Land Acquisition in Africa: Threat or Opportunity for Local Populations?[1]

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Abstract: Foreign acquisition of farmland has become a contentious political issue in African countries targeted by these deals. This paper studies the welfare effects of FDI in farmland on the local population. We build a heuristic microeconomics model of local people's occupational choice in the context where the selling or leasing of local farmland to foreign investors is decided by the government. The government invests the proceeds of these deals to subsidize farming inputs used by local farmers, thereby stimulating job-creation in the local sector producing these inputs. These new job opportunities raise the payoff to local people from shifting to wage-employment, thereby easing the pressure on farmland. The model shows that welfare gains to local people crucially depend on two necessary and sufficient conditions: (i) the country is land-abundant, and (ii) the government, in addition to being accountable to local people for the deals it negotiates and for its use of the proceeds, also has a sufficiently high capacity to negotiate such deals.

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1. Introduction

The acquisition of farmland by foreign public or private investors in Africa is on the rise (Daniel and Mittal, 2009). Such acquisitions, also referred to as land grabs by their critics, are characterized by: (i) a reduction in cultivable land for local farmers, (ii) all products being exported, (iii) the terms of the deals are negotiated by the host country central government, often without the consent of local people (Daniel and Mittal, 2009). These characteristics fuel criticism on the basis that under those conditions, the acquisition of farmland undermines local people welfare (Daniel and Mittal, 2009; Oakland Institute, 2011). The reduction of land available to local farmers, combined with unequal distribution of the benefits, may create or escalate internal conflicts over land use, for example, between food crop growers and animal herders.

While FDI in Africa's farmland may well reduce farmland available to the local population, it is not, however, and need not be, its main feature. Governments could use the proceeds from land leased to foreign investors to subsidize the cost to local farmers of modernizing their farming methods[5], or build infrastructure. Such infrastructure include dams to enable irrigation farming, or roads to better link farms to markets thus reducing transaction costs. The key aspect is that governments invest the proceeds from land-investment deals in a way that creates dynamic linkages which benefit local people either directly as farmers having improved access to modern farming inputs, or indirectly through a shift to wage employment.

Critics may however argue that wage employees would now need to purchase their food on the market instead of growing it themselves. Their purchasing power depends on their incomes and food prices. Yet, FDI in farmland entrench export agriculture (Daniel and

[5]Modernization may involve the use of commercial inputs such as seeds and fertilizers. Some of these yield-enhancing inputs are often beyond the means of smallholder African farmers For example, in a case study of Malawi, Fleshman (2008) reveals that fertilizer costs the equivalent of about $50 a bag, which may be too expensive for a smallholder African farmer, while buying it on credit may be too great a risk for farmers at the mercy of unreliable rains and poor-quality seeds.

Mittal, 2009; Cotula et al., 2009). Critics of FDI in Africa's farmland therefore fear that such investments may simply be a mechanism through which wealthy, but food-insecure countries dump their food insecurity problems onto African countries. These claims look like a stern rebuke of the "win-win" argument underlying support for FDI in farmland, and require that conditions for mutual gains to be realized, if any at all, be identified.

We analyze the effects of foreign acquisition of farmland in Africa on the well-being of people living in the targeted communities. We develop a heuristic model of local people's occupational choice under FDI in farmland. Local farmers whose land is leased to foreign companies use the remaining farmland to grow a food crop or shift into wage employment for firms producing farming inputs. We model the effects of FDI in farmland on the well-being of local people as resulting from an exogenous change in either the quantity of local land leased to foreign investors or the lease price negotiated by the government.

We propose an explanation for the "win-win" argument. We show that even if FDI in Africa's farmland entrench export-led agriculture at the expense of local markets, they can make local people better off if the following two conditions are met. First, the local government has the capacity and willingness to negotiate lucrative land deals with foreign investors. Second, the local government is accountable to local people in the way in which it uses the proceeds from land investment deals. A government that fulfills these two conditions will ensure that FDI in farmland, directly or indirectly, create sufficient employment opportunities for displaced local people, such as stimulations of activities with significant backward and forward linkages (production of farming inputs is an example). Numerical simulations conducted using a Matlab code successfully replicate the properties of this theoretical economy.

To the best of our knowledge, our paper is the first theoretical analysis of the welfare implications of FDI in Africa's farmland, although many case studies of, and reports on, land investment deals exist (e.g., Deininger and Songwe, 2009; Daniel and Mittal, 2009; Cotula et al., 2009). For example, Deininger and Songwe (2009) outline the pillar of

successful land investment deals, while warning that the modernization they may bring does not necessarily improve the welfare of local people. Daniel and Mittal (2009) question the viability of the win-win argument that has been offered to quell concerns about land investment deals, by pointing to the gravity of the risks of removing the issue of food security for the world's poor from the forefront of the international debate.

We build upon this literature by revealing the conditions that are necessary and sufficient for FDI in farmland to improve the experiences of local communities in which land is leased or purchased. Our study outlines a mechanism formalizing the "win-win situation" put forward by supporters of foreign acquisitions of African farmland, even when the targeted countries are themselves food-insecure (such as Ethiopia, Sudan, Somalia and Madagascar) and such deals entrench export agriculture. But it also warns that unless the governments negotiating these land-investment deals are accountable to communities affected by these deals, the win-win situation may not materialize.

The remainder of the study is structured as follows. Section 2 presents stylized facts about FDI in land in Africa. Section 3 describes the environment in which such investments occur. Section 4 discusses the welfare effects of these land deals. Section 5 presents a numerical simulation of the theoretical economy. Finally, section 6 concludes. All graphs and diagrams are provided in the Appendix section.

2. FDI in Africa's farmland: Some Stylized Facts

In this section, we briefly review some stylized facts about FDI in Africa's farmland, keeping tab on the nature of all actors involved. Government-backed FDI in Africa's farmland is a fast growing phenomenon which raises concerns with respect to the welfare of local populations. Remarkably, such investment deals target rural communities characterized by a quasi-subsistence livelihood and the occurrence of devastating episodes of famine and malnutrition, as recently observed in Ethiopia and Kenya in the horn of Africa. For

a government who lacks the resources needed to induce farming modernization in rural communities, international acquisitions of local farmland may become an attractive proposition. Indeed, many African governments have pursued or encouraged land investment deals with foreign entities. However, in 2008, a number of media sources including the *Financial Times* ran news reports about purported negotiations between the South Korean firm, Daewoo, and the government of Madagascar, regarding the lease of 1.3 million hectares of land in Western Madagascar to grow 5 million tons of maize annually by 2023 (Daniel and Mittal, 2009). News of this deal created a tremendous outcry in Madagascar, leading to civil unrest and violence, and sparking a worldwide debate on international acquisition of farmland in developing countries.

