaller.
9. We could not find a suitable instrument in a Heckman model, i.e. it only influences production decision influence and not production level. We further argue that the Cragg model requirement of independence of expected productivity from the residual is not satisfied.

10. We indirectly test whether the IR effect is due to moral hazard in labor and coordination problems, by running a regression on only farms larger than 12 ha, which we consider too big to be handled by a single family. The vanishing IR effect for this subsample gives some indicative evidence that this is the source. However, these results can also be due to smaller sample size.
11. The general rule was that LR beneficiaries had to wait 10 years before they were allowed to resell to the highest bidder, but for some reason it was easier for LRAD farms to circumvent this rule. We did not have the information to evaluate whether such sales were profitable in a strict economic sense, compared to proceed farming. However, we noticed that people who wanted to sell put more emphasis on immediate payoffs than the committed farmers.
12. This has normally been the result on Latin American land reform farms. The radical military regime in Peru in the 1960s expropriated large farms and gave them to the farm workers. They were expected to proceed as cooperatives, as the government was afraid fragmentation would reduce productivity and represent a poverty trap in the long run. Hidden resistance, however, led to bankruptcy, and the government finally gave in and allowed subdivision to the individual farmers (Wiig et al., 2011). The Guatemala restitution farms for war combatants and refugees were similar. As cooperative efforts failed, they soon found fragmentation to be the only viable option, and they then managed to agree on an internal distribution which everyone respected (Borchgrevink et al., 2007).

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