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Contract Farming and Food Security in Developing Economies: A Framework Model for Spillover Impact

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ABSTRACT

Empirical literature on the effect of Contract Farming (CF) on economic development of a Less Developed Economy (LDC) is divided on the basic issue of concern for the policy makers in LDCs: should CF be encouraged, and if so, under what circumstances? Broadly, there are both intermediate (yield, price etc.) and ultimate (mainly household income and food security) benefits. However, the implication of the outcomes on welfare are not unidirectional. For instance, in most cases yield per hectare and household income of farmers increased along with rise in prices of crops. *Das, Bhattacharya and Marjit (JRFM, 2023) builds a model to explore such adverse welfare impacts due to CF. This paper's focus is totally different.* Also, there is no homogeneity in the sample of crops or the country of occurrence. Since most of these contracts are private in nature with a clear objective of profit maximization, the estimates could have self-section biases, which is rarely controlled for. Additionally, these are mostly in the nature of treatment/control group studies (though not RCTs). A fundamental issue is that spillover effects bias outcomes in these methods and it should be controlled for. This implies that there is virtually no empirical literature on spillover effects. Looking at it differently, these studies conclude that *in the absence of spillover effects* CF appears to be conditionally beneficial to LDCs. Given this background, this paper investigates: what are the nature of these conditions? To what extent do spillover effects relax them? Constructing a three-sector-four-factors general equilibrium model: agricultural with contract farming, traditional agriculture, and manufacturing, we derive the conditions under which it is conducive for low-income farmers. The objective is to prescribe a clear set of recommendations to the governments of the LDCs that are experimenting with CF on the nature of priors that they need to ensure for significantly increasing the probability of net benefit from CF.

JEL Classification: F22, J31, Q15

Keywords: Land deal, Contract Farming, Vertical Coordination, Wage gap, Self-selection Bias, Spillover, Governance.

1. Introduction and Overarching Issues

Of late, the jargon "Land Grab" has entered the lexicon of development economics as a political metaphor. There are conflicting issues related to the "land question" in agrarian studies and economic history. As the Sustainable Development Goals (SDGs) proposed by the United Nations address global challenges to reduce poverty and inequality as well as climate change, land question has again taken a center stage, among others. Often, political upheaval induced by forcible land grabs driven by industrialization in developing Africa and Asia leads to social exclusion where relative poverty increases between rich and poor farmers. For ensuring a positive-sum game, benefitting landowners without hurting prospects for inclusiveness and shared prosperity, the need for a sustainable policy framework is imperative. The issue is poignant with seismic potential in political sphere causing social unrest in African and Asian sub-continents.

Transforming agriculture into agribusiness for rejuvenating farming is another mode where FDI occurs via vertical coordination. Foreign direct investment (FDI) in agriculture has taken the form of land acquisitions and 'contract farming (CF)' in developing nations. CF, defined as "an agriculture production system carried out according to an agreement between a buyer and farmers, which establishes conditions for the production and marketing of a farm product", involves vertical coordination where 'the farmer commits to providing agreed quantities of a specific agricultural product .. …and the buyer agrees to purchase the product at agreed pricing conditions and, [to] support production through the supply of farm inputs, land preparation, and the provision of technical advice' (FAO 2012). [1] Also, CF is 'a mechanism for governing transactions in agrifood supply chains and as a tool to promote the access of small holder farmers to markets through vertical coordination. There is a large empirical literature on the effect of CF on the economic development of a Less Developed Economy (LDC). On the other hand, transforming agriculture into agribusiness for rejuvenating farming is another mode where FDI occurs via vertical coordination. The crucial question is viability of such deals and transparency of leasing land for which marketable land rights barely exist.

The literature is divided on the basic issue of concern for the policy makers: should CF be encouraged? And if so, under what circumstances: On which type of land and crops, under what sort of legal framework? All these have created commotion via generating agitprop and reactions. In LDCs in Africa and Asia where human capital is weak and agriculture suffers from land degradation, investments in human and natural capital could be key candidate for sustained growth.[2]

The empirical literature for CF has explored several possible sources of benefit, both intermediate (yield, price, use of household labor etc.) and ultimate (mainly household income and food security). However, it is difficult to form any clear opinion regarding the issues mentioned above. First, the implication of the outcomes on welfare are not unidirectional: For instance, in most cases yield per

[1] Potato and tomato cultivation in India is example where 'Lays' potato chips company could procure potato from traditional farm by guaranteeing market access via vertical linkages through the retail sector. Fresh fruits and vegetables sector is one such sector. It is to be remembered that this is not broad-based rural or agricultural development as specific commodity and markets are subject to contract farming only.

[2] See Das (2013, 2018) on this issue.

hectare and household income of farmers increased, however so did the prices of crops. Second, there is no homogeneity in the sample of crops studied or the country of occurrence. It is thus impossible to identify proper legal frameworks and the nature of crops on which CF has a significantly higher probability of success. Das et al. (2023) analyzes the welfare impacts and food insecurity problems in the wake of CF. It has been shown that adverse distributional consequences and inequality could emerge out of CF-based agriculture.

This kind of farming encourages diversification of crop portfolio and integration of farmers vertically with supermarkets and retail chains (Sarkar 2014, Minot 2007, FAO 2012). Sarkar (2014) analyzes the contentious political issue of confidential 'McKinsey plan for transforming West Bengal's agriculture.' For example, in an Indian state of West Bengal this raised hue and cry when industrialization drive tried to displace farmers for building automobile factory initiated by an Indian Multinational, Tata, with implicit support of the ruling party having political hegemony. Recently, in India the current government's Land Acquisition Ordinance is viewed with mixed reactions although improving investment climate is projected as pressing need for development. All these have created stir and commotion via generating agitprop and reactions to anti-farmer sentiments.

The overarching question of contemporary development policy in this context concerns transparency, adequate compensation scheme, protecting land rights in the absence of a well-functioning land markets, land value, and hence balancing growth, equity, and efficiency. Several interesting questions arise: Do these really improve investment climate? What preconditions need to be satisfied for beneficial effects of improved investment climate? Does it aid industrialization and growth, and make farmers partner in the development process?

Also, since most of these contracts are private in nature with a clear objective of profit maximization there are possibilities of self-section bias in the estimates, which is largely recognized in the literature; however, it is rarely controlled for. Additionally, these studies are mostly in the nature of treatment/control group studies. A fundamental issue in these studies is that spillover affects bias outcomes and hence should be controlled for. There is virtually no empirical literature on the spillover effects of CF. The main conclusion of all these studies is that *in the absence of spillover effects* CF appears to be conditionally beneficial to LDCs.

In this paper, we present evidence, and attempt to formalize the arguments in terms of analytical model/s. Following a brief literature review, the research will offer its multi-faceted nature based on variants of a theoretical framework (Das 2013 & 2018). For this, we consider *benchmark model (pre-CF), and compare the results by constructing a three-sector-four-factors general equilibrium model with CF*: agricultural with contract farming, traditional agriculture, and manufacturing, *we derive the conditions under which it is conducive for low-income farmers*. The objective is to prescribe a clear set of recommendations to the governments of the LDCs on the nature of priors that they need to ensure for significantly increasing the probability of net benefit from CF. Das, Bhattacharya and Marjit (2023) builds a model to explore such adverse welfare impacts due to CF. *This paper's focus is totally different.* In addition to taking stock of the current state of the debate and latest evidence to date, Section 2 offers evidence of 'CF'. Section 3 develops an analytical framework to embed the meta-analysis in a cogent structure. Section 4 offers comparative statics and policy scenarios. Section 5 offers an empirical validity and policy impacts. Section 6 concludes.

2. Meta-Analysis on CF and Stylized Facts.

2.1 Background Studies:

In the uproar about food security, the discussion on food price spike, export bans, water stress, and underinvestment in agriculture in the poor countries is not uncommon. With shortages in world food market, countries experiencing high demand and the agriculture-deficient, water-short net food importers are involved in 'land deal' to circumvent food perils. Typically, African countries are 'land-abundant, investor-scarce'. The middle-income oil-exporting countries like Saudi Arabia, Kuwait or Qatar are aggressively involved in farmland acquisition in mainly African economies (e.g., Sudan), as well as in Cambodia, the Philippines, Vietnam etc. Covering 14 countries, Deininger et al. (2011) documents that the total amount of reported large-scale deals sums to 45 million hectares. Another estimate (*The Economist*, 7 May 2011) documents an upsurge to 80 million hectares, of which 51 million hectares are in Africa. In this context, we quote BM (2009): "Well-documented examples are scarce, and some reports are contradictory. This lack of transparency limits the involvement of civil society in negotiating and implementing deals and the ability of local stakeholders to respond to new challenges and opportunities." Kugelman and Levenstein (2009) gives a broad perspective with case studies on the 'roots and reasons' propelling such deals.

Cotula et al. (May 2009)'s study covers qualitative interviews and case studies for five sub-Saharan African and other countries, viz., Ethiopia, Ghana, Madagascar, Mali, Sudan, Mozambique, and Tanzania. As Cotula et al. (2009) mentions, "international land deals and their impacts remain still little understood." According to the European Report on Development (ERD 2009), the FDI in land is spreading in most of the areas of the continent, such as, starting from Ethiopia, Madagascar, Sudan, Mozambique to Congo, Ghana, Liberia, Nigeria, and Tanzania. By presenting a mixed picture across 14 countries, DB (2011) points out the failure on the part of most of the host governments to ensure rights to land and livelihood for the local people and thus, undermining the potential benefits via improved productivity.