According to the UN's *Food and Agricultural Organization* (FAO), FDI in farmland are rooted in a combination of factors, including the global food crisis of 2007 and 2008 that sparked sharp hikes in food prices worldwide, pressure from growing populations (particularly in Asia) and climate change. While most land-rich developing countries have been targeted, Africa is a particularly hot spot, attracting interest from investors from the likes of China, India, South Korea, Saudi Arabia and Qatar. Many African countries, including Sudan, Ethiopia, Madagascar, Mozambique and Somalia have become key recipients of FDI in land (Cotula et al., 2009). In Mozambique, for example, the World Bank estimates that the demand for farmland from foreign investors is more than twice the total quantity of land being cultivated in the country (Deininger and Songwe, 2009). In its 2011 Report[6], the US-based *Oakland Institute* reveals that "in 2009 alone nearly 60 million hectares—an area the size of France—was purchased or leased in Africa." In its 2011 Country Report for Ethiopia, the *Oakland Institute* also reveals that, since 2008, at least 3,619,509 hectares of land have been sold or leased to foreign investors. In its 2011 Country Report for Mali, the corresponding figure was 819,567 hectares of fertile land in 2010, much of which involves

[6]Available online at http://media.oaklandinstitute.org/press-release-understanding-land-investment-deals-africa

crops for biofuels. It is also reported that, although they oppose the deals, most local communities in Mali affected by foreign acquisition of peasants' farmland are forced to contend with serious disruptions and threats to their livelihoods due to a poor ability to organize socially (*Oakland Institute*, 2011). Drawing on these figures as well as on reports of social uprisings in some rural communities in Africa, critics of land investment deals suggest that a government that is acting in the best interests of its communities will not approve the sale or lease of farmland to foreigners (Cotula et al., 2009). This view suggests that African governments that have negotiated or are negotiating land lease contracts with foreign investors may not be acting in the best interests of the threatened communities.

But there are not only critics of FDI in Africa's farmland. They are also supporters, including international organizations such as the *Food and Agriculture Organization* (FAO), the *International Fund for Agricultural Development* (IFAD) and the *International Food Policy Research Institute* (IFPRI). These supporters claim that, if properly conducted, FDI in farmland can only result in a win-win situation both for the investors and the targeted communities. There are three angles to their arguments. First, they argue that in Africa, large areas of suitable land are either unused or under-utilized, which means that leasing or selling them to foreign investors may not lead to massive displacement of peasants. Second, even if peasants are displaced, they may simply shift to wage employment, either directly with the foreign companies leasing their farmland, or indirectly through upstream and downstream linkages created by the land investment deals (FAO, 2009). Third, proceeds from farmland leased to the foreign investors could be reinvested in the local community so as to improve the livelihoods of local people. A good example is subsidization of the use of commercial inputs by local farmers, which would enhance agricultural productivity. But if FDI in Africa's farmland bring such opportunities to local communities as supporters claim, then why is there opposition (both tacit and active) to these deals in Africa?

Africa differs from other land-rich regions at least in two respects. First, its rural communities do not have legal tenure over the land they farm, and therefore in most cases

cannot directly negotiate the land deals with foreign investors. This raises the important issue of whether African governments endowed with the power to negotiate these deals are accountable to local communities affected by them. Suppose they are: would they consent to leasing or selling local farmland to foreign investors acting solely on the interests of their country of origin if their own countries are threatened by food insecurity? The analysis that follows gives a positive answer to this question.

3. Preliminaries

Government-backed FDI in farmland is a fast growing phenomenon which raises concerns with respect to the welfare of local populations. In this section, we develop a framework to capture the potential effects of foreign acquisition of African farmland and also highlight the mechanisms driving these effects.

Consider an agrarian economy with two sectors, a farming sector producing a food crop and a manufacturing sector producing a composite input used in farming. The economy is populated by a unit mass of ex-ante homogeneous natives, and is endowed with a fixed stock of land, Z, which can be used to produce a food crop taken as the numeraire. The food crop is produced solely for the domestic market. Land is the property of the state. The government leases some of it free of charge to native farmers (Z_N), and the rest of it to a representative foreign firm (Z_F), at a price, p_z, per unit of land leased. Therefore, land use satisfies the following constraint:

$$Z_F + Z_N = Z. \tag{3.1}$$

Supporters of FDI in Africa's farmland claim that such deals could be win-win for the local people and foreign investors if proceeds from leased land could be reinvested into the local community. While one can think of many ways in which the host government can reinvest proceeds from such land-investment deals, a good policy could be to use these

proceeds to expand local farmers' access to commercial inputs such as high-yielding seeds, fertilizer, pesticides, or irrigation. This is the policy we consider in this paper, owing to the effective role it played in ushering in the so-called Indian *green revolution*.

For simplicity, FDI in farmland do not directly create jobs in the local economy, but do so indirectly through government's use of the proceeds from leased land. More formally, denote as e the quantity of the composite input used by a local farmer. Let p_e denote the relative price of the composite input. To the extent that the government benevolently allocates the entire proceeds from land-investment deals, $p_z Z_F$, to subsidizing the use of the composite input by local farmers, and there is a measure n of homogeneous farmers, then the per capita input subsidy is

$$\theta p_e e = \frac{p_z Z_F}{n}, \tag{3.2}$$

where $\theta \in [0, 1]$ denotes the subsidy rate.

To implement this subsidization policy, the local government therefore has two instruments: (i) the amount of local farmland, Z_F, leased to the representative foreign investor, and (ii) the price, p_z, charged per unit of leased land.

Government's subsidization of the composite input is the indirect mechanism through which FDI in farmland create job opportunities in the local community: subsidies expand local farmers' demand for the composite input, which in turn may trigger a supply response through job creation, thereby pulling some local people out of farming and into wage employment. We describe this mechanism more formally below.

3.1. Local People's Occupational Choice

Each native of the agrarian community has a choice between farming ($s = 0$) and wage employment ($s = 1$) as a source of livelihood. A native who chooses wage employment ($s = 1$) earns a wage ω by supplying labor to firms operating in the composite input sector.

A native who chooses farming ($s = 0$) purchases e units of the composite input from the local market and combines them with z units of land to produce y units of the food crop. The crop thus produced is then sold to the local market and proceeds net of input costs are then used to finance own consumption of the food crop.

For each native, the payoff from choosing occupation s in the presence of FDI in local farmland is given by his level of consumption $c(s)$:

$$V_s = c(s). \tag{3.3}$$

V_s denotes the quantity of food consumed when the native has occupation s:

$$c(s) = \begin{cases} c_0 & \text{if } s = 0 \\ c_1 & \text{if } s = 1 \end{cases},$$

The occupation-dependent budget constraint facing a typical native is as follows:

$$c(s) \leq s\omega + (1 - s)[y - (1 - \theta) ep_e], \tag{3.4}$$

where, just to recall, $s \in \{0, 1\}$ is the binary occupational choice variable, p_e the relative price of the composite commercial input, and $\theta \in [0, 1]$, the subsidy rate. The above specification of the budget constraint implies that each local farmer finances its purchase of the composite input from a loan which is paid back (interest free, for simplicity) after harvest. One can think of these loans as being government-sponsored or, alternatively, as provided through microcredit institutions.

A native who engages in wage employment (i.e., $s = 1$) receives a payoff

$$V_1 = \omega. \tag{3.5}$$

To determine the payoff received by a farmer (i.e., $s = 0$) requires more structure.

Assume that the output for each local farmer is Cobb-Douglas in land use, z, and the quantity used of a composite input, e:

$$y = z^{\alpha} e^{\gamma}, \tag{3.6}$$

where $\alpha + \gamma = 1$, with $\alpha, \gamma \in (0, 1)$. We take the level of commercial input use, e, as a measure of local farmers' modernization effort. A native that chooses the occupational strategy $s = 0$ therefore receives a payoff amounting to

$$V_0 = z^{\alpha} e^{\gamma} - (1 - \theta)\, e p_e. \tag{3.7}$$

As is the case in most rural societies, assume that all local farmers receive an equal plot of farmland (Seavoy, 2000), such that they face a land use constraint of

$$zn = Z_N, \tag{3.8}$$

where $n \in [0, 1]$ denotes the measure of local farmers. We can then use (3.8) to obtain per capita farm size among local farmers as follows:

$$z = \frac{Z - Z_F}{n}, \tag{3.9}$$

where $Z - Z_F \equiv Z_N$.

From (3.7), substituting in (3.9) and (3.6) thus yields a typical local farmer's payoff as follows:

$$V_0 = \left[\left(\frac{Z - Z_F}{n} \right)^{\alpha} e^{\gamma} - (1 - \theta)\, e p_e \right]. \tag{3.10}$$

Therefore, the optimal level of input use by a local farmer is

$$e = \left[\frac{(p_e)^{-1}\gamma}{(1-\theta)}\right]^{\frac{1}{\alpha}}\left(\frac{Z-Z_F}{n}\right). \tag{3.11}$$

Expectedly, this optimal level of input use rises with an increase in the subsidy rate, θ, while it decreases with an increase in the price of the input, p_e.

Combining (3.2) with (3.11), using the fact that $\alpha+\gamma = 1$ yields the equilibrium subsidy rate, θ, as the unique solution to the following equation:

$$\theta\left[\frac{\gamma}{(1-\theta)(p_e)^{\frac{1}{\gamma}}}\right]^{\frac{1}{\alpha}} = \frac{p_z Z_F}{Z-Z_F}. \tag{3.12}$$

Taking a first order Taylor series expansion of the function

$$f(\theta) = \theta\left[\frac{\gamma}{(1-\theta)(p_e)^{\frac{1}{\gamma}}}\right]^{\frac{1}{\alpha}}$$

around $\theta_0 = 0$ and solving equation (3.12) then yields the optimal subsidy rate as follows:

$$\theta = \frac{p_z Z_F}{\bar{\gamma}(Z-Z_F)}(p_e)^{\frac{1}{\alpha\gamma}}, \tag{3.13}$$

where $\bar{\gamma} = \gamma^{\frac{1}{\alpha}}$. On final analysis, from (3.10), substituting in (3.11) and (3.13), re-arranging terms yields a local farmer's optimal payoff as

$$V_0 = \frac{\alpha}{n}\left[\frac{\gamma(p_e)^{-1}(Z-Z_F)^{\frac{1}{\gamma}}}{(Z-Z_F)-\gamma^{-\frac{1}{\alpha}}(p_e)^{\frac{1}{\alpha\gamma}}p_z Z_F}\right]^{\frac{\gamma}{\alpha}}. \tag{3.14}$$

As the reader can see, FDI in farmland (an exogenous increase in Z_F) has an ambiguous effect on a local farmer's welfare, as measured by V_0. There are three factors mediating this effect: the composite input price, p_e, the land price, p_z, and the measure of local farmers, n. But both n and p_e are endogenous variables, whose respective levels adjust in

equilibrium. More on that later.

Natives decide on their occupation in the presence of FDI in farmland by balancing between V_0 and V_1. We define as $\vartheta(n, p_e, p_z, \omega, Z_F) = V_0 - V_1$, the net gain from being a local farmer. A native chooses farming over wage employment if and only $\vartheta(n, p_e, p_z, \omega, Z_F) > 0$. The reverse is true if and only $\vartheta(n, p_e, p_z, \omega, Z_F) < 0$. Using (3.5) and (3.14), we obtain this net gain as follows:

$$\vartheta(n, p_e, p_z, \omega, Z_F) = \frac{\alpha}{n}\left[\frac{\gamma(p_e)^{-1}(Z - Z_F)^{\frac{1}{\gamma}}}{(Z - Z_F) - \gamma^{-\frac{1}{\alpha}}(p_e)^{\frac{1}{\alpha\gamma}} p_z Z_F}\right]^{\frac{\gamma}{\alpha}} - \omega. \tag{3.15}$$

A complete characterization of this net gain requires that we specify the determinant of the wage ω. We get to this task next.

3.2. The Composite Input Sector

The composite input sector is perfectly competitive. Labor is the only hired input in this sector. Output of the composite input is given by:

$$Y_F = \phi L, \tag{3.16}$$

where $\phi > 0$ is a productivity parameter. The labor input constraint is given by

$$L_F \leq 1 - n, \tag{3.17}$$

where $1 - n$ denotes the total number of displaced local people who shift to wage employment as their new source of livelihood. Under perfect competition, the representative firm pays a market-clearing wage of

$$\omega = p_e \phi. \tag{3.18}$$

Therefore, from (3.15), substituting in (3.18) yields the net payoff gain from choosing

farming over wage employment as follows:

$$\bar{\vartheta}\left(n, p_e, p_z, Z_F\right) = \frac{\alpha}{n}\left[\frac{\gamma\left(p_e\right)^{-1}\left(Z - Z_F\right)^{\frac{1}{\gamma}}}{\left(Z - Z_F\right) - \gamma^{-\frac{1}{\alpha}}\left(p_e\right)^{\frac{1}{\alpha\gamma}} p_z Z_F}\right]^{\frac{\gamma}{\alpha}} - p_e\phi \tag{3.19}$$

This net payoff gain depends on two endogenous variables namely n and p_e, which themselve adjust to changes to exogenous variables such as p_z and Z_F. Solving the model for the endogenous pair (n, p_e) thus is crucial for our welfare analysis, which follows below.

4. The Welfare Effects of FDI in Farmland

In this section, we analyze the welfare effects of FDI in farmland, highlighting the mechanisms that drive these effects. To the extent that foreign acquisition of local farmland is compensated by subsidization programs that reduce the costs of modernizing farming practices, in addition to drawing some natives into wage employment, one may be compelled to think that such deals are indeed a win-win situation for both foreign investors and local people.

Taken individually, however, each of the two rationales mentioned above can be undermined by any of the following issues. In relation to any prospective reduction in the cost of modernizing local farming practices, we should consider the compensation that comes in the form of the subsidization of commercial inputs. A problem can arise if the government is not accountable to the community targeted by FDI in farmland, in which case the compensation may not be received in full. Even if the government were to act benevolently, such that all the proceeds from leasing farmland to the foreign-owned company are totally invested in the subsidization of commercial inputs used by local farmers, there is also the question of whether the government has the capacity to negotiate adequate compensation with the foreign-owned company, for example, in the form of a sufficiently high lease price, p_z. Unless such a capacity exists, the compensation received will be too small to have any

significant impact on local people's livelihoods.