Collier and Venables (2012a&b) provided an intuitive economic framework by distinguishing investors—benevolent pioneers with positive externalities and those with purely speculative demand—for charging appropriate price to the leaseholders. Also, they call for government strategies (e.g., monitoring, enforcing, and screening) for dealing with investors' objectives, market failures, factors constraining productivity (e.g., lack of: skill, agronomic knowledge, technology, and infrastructure) and institutional deficiencies (i.e., weak governance and slack property rights).

There is a vast empirical literature on CF. Wang et al (2014) reviews this literature and conclude that more than 75 percent of the studies show an increase in income from CF. This has resulted in increasing popularity of CF in many underdeveloped countries (Martin (2015)). However, a more careful look at this literature reveals that many of these empirical results suffer from inherent weaknesses (Ton et al. (2018)). As Bellemare and Bloem (2018) point out "(A) particularly challenging limitation of these studies is selection bias, or the fact that farmers choose whether to participate in contract farming on the basis of factors that are both unobserved by researchers and highly likely to be confounders". Many authors argue that contracting farmers have special characteristics (Minot and Ronchi, 2015; Barrett et al., 2012).[3] The nature of these characteristics is reported in Michelson (2013) as availability of irrigation facilities, farm size and human capital and others.[4]

In the Indian context, there are some evidences which raise concerns on the adverse impact of 'Land acquisition' thanks to CF. As **Sukhpal Singh** observes: "Land continues to remain important for production and rural livelihoods in developing economies like India. But, globalization and liberalization in these economies has brought up land as an important policy issue as various stakeholders lay claims to it as never before. Although India is not a victim of land grab unlike many African and Asian countries,

[3] https://www.future-agricultures.org/blog/designs-on-the-range-corridors-grabs-and-extractions-at-the-pastoral-margins/

[4] https://www.future-agricultures.org/blog/ethiopia-commercial-farming-investment-and-policy/

there has been a rush for acquiring and retaining land for various purposes which has led to local level conflicts."[5]

Brief review above confirms the necessity of in-depth works on mode of organizing large-scale commercialization of agriculture in LDCs. As the small farmers in LDCs suffer from lack of technology, financial reserves, imperfect information about markets, uncertainty, and risk of production, these affect their productivity. It needs to be seen whether and under which alternative scenarios/conditions these modes of contract farming could solve the problems faced by small farmers in commercial production or, it aggravates the deficiencies. The entire picture is murky, and lack of academic literature leads us to consider media reports—biased or impartial—concerning the impacts. Quoting Deininger (2011): "Currently none of the African countries of interest to investors achieves even a quarter of its potential productivity. Rather than just focus only on an expansion of uncultivated land, it is important that investors and governments support improvements in technology, infrastructure, and institutions that can improve productivity on existing farmland."

In case of CF, shift from traditional farming to contract farming involves vertical coordination between sellers and buyers based on trust and across the food value chain the stakeholders play important role in provisioning of inputs, storage, marketing, processing and retailing. Thus, contract farming involves the following stakeholders: contracting large-firm or agribusiness company, small scale farmers, non-participating farmers, government (facilitator and regulator), and farmer organizations or NGO (Minot 2007). Different forms of vertical coordination could happen, viz., via vertical integration (backward or forward) where the company leases (or purchases) farmland (like land deal above) and hires low-income farmers for production and processing within the same company, or just informal or formal contract between farmers and agribusiness company, or spot markets characterized by one-off sales without prior agreement.

The empirical literature on Contract Farming (CF) has pointed out many of its lacunas: CF arrangements do not always include the poorest households, can only include a limited number of households, or may even increase relative poverty (Glover, 1987; Key & Runsten, 1999; Miyata, Minot, & Hu, 2009; Simmons, Winters, & Patrick, 2005).

These observations point to the fact that one of the main problems with contract farming is the ***self-section bias (SSB)*** of the incumbent firms (Bravo-Ureta and Pinheiro, 1997; Begum et al., 2012). Assuming that contracts are private in nature with an objective of profit maximization, the contracting firm is likely to choose the most efficient of the agricultural farms. Being efficient the owners of these farms are relatively less poor. Even in case of success of CF therefore these relatively less poor farmers get better off and wage inequality (relative poverty) in the rural sector rises. Also since a large proportion (or even the whole amount of) output produced by these contracting firms is exported, domestic supply of these goods falls leading to food insecurity and prices of agricultural goods rise increasing poverty for the non-participating poorer households.

A recent study controls for this '***Self-selection Bias (SSB)***' and finds a negative impact of CF on profits from production (see Ragasa (2018)). Bellemare and Bloem (2018) after carefully analysing the literature conclude that the euphoria on CF is not substantiated by evidence as the empirical evidence suffers from many limitations. In the presence of such self-selection bias CF land is expected to be more productive than non-CF land. This leads to the following conclusions: (a) farmers working in more productive CF farms are expected to earn more than others. CF, by increasing the yield of these farms further increase inequality in the rural areas of underdeveloped countries. (b) since input prices of

[5] https://www.future-agricultures.org/publications/working-papers-document/the-political-economy-of-agricultural-commercialisation-in-africa/

contracting farms are higher and at least a part (mostly the whole) of the produce is shipped abroad, the farmers in the non-contracting farms tend to become worse off in the post CF scenario due to higher prices of food grains and lower food security in the participating countries. The empirical literature has clearly pointed this out. Several studies have shown that CF leads to undesirable outcomes like increases relative poverty in many countries (see Glover, 1987, Key and Runsten, 1999, Miyata et al., 2009, Simmons et al., 2005), income inequality and concentration of wealth (see Bellemare and Bloem (2018).

One way of mitigating the negative effects of self-selection on the welfare of non-participating farmers is through '***Spillover Effect (SOE)***'. There is a large literature to show that spill over effects do occur and are often substantial (Minten (2006) for Madagascar, Klaus et al (2006) for Mozambique, and Bielik (2017) for Slovakia.[6] *Definitely, potential Spillover effect generated via CF is a kind of non-cash compensation*. Spill-over effects increase the efficiency of the non-participating farms increasing their marketable surplus. This increases the absolute income of the poorest farmers (Minten et al (2007)) and also tends to reduce the extent of price rise and mitigate food security due to CF. Theoretically, if spill-over effects are substantial then net welfare of the agricultural community as a whole can be improved due to CF. Relative poverty will however continue to increase as long as the spill-over effects do not overweigh the increase in efficiency of the participating firms which is an extremely unlikely outcome.

Given the above scenario the success of CF depends on its spill over effects. The extent of spill over can be modelled in many ways. Two likely candidates are: (1) technological spill over (2) spill overs depend on the extent of information asymmetry between the participating and non-participating farmers. In the former case the threshold level of spill over can be determined under which net welfare increases. The latter case assumes that CF imparts some technical knowledge to the participating framers that are unavailable to the non-participating farmers. The government can play an important role in designing a mechanism for guaranteeing the spill over of technical knowledge turning unskilled workers to skilled workers.

Also, adverse inter-sectoral effects cannot be ruled out as displacement from land, destruction of agriculture, battle over resources have bred conflicts, unrest, and sectoral displacements through forward and backward linkages. In the context of FDI in land purchases such resource allocation and resultant income distribution effects can be quite plausible as the FDI in land involves sectoral re-adjustment in terms of land-use. As emphasized by BM (2009, p.1): "These land acquisitions have the potential to inject

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[6] Martin (2015) http://portal.research.lu.se/ws/files/5824557/5218915.pdf

Bellemare and Bloem (2018) http://marcfbellemare.com/wordpress/wp-content/uploads/2018/05/BellemareBloemContractFarmingMay2018.pdf

Ragasa (2018) https://www.sciencedirect.com/science/article/pii/S0305750X17303005

Spillovers from high-value agriculture for exports on land use in developing countries: evidence from Madagascar. Bart Minten, Lalaina Randrianarison, Johan Swinnen https://doi.org/10.1111/j.1574-0862.2007.00273.x

Minot and Ronchi, 2015; Barrett et al., 2012 to be found in http://edepot.wur.nl/377875

Michelson 2013 to be found in Bellemare and Bloem (2018)

(Glover, 1987, Key and Runsten, 1999, Miyata et al., 2009, Simmons et al., 2005) to be found in https://www.sciencedirect.com/science/article/pii/S0305750X17303005#b0270

(Minten (2006) for Madagascar (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=881729),

Klaus et al (2006) for Mozambique, (https://openknowledge.worldbank.org/handle/10986/22886?show=full)

much needed investment into agriculture and rural areas in poor developing countries, but they also raise concerns about the impacts on poor local people, who risk losing access to and control over land on which they depend. It is crucial to ensure that these land deals, and the environment within which they take place, are *designed in ways* that will *reduce the threats and facilitate the opportunities* for all parties involved for a 'win-win' situation."