We can also consider the displacement of local farmers induced by foreign acquisition of local farmland. We assume that displaced farmers shift into wage employment. There is no problem in this regard if the production process adopted by the foreign-owned company is sufficiently labor-intensive. If this process is either capital-intensive, or creates few backward and forward linkages, then the potential for job creation may be negligible: this could result in a more than proportional reduction in farm size in the local community. Below, we provide an analysis of these rationales, keeping track of the related potential problems.

4.1. Equilibrium

We stated above that the pair (n, p_e) adjusts in equilibrium. In this sub-section, we compute the equilibrium levels of these two variables.

Observe that aggregate supply of the composite input is

$$S = \phi (1 - n), \tag{4.1}$$

while aggregate demand, D, is given by

$$D = en.$$

Therefore, using optimal values for e and θ, re-arranging terms, yields aggregate demand for the composite input as follows:

$$D = \left[\frac{\gamma (p_e)^{-1} (Z - Z_F)^{\frac{1}{1+\alpha}}}{(Z - Z_F) - (\gamma^{-1} p_e)^{\frac{1}{\alpha}} p_z Z_F} \right]^{\frac{1}{\alpha}}. \tag{4.2}$$

In equilibrium, demand equals supply (i.e., $D = S$). Combining (4.1) and (4.2) leads to

the following equation in two unknowns (n, p_e) :

$$\left[\frac{\gamma\left(p_e\right)^{-1}\left(Z-Z_F\right)^{1+\alpha}}{\left(Z-Z_F\right)-\gamma^{-\frac{1}{\alpha}}\left(p_e\right)^{\frac{1}{\alpha\gamma}}p_z Z_F}\right]^{\frac{1}{\alpha}}=\phi\left(1-n\right). \tag{4.3}$$

Next, we look at the allocation of local people between occupations in equilibrium. Recall that natives in unit mass have the option to pursue one of two different occupations: farming or wage employment. Observe from (3.19), that the net payoff gain is strictly decreasing in the measure of local farmers, n. In other words, as more local people choose to remain farmers, the net gain from doing so diminishes, so that in equilibrium, local people are indifferent as to which occupation to choose: $\vartheta\left(n, p_e, p_z, Z_F\right)=0$. Using (3.19), this equation in two unknowns (n, p_e) can be shown to reduce to:

$$\left[\frac{\gamma\left(p_e\right)^{-\frac{1}{\gamma}}\left(Z-Z_F\right)^{\frac{1}{\gamma}}}{\left(Z-Z_F\right)-\gamma^{-\frac{1}{\alpha}}\left(p_e\right)^{\frac{1}{\alpha\gamma}}p_z Z_F}\right]^{\frac{\gamma}{\alpha}}=\frac{n\phi}{\alpha} \tag{4.4}$$

We define a general equilibrium of this agrarian economy as a pair, (n, p_e), of endogenous variables that solves the system of two equations in two unknowns specified by (4.3) and (**??**). In what follows, we solve this equilibrium and analyze its implications for the welfare effects of FDI in farmland.

4.2. Equilibrium Measure of Local Farmers

To solve for the equilibrium, we proceed by substitution. Consider the equations (4.3) and (4.4) respectively. Dividing the first by the second, side by side, and re-arranging terms yields the measure of native farmers (i.e., those who choose $s=0$) as follows:

$$n=\frac{\alpha}{\alpha+\gamma f\left(p_e, p_z, Z_F\right)} \tag{4.5}$$

where

$$f\left(p_e, p_z, Z_F\right) = \frac{\left(Z - Z_F\right)^{1+\alpha}}{\left[\left(Z - Z_F\right) - \left(\gamma^{-1} p_e\right)^{\frac{1}{\alpha}} p_z Z_F\right]}. \tag{4.6}$$

It can then be shown by way of partial differentiation that the equilibrium measure of local farmers has the following properties:

$$\frac{\partial n}{\partial j} < 0,$$

for $j = p_e, p_z$. Furthermore,

$$\frac{\partial n}{\partial Z_F} < 0$$

if

$$p_z \geq \left[\gamma \left(p_e\right)^{-1}\right]^{\frac{1}{\alpha}} \alpha \tag{4.7}$$

We have just established the following result:

Proposition 1. *The measure of local people who choose to remain farmers in the presence of FDI in farmland tends to decrease with an increase in (i) the price of the composite farming input, (ii) the price of leased land. However, (iii) it may either increase or decrease, as a result of an increase in land leased, Z_F. In particular, it decreases if condition (4.7) holds.*

Proposition 1-(iii) illustrates the role played by government capacity and/or willingness to negotiate lucrative land investment deals with foreign investors, as well as its accountability to local farmers. That role is captured by condition (4.7). However, since the price of the composite farming input, p_e, is endogenous and thus adjusts in equilibrium, it is not clear that this condition can always be met. Hence the importance of computing the equilibrium price of the composite farming input.

4.3. Equilibrium Price of the Composite Farming Input

To solve for the composite input's equilibrium relative price, p_e, we first substitute (4.5) into equation (4.4), using (4.6). Then, re-arranging terms yields

$$\Gamma\left(p_e, p_z, Z_F\right) = 0 \tag{4.8}$$

where

$$\Gamma\left(p_e, p_z, Z_F\right) \equiv \Psi\left(p_e, p_z, Z_F\right) - \frac{\phi}{\alpha + \gamma f\left(p_e, p_z, Z_F\right)},$$

and

$$\Psi\left(p_e, p_z, Z_F\right) \equiv \left[\frac{\gamma\left(p_e\right)^{-\frac{1}{\gamma}}\left(Z - Z_F\right)^{\frac{1}{\gamma}}}{\left(Z - Z_F\right) - \left(\gamma^{-1} p_e\right)^{\frac{1}{\alpha}} p_z Z_F}\right]^{\frac{\gamma}{\alpha}}.$$

The value of p_e that solves equation (4.8) is the equilibrium relative price of the composite farming input. This price is given by

$$p_e = P\left(p_z, Z_F\right). \tag{4.9}$$

By partial differentiation of the function $\Gamma(.)$, it can then be shown that

$$(i) \qquad \Gamma_{p_z} > 0,$$

and, if

$$p_z \geq \left(\underline{p}\right)^{-\frac{1}{\alpha}} \alpha \tag{4.10}$$

where $\underline{p} = \min p_e$, then

$$(ii) \qquad \Gamma_{Z_F} > 0,$$

where Γ_j denotes the partial derivative of Γ with respect to $j = p_e, p_z, Z_F$.

Furthermore,

$$\Gamma_{p_e} = -\Psi\left(p_e, p_z, Z_F\right)\frac{\left(p_e\right)^{\frac{1}{\gamma}}}{\alpha^2}\left[\frac{\alpha\left(Z-Z_F\right)-\left(\gamma^{-1}p_e\right)^{\frac{1}{\alpha}}p_z Z_F}{\left(Z-Z_F\right)-\left(\gamma^{-1}p_e\right)^{\frac{1}{\alpha}}p_z Z_F}\right]$$

$$+\frac{\phi\left(Z-Z_F\right)^{1+\alpha}}{\alpha\left(\alpha\left[\left(Z-Z_F\right)-\left(\gamma^{-1}p_e\right)^{\frac{1}{\alpha}}p_z Z_F\right]+\left(1-\alpha\right)\left(Z-Z_F\right)^{1+\alpha}\right)^2}$$

Observe then that for Z sufficiently large and for $\alpha\phi$ sufficiently small, it can also be shown that

$$\Gamma_{p_e} < 0$$

is also true. By the application of the Implicit Function Theorem, we have that

$$\frac{\partial P}{\partial Z_F} = -\frac{\Gamma_{p_z}}{\Gamma_{p_e}}$$
$$\frac{\partial P}{\partial Z_F} = -\frac{\Gamma_{Z_F}}{\Gamma_{p_e}}$$

Proposition 2. *Let condition (4.10). Suppose in addition that Z is sufficiently large and that $\alpha\phi$ is arbitrarily small. Then, the relative price of the composite farming input rises with an increase in (i) the relative price of the land leased to foreign investors (i.e., $\partial P/\partial p_z > 0$) and (ii) the extent of land expropriation (i.e., $\partial P/\partial Z_F > 0$).*

Condition (4.10) is a stronger condition than condition (4.7) underlying Proposition 2. It states that the relative price of the land leased to foreign investors is sufficiently high. This in turn implies that the government endowed with the power to negotiate this price has both the willingness and the capacity to secure lucrative land deals on behalf of the local population. For part (ii) of Proposition 2 to hold, we need Z to be sufficiently large. This implies that the targeted community is sufficiently land-abundant. This condition is easier to defend as most targeted African countries are land-rich.

4.4. FDI in farmland and the Welfare of Local Populations

In this subsection, we analyze the effects of FDI in farmland on the economic well-being of local populations (including farmers and wage earners). Since farmers and wage earners achieve the same level of utility in equilibrium (otherwise natives would continue to move from the low-utility occupation to the high-utility one), we can use (3.18) and (4.9) to rewrite this common utility payoff as follows:

$$\bar{V}\left(p_z, Z_F\right) = \phi P\left(p_z, Z_F\right). \tag{4.11}$$

We now establish our main result as an implication of Proposition 2.

Proposition 3. *Let condition (4.10). Suppose in addition that Z is sufficiently large and that $\alpha\phi$ is arbitrarily small. Then, local people's welfare rises with an increase in (i) the relative price of land leased to foreign investors (i.e., $\partial\bar{V}/\partial p_z > 0$) and (ii) the extent of land expropriation (i.e., $\partial\bar{V}/\partial Z_F > 0$).*

In other words, FDI in farmland—whereby a host nation's government takes farmland from local people to lease or sell to foreign countries or companies—will improve local people's welfare if (i) the host government, in addition to being accountable to local people, has the capacity to secure sufficiently lucrative land-lease contracts with foreign investors, and (ii) the country is sufficiently land-rich. Proposition 3 thus establishes the welfare effects of FDI in farmland. It implies that both local people who remain farmers and those who shift to wage-employment equally benefit from this phenomenon, which is a strong dissent from the presumption in the existing literature (Daniel and Mittal 2009; Cotula and al. 2009) that it has an adverse effect on local population. Why may FDI in farmland make local people better off as implied by Proposition 3 above? Our next comparative statics exercises provide a discussions of the reasons behind this outcome.

4.5. FDI in Farmland and the Transition to Wage Employment

Our first claim in explaining the reasons why local people may gain from foreign acquisitions of local farmland is that such acquisitions may lead to a welfare-enhancing shift to wage-employment.

Suppose that condition (4.10) holds. We first ask how an increase in Z_F affect the equilibrium measure of local farmers, n. We denote this effect as dn/dZ_F. Proposition 2 applied to (4.5) leads to the following reformulation of the equilibrium measure of local farmers:

$$n = \frac{\alpha}{\alpha + (1-\alpha) f\left[P\left(p_z, Z_F\right), p_z, Z_F\right]}$$

where $P\left(p_z, Z_F\right) = p_e$ denotes the equilibrium price of the composite farming input. We obtain the effect of FDI in farmland on the measure of local farmers as follows:

$$\frac{dn}{dZ_F} = \frac{\partial n}{\partial Z_F} + \frac{\partial n}{\partial p_e}\frac{\partial P}{dZ_F}.$$

The two components of this effect are a direct effect ($\partial n/\partial Z_F$), and an indirect effect working through the price of the composite farm input, p_e. Propositions 1 and 2 then imply that the direct and the indirect effects reinforce each other, thereby increasing the magnitude of the shift to wage employment brought about foreign acquisition of local farmland:

$$\frac{dn}{dZ_F} < 0.$$

This means both push-, and pull-factors are at play in triggering this shift to wage-employment. To the extent that the targeted country is abundantly endowed with farmland, the pull-factors may actually be doing all the driving. The main pull-factor is the rise in the wage rate, induced by an increase in employment opportunities in the composite input sector. Recall that this increase is itself driven by the government's reinvestment of proceeds of land investment deals into the system via subsidies to local farmers to boost

the use of modern inputs in farming. The rise in farmers' demand for modern inputs thus stimulate job-creation in the input sector, thereby attracting local people, who otherwise would have been occupied as farmers.

4.6. FDI in Farmland and Local Farm Size

How does foreign acquisition of local farmland affect farm size for local people? One of the concerns raised by critics of FDI in Africa's farmland is that it reduces farmland available to local people. Clearly, with no reallocation of local people away from farming, per capita farm size will certainly decrease. However, as pointed above, FDI also indirectly induced a shift to wage employment for some local people, which in turn reduces pressures on the availability of farmland. Arguably, how FDI affect farm size for the local population ultimately depends on which effect is stronger. Our second claim therefore is that FDI in farmland do not necessarily reduce farm size among local people. In fact it may actually raise it, and here is why.

Equilibrium farm size is given by:

$$z = \frac{Z - Z_F}{N\left(p_z, Z_F\right)}$$

The effect of FDI in farmland on farm size, thus is given by

$$\frac{dz}{dZ_F} = -\frac{1}{N\left(p_z, Z_F\right)}\left[zN_{Z_F} + 1\right] \tag{4.12}$$

where $N_{Z_F} = \partial N/\partial Z_F < 0$. Therefore, letting

$$\varepsilon = -N_{Z_F}\frac{Z_F}{N\left(p_z, Z_F\right)}$$

denote the elasticity of the measure of the local farming population to FDI in farmland,

we can reformulate (4.12) as follows, re-arranging terms:

$$\frac{dz}{dZ_F} = \frac{1}{N\left(p_z, Z_F\right) Z_F}\left[\varepsilon Z - \left(1+\varepsilon\right) Z_F\right].$$

Therefore,

$$\frac{dz}{dZ_F} > 0$$

if and only if

$$Z > \left(\frac{1+\varepsilon}{\varepsilon}\right) Z_F. \tag{4.13}$$

Hence the following result:

Proposition 4. *Let condition (4.10) hold. Then, FDI in farmland lead to the expansion of farm size for local farmers if and only if condition (4.13) also holds.*

Condition (4.13) which is crucial for Proposition 4 to hold suggests that there is abundance of farmland to begin with, so that how much of it is acquired by foreign investors does not significantly reduces the share available for the local population. Indeed, one of the reason why African countries are targeted is precisely their abundant endowment of farmland, which is implies that a condition such as (4.13) is likely to obtain in most African countries targeted by these land investment deals. For such countries, the indirect effect of these land investment deals outweighs its direct negative effect, thereby leading to the expansion of farm size for local farmers.