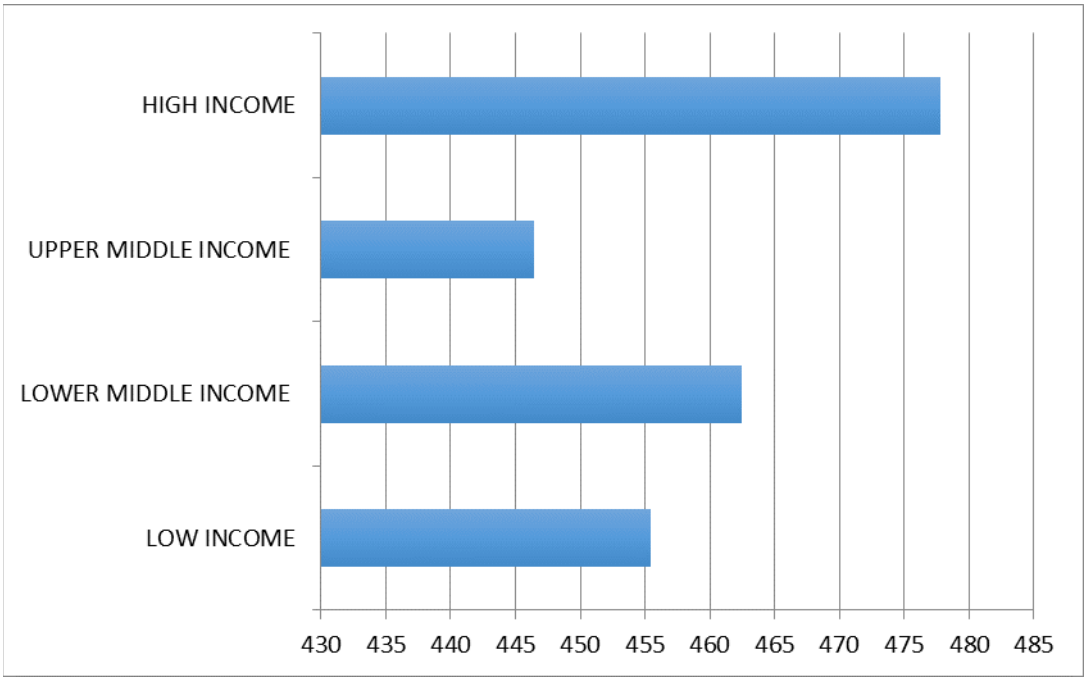
2.2 Stylized Facts (Meta-Analysis):

FDI in Agriculture and Food Security in Developing Countries

This section presents some of the main characteristics of FDI in agriculture and food security. Our main target is to analyze developing countries. The World Bank categorizes countries into four groups based on their income: High Income, Upper Middle Income, Lower Middle Income and Low Income. For this paper, all countries except the high income countries are categorized as developing countries. Since only those countries that have data on agricultural Foreign Direct Investment (FDI) are eligible to be considered here, we have a biased sample and the results reported here may not be generally true. All data used in this section are taken from the Food and Agricultural Organization (FAO of the United Nations.

Figures 1 and 2 presents the general picture regarding Foreign Direct Investment (FDI) in agriculture and Agricultural exports. Turns out that both these variables fall in the category of developmental indicators, in the sense that their values rise with the level of development of the country. While this conclusion is well known for exports, the conclusion with respect to FDI in agriculture is less documented. One major reason can be the level of institutional quality in developed countries is higher (see Sabir et al 2009). The other important reason can be data availability. FDI data in developed countries is much more documented than in developing countries. Hence the results in the table might be biased towards developed countries. Finally, many important items in the food basket of developed countries are possibly not cultivable in underdeveloped countries due to climatic reasons and soil requirements making FDI in these items infeasible in underdeveloped countries. This trend continues in the country wise agricultural FDI data for developing countries in table 1.

Figure 1: Foreign Direct Investment in Agriculture

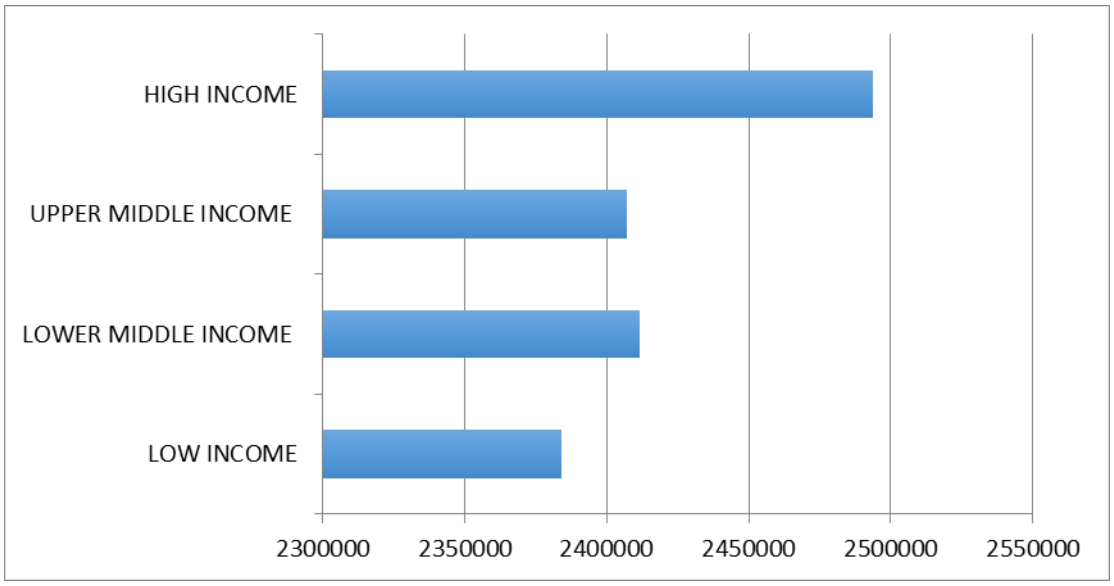


Source: Das et al. (2023).

FDI in the highest ranked lower middle income country (Indonesia) is more than six time that of the highest ranked low income country (Uganda). The fact about paucity of data mentioned above is clearly manifested in this table. It can be easily seen that the number of countries in the sample rapidly increases as we move towards more developed countries. In fact, data for a large number of low and lower middle income countries reported in the FAO website were unusable for this work as they had no FDI data.

There is a wide fluctuation in the mean value as well as the growth rate among countries within an income category (Table 1). The positive relationship between income levels and FDI in agriculture breaks down when we look at intra group data. When we arrange the data in terms of mean FDI, countries are more or less randomly dispersed in terms of income within every group. If we can assume that all the FDI data reported in Table 1 are for CF alone then it can be concluded from the table that CF has become popular only in a few developing countries. The number is especially small for low income and lower middle-income countries. In fact there are only 7 (seven) countries in the sample that had a foreign investment in CF beyond US $ 100 million. There are many countries in which total investments amounted to less than US $ 1million. A similar conclusion holds for the growth rates of FDI. There are only two countries with a growth rate greater than 10 per cent (Malawi and Cost Rica). In both cases the means values are fairly low so that the base base effect is one of the major reasons for the high growth rates.

Figure 2: Export of Agricultural Commodities



Source: Das et al. (2023).

The literature so far available provides evidence-based information. The general equilibrium framework is suitable to trace interplay between structural features of land-abundant economies.

3. Theoretical Underpinning of the Empirical Observations

Based on Das et al. (2023), we begin by **assuming a closed economy** with an agricultural and manufacturing sector. Host countries are land-abundant and scarce in investors, skills, and quality institutions. Unlike the dynamic Asian economies undergoing shifts in comparative advantage (*bimodal* in manufacturing and services), the exports are typically land-intensive and few labor- intensive goods are produced (exportable), while domestic capital-intensive manufacturing is an import-competing sector. They have vast cheaper land (V) some of which are under land deal and rest of it (V_d) is kept for traditional agriculture. Viable land deals under CF need to address the concomitant development of associated prerequisites for improving productivity of low-value land.

In the contract farming (CF), vertical linkages are key feature (Minot 2007, Sarkar 2014). However, both modes affect small farmers and hence, the factor market directly or indirectly via interconnectedness. As there are empirical evidence on adverse consequences of 'Land Acquisition' on land owners and/or, farmers, it is pertinent to analyze under what forms of land deals for 'contractual farming' such adversaries could be avoided, or, minimized. It requires understanding of repercussions across sectors and factor markets. *Without 'spillover effects'*, such benefits are conditional or more stringent.

A variant stylized model, based on Jones (1965, 1971), is developed to closely resemble the phenomenon of land deal and its consequences. In our model, T_o, T_d, and S are *not* mobile whereas K, U are mobile across A, X, and M sectors. Literatures have been inundated with models based on Heckscher-Ohlin and its derivatives to explore the trade and wage inequality debate (see for example, Jones, 2000; Marjit and Acharyya, 2003; Anwar (2006, 2009), Das (2009) Weiss (2008), Beladi et al. (2006) Feenstra and Hanson, 2003; Feenstra 2004; amongst others). However, we start with an intuitive stylized ***Benchmark Model*** below.

3.1 Benchmark Model of Pre-Contract Farming:

Following notations are used to describe the model structure:

P_j: exogenously given prices for j[th] final output, $\forall j \in \{X_M, X_A, X_F\}$ where,

X_M: Import-competing manufacturing sector.

X_A: Agricultural sector

X_F: Contract Farming sector

w: labor's wage

r: Return to capital (generic)

r_M: Return to capital in manufacturing

r_A: Return to capital in farm sector

V: land (in general) in broader terms of agriculture sector.

V_F: Land under CF (i.e., acquisition of land under deal irrespective of modes of acquirement)

V_A: Land preserved via customary rights for locals and used in domestic agricultural sector, $\lambda_{ij} = a_{ij}Y_j / f_j$ or land with inferior quality used for peripheral activities like cattle-raising, primary products, forestry, etc.