4.7. FDI in Farmland and Modern Input Use by Local Farmers

Our third claim is that FDI in farmland raise the subsidy rate for modern input purchased by local farmers. From (3.13), this yields a reformulation of the equilibrium subsidy rate as follows:

$$\theta = \frac{p_z Z_F}{\bar{\gamma}\left(Z - Z_F\right)}\left[P\left(p_z, Z_F\right)\right]^{\frac{1}{\alpha\gamma}}, \tag{4.14}$$

where $\bar{\gamma} = \gamma^{\frac{1}{\alpha}}$. We thus obtain the effect of FDI in farmland on the subsidy rate as follows:

$$\frac{d\theta}{dZ_F} = \frac{\partial \theta}{\partial Z_F} + \frac{\partial \theta}{\partial p_e}\frac{\partial P}{\partial Z_F}.$$

From (4.14), it can be verified that the direct effect $\partial\theta/\partial Z_F$ is strictly positive, as is the component $\partial\theta/\partial p_e$ of the indirect effect. Proposition 2, therefore, ensures that again both the direct and the indirect effects reinforce each other, thereby rasing the magnitude of the positive effect FDI in farmland have on the subsidy rate for farming inputs:

$$\frac{d\theta}{dZ_F} > 0.$$

This in turn has implications for the level of input used by local farmers, as described in (3.11). In particular, in equilibrium, the optimal level of input use by a local farmer is

$$e = \left[\frac{\gamma\left(Z - Z_F\right)^{1+\alpha}\left[P\left(p_z, Z_F\right)\right]^{-1}}{Z - Z_F - \gamma^{-\frac{1}{\alpha}}\left[P\left(p_z, Z_F\right)\right]^{\frac{1}{\alpha\gamma}} P_z Z_F}\right]^{\frac{1}{\alpha}} \left[N\left(p_z, Z_F\right)\right]^{-1} \equiv E\left(p_z, Z_F\right).$$

At the cost of tedious algebra, the interested reader can verify that for a sufficiently land abundant country, the equilibrium level of the modern input used by a local farmer rises with the level of FDI in farmland, Z_F, because an increase in Z_F raises the level of government subsidies to local farmers.

Our analysis thus identify two necessary and sufficient conditions for international acquisitions of farmland to yield welfare gains for the local population: (i) the country is land-abundant in the sense of condition (4.13), and (ii) the government, in addition to being accountable to local people for the deals it negotiates and for its use of the proceeds, is highly capable of negotiating lucrative deals for the benefit of its people, in the sense of condition (4.10).

Observe however that since the minimum input price, $\underline{p}$, underlying condition (4.10) is a purely theoretical concept, it is not clear what order of magnitude it takes for this

condition to be satisfied. In particular, critics of our theory may fear that this condition may not obtain for realistic levels of p_z, which in turn may cast doubt on the validity of Propositions 2-4. To allay these fears we use numerical methods to quantitatively replicate the behavior of the theoretical economy.

5. A Numerical Simulation

In this section, we use numerical methods to simulate the properties of the theoretical economy described in the previous sections. To make sure that our simulation results are not conditioned by numerical values assigned to parameters, we only assign fixed numerical values to a limited number of parameters, leaving the values of key parameters free to vary within specified ranges. We use this numerical version of our model to replicate comparative statics results of the theoretical model in a way that reveals the order of magnitude of the relevant effects. The numerical simulation is done using a Matlab Code (which is available upon request).

5.1. Numerical Values

Our theoretical model comprises six exogenous variables namely, the land's production elasticity, α, the composite market input's production elasticity, γ, the productivity parameter for the production technology of the composite input, ϕ, the total supply of farmland, Z, the quantity of local farmland leased to the foreign firm, Z_F, and the lease price, p_Z. However, since $\alpha + \gamma = 1$, the number of relevant exogenous variables is indeed reduced to five. In what follows we outline our strategy for selecting numerical values for these exogenous variables.

We start with the choice of a numerical value for the land's production elasticity in farming, α. We draw its value from a recent empirical study by Fuglie (2010). Using FAO data, Fuglie (2010) estimates that for developing countries including, India, Indonesia,

China, Brazil, Mexico, and Sub-Saharan Africa, the land's production elasticity in agriculture falls in the range $0.22 - 0.29$. In our model simulation, we set this land's production elasticity at $\alpha = 0.25$, which is well within the estimated range. This in turn implies that the composite input's production elasticity is set $\gamma = 1 - \alpha = 0.75$. This is a reasonable estimate as the composite input is indeed a proxy for a mixture of inputs, including fertilizer, hybrid seeds, pesticides, extension services, etc., all of which contribute to agricultural production.

Next, in choosing a numerical value for the productivity factor for the production technology of the composite input, we want to ensure that the system of two equations in two unknowns described by (4.3) and (4.4) admits a unique solution, (p_e, n), satisfying $n \in [0, 1]$, since we normalized the total local population to unity. We thus set this productivity factor at $\phi = 100$.

Furthermore, we set the aggregate supply of local farmland at $Z = 100$. We then restrict total farmland leased to foreigners in the range $Z_F \in [0, 6]$, which implies that the maximum quantity of farmland that can be leased to foreigners is less than 10% of available farmland. This is consistent with the hypothesis that FDI in farmland target countries with an abundance of farmland, as implied by condition (4.13). Finally, we select the range of the variable p_z so as to ensure that the denominators of equations (4.3) and (4.4) are both strictly positive, a necessary condition for the system of two equations in two unknowns to admit a solution. We thus restrict the values of p_z within the range $[0, 1]$. The higher p_z, the higher government's capacity to negotiate lucrative land-investment deals on behalf of the local people.

5.2. Comparative Statics

To replicate numerically the properties of the theoretical economy described in the previous section, we first solve for the equilibrium of this economy as described by the system of two equations in two unknowns. Given numerical values for α, γ, and ϕ, the solution to

this system of equations is obtained as a vector of two functions of respectively $p_z \in [0,1]$ and $Z_F \in [0,6]$:

$$\begin{aligned} p_e &= P(p_z, Z_F) \\ n &= N(p_z, Z_F). \end{aligned}$$

Recall that p_e is the price of the composite input, while n is the measure of local farmers. Figure 1 in the Appendix represents the comparative statics for the relative price of the composite input, p_e in a three-dimensional diagram:

Insert Figure 1 Here

Two importants remarks can be derived from Figure 1:

Remark 1. *A simultaneous increase in the lease price, p_z, and the quantity of farmland leased to foreigners, Z_F, causes the relative price of the composite input to rise.*

Remark 2. *In particular, at low levels for the lease price, p_z, an increase in the quantity of local farmland leased to foreigners causes the relative price of the composite input to decrease.*

Both remarks are quite intuitive. At a low lease price— reflecting the local government's low capacity to negotiate lucrative land-investment deals on behalf of local people—, an increase in the quantity of farmland leased to foreigners generates fewer financial resources for the government, which causes the level of per capita subsidy to farmers to decrease. This in turn reduces farmers' incentive to purchase the composite input, so that its price has to decrease to encourage farmers to buy. By contrast, at higher levels for the lease price— reflecting the government's high capacity to negotiate lucrative land-investment deals—, an increase in the quantity of farmland leased to foreigners generates substantial

revenues for the government, which in turn boosts subsidy to local farmers, leading them to increase their demand for the composite input. As a result, the price of this composite input rises, as shown in Figure 1.

Figure 2, also provided in the Appendix, summarizes comparative statics for the measure of local farmers, n.

Insert Figure 2 Here

Two remarks can also be derived from Figure 2:

Remark 3. *A simultaneous increase in the lease price, p_z, and the quantity of farmland leased to foreigners, Z_F, causes the measure of local farmers, n, to decrease.*

Remark 4. *At low levels for the lease price, an increase in the quantity of farmland leased to foreigners causes the measure of farmers to rise.*

The intuition behind these two remarks is as follows. A simultaneous increase in the lease price and the quantity of farmland leased to foreigners provides the government with substantial financial resources with which to subsidize farmers' purchase of the composite inputs. This in turn boosts the demand for the composite input, causing the demand for labor services in the composite input sector to increase. As result, more local people switch to wage employment to take advantage of higher wages, thereby causing the population of local farmers to decrease, as shown in Figure 2.

Our main comparative statics result concerns changes in local people's welfare as induced by FDI in farmland. Figure 3 summarizes these comparative statics in a three-dimensional diagram:

Insert Figure 3 Here

Indeed, Figure 3 represents the mapping of the vector (p_z, Z_F) to the level of welfare of a typical native of the agrarian community, through the function $\bar{V}(p_z, Z_F)$ described in

(4.11). Two important remarks can be derived from Figure 3:

Remark 5. *A simultaneous increase in the lease price, p_z, and the quantity of farmland leased to foreigners, Z_F, causes local people's welfare to rise.*

Remark 6. *At low levels for the lease price, an increase in the quantity of farmland leased to foreigners reduces local people's welfare.*

In other words, Figure 3 states that FDI in farmland reduce local people's welfare only when the government, though possibly benevolent, has a low capacity to negotiate lucrative land-investment deals on behalf of local people, as reflected by low levels of lease prices. This behavior is more clearly illustrated in a two-dimensional diagram, as presented in Figure 4.

Insert Figure 4 Here

Indeed, Figure 4 represents local people's welfare in a two-dimensional diagram, as a function of the quantity of farmland leased to foreigners, Z_F, and for different values of the relative lease price, p_z, namely, (a) $p_z = 0.2$; (b) $p_z = 0.26$; (c) $p_z = 0.45$.

In Figure 4, the solid surve represents the univariate function, $\bar{V}(0.2, Z_F)$, which is strictly decreasing in Z_F, implying that foreign acquisitions of local farmland (i.e., an increase in Z_F) have an adverse effect on local people's welfare when the government has too low a capacity for negotiating lucrative deals on behalf of the people, as measured by $p_z = 0.2$. The semi-solid flat curve represents the univariate function $\bar{V}(0.26, Z_F)$, which is almost a constant function of Z_F. This function highlights the existence of threshold lease price, $p_z^* = 0.26$, below which FDI in farmland make local people worse off, and above which they make them better off, as shown by the dotted upward slopping curve representing the univariate function, $\bar{V}(0.45, Z_F)$. In other words, a local government with a capacity to negotiate lease prices above the threshold $p_z^* = 0.26$ can enhance local people's welfare through the leasing of local farmland to foreign investors.

6. Conclusion

We studied the welfare effects of FDI in farmland. We highlighted four features driving these effects. First, local farmers have no legal tenure to the land they use to grow food crops, which mean they cannot directly negotiate the sale of part of it to foreign investors, nor directly receive the proceeds from land leases or sales. Second, farmland leased or sold to profit-oriented foreign companies generates public funds that are used to expand local farmers' access to modern farming inputs. This may include subsidies on fertilizer, high-yielding seeds, as well as the construction of locks and dams to encourage the practice of irrigation farming.

Second, expanding farmers' access to modern farming inputs has linkage effects to the sector producing these inputs, leading to the creation of job opportunities for local people. Subsidies enhance the demand for farming inputs, which in turn causes their relative price to rise. To the extent that this sector is perfectly competitive, the profit caused by the rise in the market price of the farming inputs will attract new entrants into the sector, which in turn may stimulate the demand for labor. As a result, some local people are pooled out of farming and into wage employment, thereby mitigating the adverse effect of land expropriation by the government.

Finally, farmland leased or sold to foreign investors is used solely to grow an export crop, thus entrenching export-oriented agriculture. This feature reflects the fact that countries involved in the acquisition of African farmland, namely Bahrain, China, Egypt, India, Japan, Jordan, Kuwait, Libya, Malaysia, South Korea, Qatar, Saudi Arabia and the United Arab Emirates, all have a vested interest in outsourcing their own food security in order to escape high food prices (GRAIN, 2008), or are in dire need of alternative sources of energy to support their industrialization process (e.g., China). This implies that land-investment deals with foreign companies do not directly boost the supply of food for local people. As the targeted countries are themselves food-insecure, as is the case for Ethiopia, Kenya,

Somalia and South Sudan, just to name a few, critics of foreign acquisition of Africa's farmland advance the idea that food security for the investors' countries may trade-off food security in the targeted countries as a result of the export focus of land investment deals. Our model, however, turns this presumption on its head. Indeed, government subsidies can boost local production of food in two ways. Firstly, directly through more use of modern farming inputs. Secondly, as a supply response to a rise in the demand for food emanating from local people who shift to wage employment. The result is an improvement in the welfare of all local people. Our analysis therefore suggests that the fact that land-investment deals serve the economic interests of foreign countries (production of non-food agricultural commodities solely for export) need not be the source of a decline in food production in the communities affected, if (i) the country is land-abundant, and (ii) the government, in addition to being accountable to local people for the deals it negotiates and for its use of the proceeds, also has a sufficiently high capacity to negotiate such deals. It also suggests that African countries where FDI in farmland are met with opposition or do not benefit local people are those where one or all two of these conditions are violated. Numerical simulations conducted using a Matlab code supports these results for realistic choices of parameter values.