R: return to V (generic land types)

R_F: return to land under CF (V_F)

R_A: return to V_A.

a_{ij} = i[th] input required to produce 1 unit of j[th] final good, i =K, L, V;

$\theta_{ij} = wa_{lj} / P_j$ is the distributive share of l^{th} labor-types in $j \in \{ X_M, X_A, X_F \}$, $\forall l$;

$\theta_{kj} = r_{kj}a_{kj} / P_j$ is the distributive share of owner of specific capital types K for j =A, M;

$\theta_{vj} = R_j a_{vj} / P_j$ is the distributive share of owner of V[th] specific land for $j \in \{A,F\}, \forall v \in \{V_F, V_A\}$;

$\lambda_{ij} = a_{ij}Y_j / f_j$ is j[th] commodity's input share in i[th] factor's endowment, where Y is generic output and f is generic endowment;

"$\wedge$" = proportional changes for a variable, *say x*, such that generically $\hat{x} = \frac{dx}{x}$

Consider a simple 2-sectors× 3-factors framework with capital specific to the farm (broader definition inclusive of agriculture, A) and manufacturing sector (M) and homogenous labour--the common mobile factor-- across 2 sectors. Here, we *do not* explicitly introduce agriculture subject to contract farming. Thus, a pertinent structure could be formulated as below (or, a variant):

$$X_M = X_M(L, K_M); X_A = X_A(L, K_A).$$

However, the basic structure could be extended or modified as necessary, and accordingly notations will be altered. We assume perfect competition in product and factor markets. Mobility of labor ensures a uniform low-wage (w) across Manufacturing (M) and Agriculture (A). On the contrary, immobility of specific capital types causes returns to vary across A and M. Production functions represented above are assumed to exhibit linear homogeneity and diminishing returns to respective inputs.

Full employment of resources ensures:

$$a_{LA}X_A + a_{LM}X_M = \overline{L} \quad (1a)$$
$$a_{KA}X_A = \overline{K_A} \quad (1b)$$
$$a_{KM}X_M = \overline{K_M} \quad (1c)$$

Competitive equilibrium implies that:

$$a_{LA}w + a_{KA}r_A = P_A \quad (1d)$$
$$a_{LM}w + a_{KM}r_M = P_M \quad (1e)$$

$$a_{ij} = a_{ij}(w, r_A, r_M), \forall L, K; j = X_M, X_A \quad (1f)$$

We have 5 equations, 5 variables (3 factor prices and 2 outputs); we solve for w, r_A, r_M and outputs for M, and A. Given exogenous r_p and P_j ($\forall$j), we solve for w and r's and using full-employment conditions, we can solve to get outputs.

Let r_p>0: without perfect mobility, rent-differentials or, premium per unit of land leased out for CF, creating a wedge between R_F and R_A. Under chronic food shortage, malnourishment, and potential famine the poor host country is more than willing to offer a reasonably higher premium directly or in alternative forms. A reasonably high premium raises the post-concession returns to V.[7] Following discussion above, assuming V_A and V_F as imperfect substitute non-homogeneous land types, in case of explicit CF-model (on which more to follow later) we can invoke:

$R_F = r_p + R_A$ or, $R_F = r_p R_A$, r_p>1, where r_p >0. [8] (1g)

Also, from (1g), $\widehat{R_F} = \widehat{r_p} + \widehat{R_A}$ with $\widehat{r_p} \geq 0$. (1g')

Suppose capital specific to the farm sector expands (due to FDI or foreign capital (K_F), as malleable as domestic one so that ***in the long run*** $K_F \equiv K_A$) then labor's return will increase as MPL rises - a distinct benefit to the LDCs. With rise in wages, technology in both sectors become more capital intensive as the manufacturing sector substitutes capital for labor. With a rise in capital intensity of the manufacturing sector the country becomes more sophisticated in terms of the manufacturing goods it produces - another benefit to the LDC. Thus, if switching of capital intensity happens in both the sectors, foreign capital flow in farm(agriculture) is beneficial.
Using (1g and 1g'), we can invoke in this context that under FDI in farm sector,

$$\widehat{r_A} = \widehat{r_p} + \widehat{r_M} \quad \text{with } \widehat{r_p} \geq 0. \quad (ih)$$

[7] If the premium is sufficiently higher than premium to other locations, then incentive to outsource more might lead acquirers to invest in barren fallow land *to convert*.
[8] Agricultural investment in such economies is highly risky, especially, with backward agriculture and lack of green revolution technologies. We consider perceived 'ex ante' risk and r_p compensates for that. Under alternative specification, we get the 'hat' changes (see later). But, here we make approximate changes without undermining the purpose.

We consider comparative statics parametric changes to focus on ensuing policy changes. For enumerating proportional changes for the equation system (1) to (4), employing envelope theorem (Jones 1965), we derive the factor-return shares—θ_{ij} --to obtain 'Equations of Change':

$$\theta_{LA}\widehat{w} + \theta_{KA}\widehat{r_A} = \widehat{P_A} \qquad (2a)$$

$$\theta_{LM}\widehat{w} + \theta_{KM}\widehat{r_M} = \widehat{P_M} \qquad (2b)$$

Consider a situation where land is immobile, land-intensive goods can then be produced by exporting capital or labor (or both) to land-abundant country (like India or China), which can then be imported. For example, developed countries like EU or USA might export "K" to use 'Land' in Africa, India, or China. China exports both labor and capital to Africa, though. The question that arises is the distribution of gains from such trade between countries and among people within these host nations.[9]

Lemma 1: *A ceteris paribus* relative price changes be such that world price of agricultural exports increase where $\hat{P}_A > \hat{P}_M = 0$. Thus, from (1) and (2) systems of equations, using Cramer's Rule, we can derive:

$$\hat{r}_A = \frac{\hat{P}_A - \theta_{LA}\hat{w}}{\theta_{KA}} > 0 \Rightarrow \hat{r}_A > \hat{P}_A > \hat{w} > 0 > \hat{r}_M$$

The return to FDI in agriculture (farm) sector increases benefitting unambiguously them more while wage increases temporarily in short to medium run, not much though, thanks to reverse migration to farm sector from contracting manufacturing sector suffering from capital flow.

Also, $\hat{X}_A > 0, \hat{X}_M < 0$. <u>*Relative poverty increases*</u> here as real wage in terms of farm sector falls (welfare loss with decline in real wage income); but we could envisage that returns to contract farmers could rise benefiting from such augmentation of capital.

This model is a stylized one to show that FDI sans contract farming causes premium to increase resulting in rise in return to farm with FDI. However, like Das (2013) it could have pauperizing effects in the absence of responsible investment in technology adoption, skill (human capital), lack of food-and-nutritional security. It is indicative of the fact that agribusiness or agrifood supply chain can be beneficial (welfare improving) in the presence of FDI (see Chaudhuri and Banerjee 2010, Chaudhuri and Yabuuchi 2010). *In other words, if these opens up vistas for spillover effects under contract farming could be beneficial.*

This result also *generalizes to the realistic case* where both <u>*labour and capital are mobile*</u>, as in the above H-O-V case, but there is an <u>*additional factor land*</u> <u>*specific to the agricultural sector*</u>. This is variant of the above 2-sectors× 3-factors specific factor model. Continuing to assume that agriculture is relatively more intensive in labour relative to capital than the manufacturing sector and land is specific to agriculture, if the price of the agricultural good rises with no rise in the price of the manufacturing good then labour as well as landowners gain in terms of both goods. Here, as written below we get 3 full-employment conditions: -

$$a_{LA}X_A + a_{LM}X_M = L$$

$$a_{KA}X_A + a_{KM}X_M = K$$

$$a_{VA}X_A = V$$

and 2 price formation equations: -

[9] Export of 'K' and 'L' to land-abundant country (Newly emerging countries or Southern Engines of Growth).

$$P_A = a_{LA}.w + a_{KA}.r + a_{VA}.R$$
$$P_M = a_{LM}.w + a_{KM}.r$$

Determine endogenously 5 variables: returns to 3–factors (r, w, and R) and output levels of 'A' and 'M'.

To make things simple we consider a small open economy so that prices can be considered as exogenous. With the full employment conditions and zero profit conditions being identical to the closed economy model and prices exogenous the above results continue to hold:

$$\hat{R} > \hat{w} > \widehat{P_A} > \widehat{P_M} = 0 > \hat{r} \qquad (1')$$

Also production of the agricultural sector increase at the cost of the manufacturing sector:

$$\widehat{X_A} > 0 \; and \; \widehat{X_M} < 0 \qquad (2')$$

Next, relaxing the assumption of no international investments (FDI), capital can flow into "A" from three sources:

(a) exclusively domestic (capital moving from manufacturing to industry) and
(b) exclusively foreign (FDI in agriculture)
(c) a mix of both.

Since our intention is to look at the effects of CF (a) is ruled out. (b) implies that new farms are all foreign – an absurd assumption to make as there is equal incentive for domestic capital to move to the agricultural sector from the manufacturing sector. We therefore proceed with assumption (c) where new firms can both be domestic and foreign entering into 'Farm'. FDI in land (K_f) comes via high-yielding seeds, fertilizers, biotechnology, know-how, irrigation technology, extension program in agriculture—to name few.[10] Then, $a_{KA}X_A + a_{KfA}X_A = K_A + K_f$

FDI in agriculture coupled with an exogenous rise in price of agricultural goods lead to an increase in the capital stock of the country and a Rybczynski effect follows leading to an increase in the agricultural output at the cost of manufacturing sector *along with* the normal Stolper Samuelson effect in Equation (1'). *The net result will be that both (1') and (2') will be magnified* (graphically, the value of marginal product of labour curve for agriculture now shifts up due to two reasons: *firstly*, increase in price and *second*, inflow of capital in this sector). As MP of labor and MP of land increases due to influx of FDI, that will translate into rise in real wage (income) of labor as well as for land under the beneficial spell of FDI.[11]

Comparing the two situations in (1') and (2') we see that FDI in agriculture is unambiguously better for farmers and landowners (and worse for capitalists) in underdeveloped countries as the Rybczynski effect magnifies the Stolper-Samuelson effect that would occur if exogenous prices of agricultural goods had increased with capital stock in the country remaining the same[12]

[10] Under small open economy assumption, return to foreign capital is exogenous (given in the world market).