Our analysis, however, cannot be seen as rolling out a red carpet to foreign investors interested in Africa's farmland. One of the reasons is our model's assumption that local people can readily be made to shift from traditional farming livelihoods to wage-employment as a source of livelihood. In practice, they may lack the needed education to hold a modern day job, or they may simply hang on to peasantry as an uncompromising way of life for cultural reasons, which may act as an impediment to wage-employment. When such barriers exist, the government might have to look for other mechanisms, for example by requiring that foreign firms sell a certain proportion of their output in the local market, or directly hand the cash to local people affected by the land-investment deals.

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Appendix

Figure 1. Comparative Statics : Equilibrium Input Price

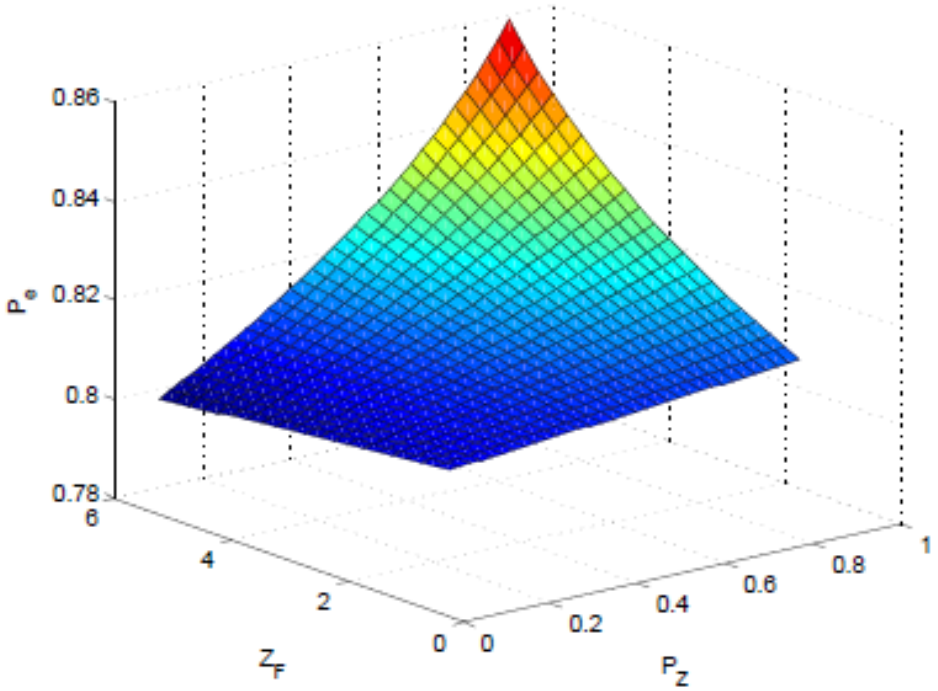

Figure 2. Comparative Statics : Equilibrium Measure of Local Farmers

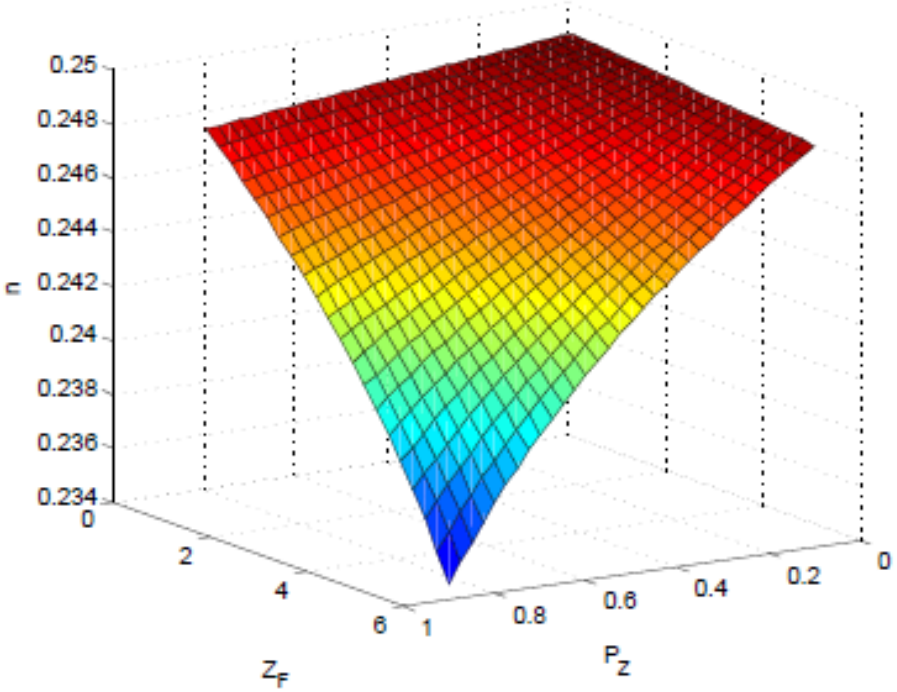

Figure 3. Comparative Statics: Welfare, Three−Dimensional Case

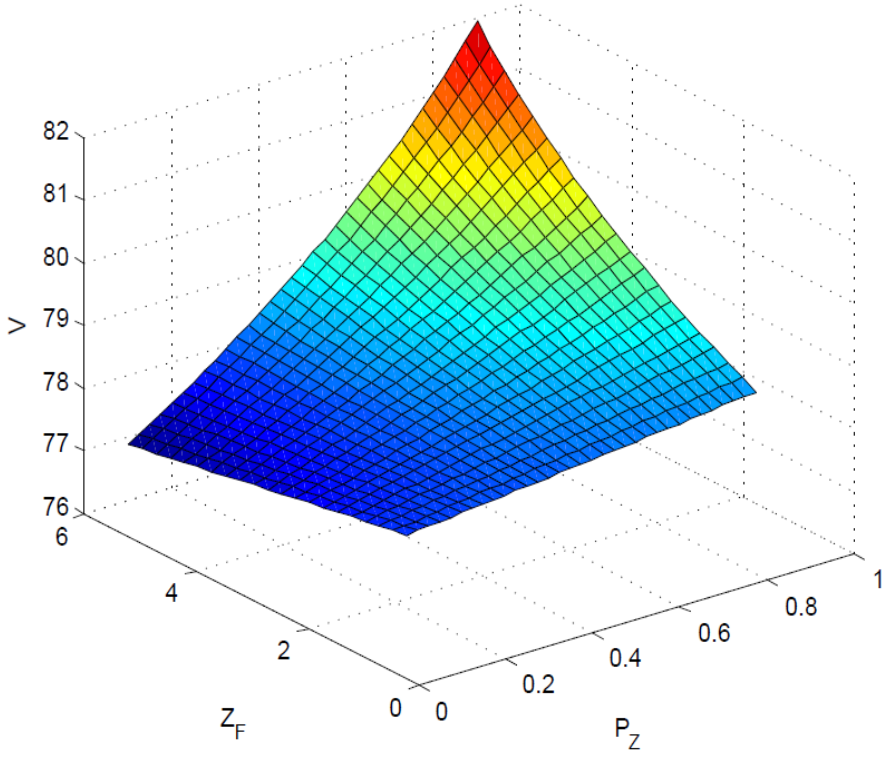

Figure 4. Comparative Statics: Welfare, Two Dimensional Case