[11] Also, with immobile land, two kinds of specific capital, and perfectly mobile labour - four factors and two goods—we can get a sophisticated benchmark model (2-sectors×4-factors) where pre- and post-CF or FDI impacts can be traced. It can be solved as there will be four full employment conditions for 4 factors and two price formation for two goods equations solving for 6 variables: w, 2 returns to specific capital types, R(return of land) and outputs X_A and X_M.) As these yield same intuitive results, we set this aside.

[12] Note the result is qualitatively independent of the assumption of specificity of land to agriculture, without that assumption both land and labour would shift from manufacturing to agriculture confirming the expansion of the agricultural sector and the shrinkage of the manufacturing sector

However, the simplistic scenario assumed above is far from the actual reality in underdeveloped countries. The empirical literature on CF (as we will call the foreign entrants) suggests three basic differences: first the foreign entrants come in with their own 'technology' that is superior to the technology of the domestic farms (scope of *spill over effects—SOE*). Secondly, they often choose better lands in terms of fertility and irrigation facilities for setting up their ventures. Third, they produce goods with a superior 'quality' in the sense that their goods are more compliant to the sanitary standards of developed countries than traditional agricultural goods. The second point is referred to as ***the self-selection bias (SSB)*** *in CF*. For the moment let us assume away this possibility. However, we allow for different 'technology' in the CF and traditional agricultural sectors in the country (the first aspect mentioned above). One way of formalizing this is to assume that the physical capital required for CF is qualitatively different from domestic capital. There is ample evidence in the literature to confirm this. This necessitates adopting a different model variant of the above—with specific capital types.

3.2 A framework for Contract Farming Models and Insights

We consider 3 sectors. The agricultural sector is split into two sectors. One uses contract farming and FDI. The other traditional agriculture. There is also a manufacturing sector. The story is as follows: the agricultural sector that uses contract farming gets their seeds and fertilizers and also the knowhow of how to produce the crop from the foreign source. So their technology is better. Second the foreign source promises to buy the crop at a predetermined price so that the profit is this sector is certain. However, there may be certain problems associated with contract farming as well. Let us assume that since contract farming is remunerative to the foreign suppliers of inputs therefore more and more farms come under contract farming. On the other hand, for the non-contracting agriculture sector technology is lower and there is price uncertainty of the crop after it is produced so that profit here comes with a probability. Due to the combined effect of better technology and certain returns the contract farming sector is expected to earn a higher return than the non-contract farming sector (non-CF). The other point is that since the contract firm owners get a fixed price, if market prices are greater than that price then they get less so that in bad harvest/high price years the return of the contract farmers are less than non-contract farmers.

The model then becomes a 3×5 one—with three good (traditional agriculture (A), CF agriculture (F) and manufacturing (M)) and five factor (capital in the three sectors with specific returns (r_A, r_F, r_M), mobile labour (with wage 'w') and immobile land (with return 'R') model. Finally, with CF goods assumed to be of better quality than traditional agricultural goods they can be treated as separate goods altogether. To focus exclusively on the effect of the CF sector, in what follows we assume that *all* subsequent price rise after the initial one that results in the influx of FDI in agriculture pertain only to the CF sector (say, due to rise in exogenous food demand in developed countries) and prices of traditional agricultural produce remain unaffected.

With the change in model structure post price rise of CF agricultural goods, simple comparisons of factor return done above become impossible as a single agricultural price is *now replaced by two different agricultural prices and different rates of return to capital appears in the economy*. Assuming CF to be more labour intensive than manufacturing but less labour intensive than traditional agriculture (unit labour requirements is smaller in CF than traditional agriculture) and only the price of the CF good rises. Then (1') and (2') changes here to:

$$\hat{r_F} > \widehat{P_F} > \hat{w} > \widehat{P_M} = \widehat{P_A} = 0 > \hat{R} > \hat{r_A} > \widehat{r_M} \qquad (1'')$$

$$\widehat{X_F} > 0, \widehat{X_A} < 0, \widehat{X_M} < 0, \widehat{X_A} + \widehat{X_F} > 0 \qquad (2'')$$

In terms of equation (1") real wage falls in terms of the CF output but increases in terms of the traditional agricultural output so that farmers' household income increase but entitlement in terms of the good produced by the CF sector falls. In terms of equation (2''), agricultural output in the traditional sector falls, but output in the CF sector as well as combined output of agriculture rises. *So food deficit apparently declines.*

However, that is not the case as the entire amount of CF output is exported. Hence food deficit rises and the resultant excess demand in food leads to increase in the price of food. This is clearly the case following Das et al. (2023), where we have noted that (i) food deficit has intensified (ii) food inflation has been positive and often severe and (ii) net export of food has been on the rise in the poorest countries of the world where FDI in agriculture has been rampant[13]. Thus, the increase in wage due to FDI in agriculture comes with a caveat: *real wage falls in terms of the CF output. Thus, household income increase but entitlement in terms of the good produced by the CF sector falls.*

To focus once more exclusively on the CF sector, we assume that this price rise once more has its source in DCs and hence, only the price of the good produced by the CF sector increase. Is it possible for workers to gain in this situation? To make wage rise in (3) to be greater than the rise with the no FDI case, we need relative increase in wage (value of marginal product) to be more in (3) than in (1) for the same relative increase in P_F. This requires some structure on the technology prevalent in the traditional agricultural sector as well as the manufacturing sector. In particular, if technology is such that the marginal productivity of labour is convex to the origin for these industries, then the wage increase with FDI is guaranteed. Assuming lower labour coefficients for the CF sector in the presence of FDI (henceforth simply denoted by CF as we continue to assume this for the rest of the analysis), the marginal productivity curve for CF is higher than non-CF and price rise is constant in both cases. **Figure 1 demonstrates the case for a two good specific factor framework with labour as the mobile factor**.

Thus in addition to a fall in real wage relative to CF output, FDI in agriculture together with the greater acceptability of the output from this sector in developed countries makes a gain in returns to labour *conditional* for any rise in international price of the agricultural good. In the H-O framework considered here technology is of course a function of the factor returns and it is impossible to assume difference of the unit factor requirements *unless we assume factors returns (and hence factors) that are specific to the CF sector. Specificity in any one can potentially generate the desired difference in technologies of CF and non-CF sectors.*

3.3 Self-Selection Bias

The self-selection bias (**SSB**) occurs predominantly due to the fact that *efficient firms self-select* into CF by setting contract with the' rich' farmers owning fertile land, while the infertile land is owned by the 'relatively poor' households. So, returns to two types of lands (non-homogeneous) should be different, and thus, distinguishes between poor vis-à-vis non-poor farmers/households (here we consider only

[13] Note that the positive second order effect of this food inflation on output of traditional agriculture will be dominated by the negative first order effect in (1'') due to the stability of the equilibrium condition.

farming households without considering other households, who are non-agriculturalists. Obviously, productivity of CF farms is expected to be higher. Self-selection is at work because with CF, fertile land-owners self-selects into contract farming with the 'firms'. We will offer a model to show the importance of investments for sustained growth in host country so as to generate spillover effects outweighing the adverse effects to non-CF farmers experiencing negative impacts due to self-selection bias.

To model it, consider the case of self-section bias in the choice of land. Specifically we assume that CF occurs only in those land that are more productive than the non-CF sector. To block the channel of distortions caused by specificity of capital we can make ***three assumptions***:

(a) capital used in agriculture is fully mobile across both types of agriculture but *capital used in manufacturing is different (immobile)*

(b) *capital is mobile* across all sectors

(c) *capital is specific* only to the manufacturing sector (this, of course, eliminates the possibility of free entry of domestic farms into the CF sector (empirical….). Note that these assumptions have *no effect* on the relative return to labour though the relative return to capital changes in each of these situations.

Given this observation we choose (c) as it is the simplest alternative. Consider then a situation where there are three factors: Land, labour and capital. Labour is fully mobile across 3-sectors. Capital is specific to manufacturing. Land is not only specific to agriculture but also to the two types of agricultural practices in the economy, viz., CF and non-CF. Further, in order to model the higher productivity of land in the CF sector compared to the non-CF sector, we *assume* that the non-CF sector is more land intensive than the CF sector. Consider 3 sectors (as before), but we introduce land with heterogeneous quality (following notations, V_F and V_A are imperfect substitutes in use). Thus, we have 4 factors and the altered structure becomes[14]:

$$CF: X_F = X_F(V_F, L)$$
$$Non-CF: X_A = X_A(V_A, L)$$
$$MFG: X_M = X_M(K_M, L)$$

Full-employment conditions are:

$$a_{LF}X_F + a_{LM}X_M + a_{LA}X_A = L \quad (1)$$
$$a_{KM}X_M = K_M \quad (2)$$
$$a_{VF}X_F = V_F \quad (3)$$
$$a_{VA}X_A = V_A \quad (4)$$

Presumably, 'SSB' implies that MP of $V_F = R_F >$ MP of $V_A = R_A$. Competitive equilibrium and P = AC means:

$$a_{LF}.w + a_{VF}.R_F = P_F \quad (5)$$
$$a_{LM}.w + a_{KM}.r = P_M \quad (6)$$
$$a_{LA}.w + a_{VA}.R_A = P_A \quad (7)$$

[14] We do not, unlike benchmark model, include K_F in CF sector as that does not impart additional intuitions for SSB and SOE effects. We do not model contract negotiation here. Dealing with establishing, designing, and implementing contract is beyond the scope of this paper.

As before, we can solve for 7 variables, viz., X_M, X_A, X_F and w, r, R_F, and R_A, from 7 equations.

Also, $\lambda V = a_{VF}.X_F = V_F; (1-\lambda)V = a_{VA}.X_A = V_A,$ where $0 < \lambda < 1$ (8)

We use Eq. (8) to get allocation of land (V) across two uses, i.e., CF and non-CF traditional agriculture. Also, as mentioned in the benchmark case, we can envisage $R_F = R_A + r_P$, or, $R_F = R_A.r_P (r_P > 1)$. The premium is due to higher MP of land under CF. We also use it for propositions related to food (in-) security via effects n $\hat{X}_A, \hat{X}_F$.

Assume that 'Farm' sector (X_F) has better technology due to CF arrangement and hence, reaps better productivity benefits via access to better technology so that unit labor requirements (ULR) falls. This implies: $a_{LF} < a_{LA}$ and $a_{VF} < a_{VA}$. These are important for spillover mechanism, on which more to follow in subsequent analysis.

3.4 Equations of Change and Results:

For comparative statics, we harp on: (i) food (in-)security effects and relative poverty; (ii) spillover transmission effects thanks to foreign investment; (iii) relative strengths of two counteracting effects as it matters for inequality to returns to factors, and welfare. How much of land (i.e., what percentage of "V") should be contracted out for CF vis-à-vis conventional agricultural practices will determine the extent of relative strengths.

Now using envelope theorem and Jones (1965 & 1971), we derive as before cost-shares (θ_{ij}):

$$\theta_{LF}\hat{w} + \theta_{VF}\hat{R}_F = \hat{P}_F \quad (9)$$

$$\theta_{LM}\hat{w} + \theta_{KM}\hat{r} = \hat{P}_M \quad (10)$$

$$\theta_{LA}\hat{w} + \theta_{VA}\hat{R}_A = \hat{P}_A \quad (11)$$

In terms of shares, $\theta_{LF} + \theta_{VF} = 1$, $\theta_{LA} + \theta_{VA} = 1$.

Proposition 1: *A one-shot increase in world prices of P_F leads to contraction of import-competing manufacturing sector (X_M) and non-traded traditional agriculture sectors (X_A) causing loss in real wage-income.*[15]

Proof: Considering this system of equations in previous sub-sections, set

Case 1: $\hat{P}_F > 0, \hat{P}_M = \hat{P}_A = 0,$ to get:

$$\hat{R}_F = \frac{\hat{P}_F - \theta_{LF}.\hat{w}}{\theta_{VF}} > 0 \quad (12)$$

Following Jones (1971), $\hat{R} > \hat{P}_F > \hat{w} \geq 0 \Rightarrow (\frac{\hat{w}}{P_F}) < 0$, $\hat{R}_A < 0$, $\hat{X}_F > 0, \hat{X}_A < 0, \hat{X}_M < 0$, which means rise in relative poverty as rich farm-owner benefits at the detriment of non-rich farmers, and real wage in terms of farm food declines. As $\hat{R}_F > 0 \Rightarrow \hat{P}_F > \theta_{LF}.\hat{w},$ where $\theta_{LF} < 1$ and $\theta_{LF} + \theta_{VF} = 1$, definitely, $\hat{w} < \hat{P}_F$.

[15] Of course, relative budget shares of these outputs will determine the extent of net welfare impacts. In this case, household income and wealth effects and Engel aggregation conditions need to be satisfied. This is beyond the scope of the current emphasis of the paper; but surely, the fall in real income is critical to note.

Case 2: With $\hat{P}_M > 0$, relative poverty aggravates, deepening welfare loss. Here, $\hat{P}_F > \hat{P}_M > \hat{P}_A = 0,$ so that $\hat{P}_F = n.\hat{P}_M, n > 1$. Then, $\hat{R}_F > \hat{P}_F > \hat{w}, \hat{r} > \hat{P}_M > \hat{w} \geq 0 > \hat{R}_A$. In this case, we can easily infer that: $\hat{R}_F > \hat{R}_A, (\widehat{\frac{w}{P_F}}) < 0, \widehat{\left(\frac{R_A}{P_F}\right)} < 0, \widehat{\left(\frac{R_A}{P_M}\right)} < 0$. These scenarios resemble 'Dutch disease' type impacts when resource movements and spending or income effects for a booming sector causes ripple effects in the economy (Corden and Neary 1982).

Corollary 1: Thus, if R_F and R_A are the returns to land in the CF and the non-CF sectors respectively, then the magnification effects of an increase in the price of the CF sector is:

$$\widehat{R_F} > \widehat{P_F} > \hat{w} > \widehat{P_M} = \widehat{P_A} = 0 > \widehat{R_A} > \hat{r} \quad (12a)$$

$$\widehat{X_F} > 0, \widehat{X_A} < 0, \widehat{X_M} < 0, \widehat{X_A} + \widehat{X_F} > 0 \quad (12b)$$

Clearly thus, there is no change in the condition of workers but as expected, now ownership of land becomes an issue. Since land that would subsequently be chosen by FDI were already more productive, the return for these land owners were higher prior to the arrival of CF (this obvious result is not modelled here). With the arrival of FDI in agriculture, creation of dualism within the agricultural sector and rise in international price of only goods produced by these farms, inequality between the owners of productive and unproductive land increases. It is obvious from (12a) that the *opposite would happen if CF goes to the unproductive rather than productive land as rate of return of the unproductive land would increase* with the rise in international price of the CF farms. Government policy should clearly incentivise FDI so that it flows to the less productive farmlands.

Proposition 2: *Contract farming is beneficial provided output is absorbed domestically, not exported (at least wholly). If output is totally exported, then it is harmful because of (i) high food insecurity effect as domestic price of agricultural goods rise; (ii) high poverty impact; (iii) real wage declines and inequality aggravates further with food deficit. Controlling export for food and nutritional security (FNES, FAO 2015) could mitigate the adverse impact. Due to chronic food crisis and shortage, government's national trade policy restricts export of X_F; thus, the condition might be imposed to allow exporting a high fraction ($0 \leq \alpha \leq 1$) contingent on domestic demand.*[16]

Proof: In this context, we could consider the imposition of a *"punitive" tax* (t) — proportionally increasing with higher share of agricultural export sent back to source, i.e., as α goes up.[17] In this short-

[16] In fact, IFPRI (2009, p.4) and some international bodies like African union has initiated a process of setting a 'code of conduct' for enacting a '*good practice*' for such land deals, called 'Adherence to National Trade Policies'. World Bank (7th September, 2010) also mentions 'Seven Guiding Principles' for '*Responsible Agricultural Investment (RAI)'* in the same vein. This includes allegiance to domestic policies for meeting host's food demand to prevent hunger and malnutrition. IFPRI report by Fan (2010), in the wake of 2010 food inflation, warns against export bans by the net food exporters like Russia and calls for setting 'new international working group' and 'new institutional arrangements' for preventing practices such as 'export bans', 'panic purchases', and 'speculation'.

[17] Export Tax is quite common esp. in developing nations like Pakistan, Indonesia to support domestic interest in times of crisis. The idea is to manipulate final consumption (or, even intermediate consumption in case of processing industry for intermediates) price to guarantee food security. 'α' could be fixed via *ex ante* negotiations between the host and the contractor. It could be determined endogenously by investor's and host country's government's bargaining power in the world market, which often

run model, 'α'is exogenously (*and uniquely*) specified percentage of output of 'X_F', determined by '*ex ante*' negotiations.

Let $t = t(\alpha) = t_0\alpha$, $t' > 0$ and $0 \leq t_0 \leq 1$ are some constant tariff rates. 't' goes up as 'α' increases. In this case, incorporating this alters (9) to become:

$$\theta_{LF}\hat{w} + \theta_{VF}\hat{R}_F = \widehat{P_F(1-t)} \qquad (13)$$

Simplifying, $\theta_{LF}\widehat{w} + \theta_{VF}\widehat{R_F} = \widehat{P_F} - \mu\hat{t}$ where $\hat{t} = t_o\widehat{\alpha}$, and $\mu = t/(1-t) > 0$ (14)

The purpose is to create a wedge between export price in the world market and the domestic price in the host by lowering the latter (for instance, see Piermartini 2004). Thus, the purpose would be to reorient supply *towards* domestic market by lowering local final consumption price. This is "**food security effect**" by creating *substitution effects towards domestic consumption*. Bouet and Debucquet (June 2010, IFPRI) has considered the impacts of export taxation and 'export bans' in the context of food crisis using an applied PE/GE framework, unlike ours value-addition. It is also a *source of public receipts for the government* for use in financing domestic resource mobilization such as education, skill, investment in public assets, etc. It can also have an *anti-land-seeking* effect because as producer price falls, it might create disincentives for production of agricultural good via CF.

Using (3) and (4), $\hat{X}_F - \hat{X}_A = \hat{a}_{VA} - \hat{a}_{VF}$ (15)

Also, using Jones (1965), $\hat{X}_F = -\hat{a}_{VF} = -\theta_{LF}\sigma_F(\hat{w} - \hat{R}_F)$, $\hat{X}_A = -\hat{a}_{VA} = -\theta_{LA}\sigma_A(\hat{w} - \hat{R}_A)$ (16)

Now, from above, $\hat{a}_{VA} = \theta_{LA}\gamma_{LA}(\hat{w} - \hat{P}_A)$, and $\hat{a}_{VF} = \theta_{LF}\gamma_{LF}(\hat{w} - \hat{P}_F)$ (17)

Therefore, $\hat{X}_F - \hat{X}_A = (\hat{R}_F - \hat{w})[\theta_{LA}\sigma_A - \theta_{LF}\sigma_F] + \hat{r}_p\theta_{LA}\sigma_A$ (18)

From (18), we can infer that as $\hat{R}_F > \hat{w}$ & $\theta_{LA} > \theta_{LF}$ (i.e., higher labor share in infertile non-CF land), even with $\theta_{LA}\sigma_A = \theta_{LF}\sigma_F$, $\hat{X}_F - \hat{X}_A = \hat{r}_p\theta_{LA}\sigma_A > 0$.

Thus, any land premium or, risk premium will cause X_F to expand more than X_A ($\hat{X}_F > \hat{X}_A$), as it inflates the return to fertile land and CF. But it might further worsen the benefits of CF at the detriment of welfare. That brings us to next proposition.

Proposition 3: *A ceteris paribus increase in the premium offer ($\hat{r}_P \geq 0$) given to contracting firm so as to engage in contract farming will further lead to self-selection bias causing X_F to expand at the cost of other non-CF sectors. With $\hat{P}_F > 0$, it reinstates more contract farming, causing non-CF farmers to suffer due to loss in real income.*

Here, $\hat{R}_F = \hat{R}_A + \hat{r}_P$, $(\hat{r}_P \geq 0)$. (18a)

Proof: From Jones (1965) and Krugman and Obstfeld (2006),

$\hat{r} - \widehat{w} = 1/\theta_{KM}(\widehat{P_M} - \widehat{w})$, $\widehat{R_A} - \widehat{w} = 1/\theta_{VA}(\widehat{P_A} - \widehat{w})$, $\widehat{R_F} - \widehat{w} = 1/\theta_{VF}(\widehat{P_F} - \widehat{w})$ (19)

Also,

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depends on political economic decision-making process. Even it might be endogenously determined via domestic consumers' demand in host country. In this paper, we opt for the former 'exogenous' specification.

$$\theta_{LF}\,\widehat{w} + \theta_{VF}\,(\widehat{r_p} + \widehat{R_A}) = \widehat{P_F} \qquad (20)$$

$$\theta_{LA}\,\widehat{w} + \theta_{VA}\,\widehat{R_A} = \widehat{P_A} = 0 \qquad (21)$$

$$\theta_{LM}\,\widehat{w} + \theta_{KM}\,\hat{r} = \widehat{P_M} = 0 \qquad (22)$$

Applying Cramer's rule for (20) and (21), we obtain:

$$\begin{pmatrix} \theta_{LF} & \theta_{VF} \\ \theta_{LA} & \theta_{VA} \end{pmatrix} \begin{pmatrix} \widehat{w} \\ \widehat{R_A} \end{pmatrix} = \begin{pmatrix} \widehat{P_F} - \theta_{VF}\,\widehat{r_p} \\ 0 \end{pmatrix} \qquad (22a)$$

Under CF (assumption), $\theta_{LF} < \theta_{LA}$ and $\theta_{VF} > \theta_{VA}$. Using the share relations (see in previous section), we can infer θ_{LF} -- $\theta_{LA} = \theta_{VA}$ -- θ_{VF} so that $|\theta| = \theta_{LF}\theta_{VA} - \theta_{LA}\theta_{VF} = \theta_{VA} - \theta_{VF} = \theta_{LF} - \theta_{LA} < 0$

Solving for $\widehat{w}$ and $\widehat{R_A}$, we find:

$$\widehat{w} = \frac{(\widehat{P_F} - \theta_{VF}\,\widehat{r_p})\theta_{VA}}{|\theta|} < 0, \text{ where } |\theta| = \theta_{LF}\theta_{VA} - \theta_{LA}\theta_{VF} = \theta_{VA} - \theta_{VF} = \theta_{LF} - \theta_{LA} < 0 \qquad (23)$$

And $$\widehat{R_A} = \frac{-(\widehat{P_F} - \theta_{VF}\,\widehat{r_p})\theta_{LA}}{|\theta|} > 0 \qquad (24)$$

As $\hat{R}_F > \hat{P}_F > \hat{R}_A > \hat{P}_M = \hat{P}_A = 0 > \hat{w}$

Corollary 2: The most alarming situation, as far as developmental issues of underdeveloped countries are concerned, arises when <u>*we assume farm labourers to be specific to CF and non-CF sectors*</u> (hence, with *different wages, say, w_F & w_A* respectively). Unlike the other assumptions made above that have at least some empirical support, this assumption is a little more difficult to motivate. The simplest assumption that comes to mind is the case where <u>*farms are self-cultivated*</u>. However, this assumption does not do the job. Note that the logic that drives (12a) is as follows: as price of CF sector rises, there is entry in the CF sector and labour moves from the non-CF and manufacturing sectors to the CF sector. *With self-cultivated lands this mobility <u>cannot</u> occur* and the CF and non-CF sectors become virtually independent.

In this scenario, the only way to ensure that the transmission mechanism of a price rise in the CF sector occurs through the non-CF sector is to assume that land (or capital) now is mobile across these sectors (i.e., only one return, *R*, to mobile land). In these cases, a simple extension of (12a) and (12b) implies that workers in CF land are better off for any exogenous price rise of the CF sector and workers in non-CF land *are worse off in terms of all goods*.

Thus, if land is mobile and capital is specific to manufacturing (3-sector×4-factor variant), then:

$$\widehat{w_F} > \widehat{P_F} > \hat{R} > \widehat{P_M} = \widehat{P_A} = 0 > \widehat{w_A} > \hat{r} \qquad (12c)$$

$$\widehat{X_F} > 0, \widehat{X_A} < 0, \widehat{X_M} < 0, \widehat{X_A} + \widehat{X_F} > 0 \qquad (12d)$$

Thus FDI in agriculture not only increases inequality in the rural sector, it actually leads to impoverishment of a class of agricultural workers who are excluded from the CF process (immiserizing growth for them). ***How can this affect be reversed, if at all?*** As mentioned in the context of benchmark

model and its variants, spillover effects are important for countering these adverse impacts, on which more in the next Proposition.

3.3 Modeling Spillover Effects

Here we consider the case that productivity of labor in the CF sector transmits to those in the non-CF agriculture sector due to sharing common characteristics of production, but not having the same access to better techniques. Similarly, land productivity in CF can also diffuse to the non-CF. Both of this translates into '***Tied spillover mechanism'***:

$\hat{a}_{VA} = \eta_1 \hat{a}_{VF}$ (***Land-spillover***) and $\hat{a}_{LA} = \eta_2 \hat{a}_{LF}$ (***Labor-spillover***), where $0 \leq \eta_i \forall i = 1,2$ (25a)

η_i are parameters or coefficients of tied spillover. Higher values imply pronounced effect (***Magnified spillover***); however, for values less than 'unity', it might be a '***Damped' spillover***, in which case despite production benefits being manifested in non-CF agriculture sector, 'Price effects' might not be that conducive. In other words, prices of non-CF sector might even rise, even if the extent is low. In fact, that is supported by the stylized facts in real evidence (see Section 2).

Then, we can derive conditions pertaining to $\lambda, \eta_i{}'s$ for tracing beneficial effects (or, otherwise) *a la* contract farming as alternative arrangements.

Proposition 4: *With spillover of technological benefits—under differential rates of land and labor productivity improvements under CF--- accruing to the traditional non-CF farms, contract farming is beneficial.*

Proof: Consider Land-spillover. As we got in equation (15) above,

$\hat{X}_F - \hat{X}_A = \hat{a}_{VA} - \hat{a}_{VF} = \eta_1 \hat{a}_{VF} - \hat{a}_{VF} = \hat{a}_{VF}(\eta_1 - 1)$.

Therefore, $\hat{X}_A > \hat{X}_F$ *iff* $\hat{a}_{VF}(1-\eta_1) > 0$.

As due to technical progress parameter being factor-saving by nature, $\hat{a}_{VF} = -\beta_1, \beta_1 > 0$,

$$\hat{X}_F - \hat{X}_A = \hat{a}_{VA} - \hat{a}_{VF} = \eta_1 \hat{a}_{VF} - \hat{a}_{VF} = -\beta_1(\eta_1 - 1) \quad (25b)$$

Thus, $\hat{X}_A > \hat{X}_F$ *iff* $-\beta_1(1-\eta_1) > 0, \beta_1 > 0 \Rightarrow \eta_1 < 1$ (QED)

Now, for labor-spillover, let $\hat{a}_{LF} = -\beta_2, \beta_2 > 0$ *and* $\hat{a}_{LM} = 0$.

Then, using the above arguments and assumptions, for labor-augmenting technological change,

$$\hat{a}_{LA} = \eta_2 \hat{a}_{LF} = -\beta_2 \eta_2 \quad (25c)$$

Thus, from equation (1), we can derive using envelope theorem and Jones (1965, 1971) that:

$$\left.\begin{aligned} &\hat{a}_{LF} + \hat{X}_F + \hat{a}_{LA} + \hat{X}_A = 0 \ (as\ \hat{a}_{LM} = 0) \\ &\Rightarrow -\beta_2(1+\eta_2) + \hat{X}_F + \hat{X}_A = 0 \\ &\Rightarrow \hat{X}_F + \hat{X}_A = \beta_2(1+\eta_2) > 0 \end{aligned}\right\} \quad (26)$$

Thus, ***joint augmentation*** of both sectors are positive under tied spillover effects via labor productivity. However, it remains to be seen under what conditions the effects are pronounced and whether non-CF sector derives the transmitted benefits more as observed in the case of land productivity improvements. This can only happen when both the spillover parameters are greater than unity so that *conjointly labor and land-productivity improvements under CF are transferred to non-CF*.

Lemma 1: $\hat{X}_A > \hat{X}_F$ *iff* $\eta_2 > \eta_1$, *or, conjointly,* $\eta_1 + \eta_2 > 1$

Proof: From (25b), $\hat{X}_A - \hat{X}_F = \beta_1(\eta_1 - 1)$ and from (26), $\hat{X}_A + \hat{X}_F = \beta_2(1 + \eta_2)$. Adding these, we get on simplification that:

$$2\hat{X}_A = \beta_2(1+\eta_2) + \beta_1(1-\eta_1) \qquad (26a)$$

$$2\hat{X}_F = \beta_2(1+\eta_2) - \beta_1(1-\eta_1) \qquad (26b)$$

From (26a), we can infer that $\hat{X}_A > 0$ iff $\beta_2 + \beta_2\eta_2 + \beta_1\eta_1 - \beta_1 > 0$. As the joint impact additive terms are always positive, this relation can hold *iff* $\beta_2 > \beta_1$. Similarly, from (26b) we can infer, $\hat{X}_F > 0$ iff $\beta_2 + \beta_2\eta_2 - \beta_1\eta_1 + \beta_1 > 0$.

That means, given $\beta_2 > 0, \beta_1 > 0$, $\beta_2\eta_2 > \beta_1\eta_1 \Rightarrow \beta_2 / \beta_1 > \eta_1 / \eta_2$. As from above, $\hat{X}_A > 0$ when $\beta_2 > \beta_1$,we can easily infer that $\beta_2 / \beta_1 > 1 > \eta_1 / \eta_2 \Rightarrow \eta_2 > \eta_1$. Conjointly, using both conditions we can write that SOE effects are dominant (magnified) when $\eta_2 > \eta_1 \Rightarrow (\eta_1 + \eta_2) > 1$.Not only that, this confirms that only if $\eta_2 > \eta_1 \Rightarrow (\eta_1 + \eta_2) > 1$holds, then $\hat{X}_A > \hat{X}_F$, implying that spillover effects will *outshadow* the self-selection bias. But to trace the price effects is essential for consideration of implications from welfare point of view.

Proposition 5: *Under differential rates of land and labor productivity improvements under CF---with spillover of technological benefits tied to the traditional non-CF farms-- contract farming is '**relatively more**' beneficial depending on the values of* $\eta_1 > 0, \eta_2 > 0$. *In other words, exceeding the values of Unity will cause* P_A *to fall or, even if rises, to a smaller extent while* $X_A > 0$. *However, with damped effect (values less than unity),* P_A *will rise definitely, despite* $X_A > 0$.

Proof: Here we postulate $\hat{P}_A = T.\hat{P}_F, T > 0$ and $T \geq, =,$ or, ≤ 1 as the case may be. Consider, as before, the tied spillover relationships, (25a) and (25b), viz., $\hat{a}_{VA} = \eta_1\hat{a}_{VF}$ and $\hat{a}_{LA} = \eta_2\hat{a}_{LF}$, where $0 \leq \eta_i \forall i = 1,2$ and $\hat{a}_{VF} = -\beta_1, \beta_1 > 0$, $\hat{a}_{LF} = -\beta_2, \beta_2 > 0$. Also, consider

$$\theta_{LF}\hat{w} + \theta_{VF}(\hat{r_p} + \hat{R_A}) = \hat{P_F} \qquad (20)$$

$$\theta_{LA}\hat{w} + \theta_{VA}\hat{R_A} = \hat{P_A} \qquad (21)$$

Applying Cramer's rule for (20) and (21), we obtain:

$$\begin{pmatrix} \theta_{LF} & \theta_{VF} \\ \theta_{LA} & \theta_{VA} \end{pmatrix} \begin{pmatrix} \hat{w} \\ \hat{R_A} \end{pmatrix} = \begin{pmatrix} \hat{P_F} - \theta_{VF}\hat{r_p} \\ \hat{P_A} \end{pmatrix} \qquad (22b)$$

Under CF (assumption), $\theta_{LF} < \theta_{LA}, \theta_{VF} > \theta_{VA}$ and $|\theta| = \theta_{LF}\theta_{VA} - \theta_{LA}\theta_{VF} = \theta_{VA} - \theta_{VF} = \theta_{LF} - \theta_{LA} < 0$

Solving for $\widehat{w}$ and $\widehat{R_A}$, we find:

$$\widehat{w} = \frac{(\widehat{P_F} - \theta_{VF}\widehat{r_p})\theta_{VA} - \widehat{P_A}\theta_{VF}}{|\theta|} \qquad (23a)$$

And $$\widehat{R_A} = \frac{\widehat{P_A}\theta_{LF} - (\widehat{P_F} - \theta_{VF}\widehat{r_p})\theta_{LA}}{|\theta|} > 0 \qquad (24a)$$

With $\widehat{r_p} \geq 0$, $\widehat{w} > 0$ *iff* $\widehat{P}_F\theta_{VA} < \widehat{P}_A\theta_{VF} \Rightarrow \frac{\widehat{P}_A}{\widehat{P}_F} > \frac{\theta_{VA}}{\theta_{VF}} \Rightarrow \frac{\widehat{P}_A}{\widehat{P}_F} > 1 \Rightarrow \widehat{P}_A > \widehat{P}_F$. In this case, T>1. Same is the case with $\widehat{R}_A$. Also, at the same time following Proposition 4, $\widehat{X}_A > 0, \widehat{X}_F > 0$. This is corroborated by the evidences.

Lemma 2: With ***differential technical progress*** across sectors, price effects on non-CF sector could be different—falls or rise--as per the restrictions on the coefficients of '***tied spillover***' channel. In both scenarios, prices might rise or fall in both the CF and non-CF sectors.

Proof: Using above spillover mechanism, pairs of Eqs. (7) and (11), (5) and (9), applying envelope conditions (Jones 1965), we can write:

Case 1: *Land-spillover context:*

For non-CF sector, $-\beta_1\eta_1 = \frac{\widehat{P}_A}{\theta_{VA}} \Rightarrow \widehat{P}_A < 0$, $\widehat{X}_A = -\widehat{a}_{VA} = \beta_1\eta_1 > 0$

For CF-sector, $-\beta_1 = \frac{\widehat{P}_F}{\theta_{VF}} \Rightarrow \widehat{P}_F < 0, \widehat{X}_F > 0$.

Thus, $\widehat{P}_A - \widehat{P}_F = -\beta_1[\eta_1\theta_{VA} - \theta_{VF}] > 0, \Rightarrow \theta_{VF} > \eta_1\theta_{VA} \Rightarrow {}^{\theta_{VF}}\!/_{\theta_{VA}} (>1) > \eta_1$ (QED)

Case 2: *Labor-spillover context:*

For non-CF sector, $-\beta_2\eta_2 = \frac{\widehat{P}_A}{\theta_{LA}} \Rightarrow \widehat{P}_A < 0$, $\widehat{X}_A = -\widehat{a}_{VA} = \beta_1\eta_1 > 0$

For CF-sector, $-\beta_2 = \frac{\widehat{P}_F}{\theta_{LF}} \Rightarrow \widehat{P}_F < 0, \widehat{X}_F > 0$.

Thus, $\widehat{P}_A - \widehat{P}_F = -\beta_2[\eta_2\theta_{LA} - \theta_{LF}] > 0, \Rightarrow \theta_{LF} > \eta_2\theta_{LA} \Rightarrow {}^{\theta_{LF}}\!/_{\theta_{LA}} (=<1) > \eta_2$ (QED)

In both cases, $\widehat{P}_A - \widehat{P}_F > 0$, or $\widehat{P}_A > \widehat{P}_F$ when $0 < \eta_1 < 1, 0 < \eta_2 < 1$ (damped tying effect). In this case, extent of rise in $P_A > 0$ is much less.

Otherwise, $\widehat{P}_A < 0$, when $\eta_i > 1 \forall i = 1, 2$ (magnified tying impact).

Lemma 3: Consider the case of ***uniform Technical progress*** where $\hat{a}_{LF} = -\beta_2 = \hat{a}_{VF} = -\beta_1 = -\beta(say), \beta > 0$. Under this scenario, returns to labor and owner of non-CF lands benefit as returns inflate.

Proof: Using above relationships, we can deduce that:

$$\hat{a}_{LA} = -\beta\eta_2, \hat{a}_{VA} = -\beta\eta_1 \Rightarrow \hat{a}_{LA} + \hat{a}_{VA} = -\beta(\eta_1 + \eta_2) < 0 \qquad (27)$$

This confirms positive transmission of benefits via tied diffusion. Not only that, (27) indicates that when technical progress happens under CF-arrangements augmenting both land and labor productivity via Farm acquisition, SOE is the only way that can deliver potential benefits via tied-spillovers to non-CF. Without these spilling over of productivity benefits, CF is not conducive and fails to counter the in-built self-selection bias.[18]

Using the above specifications and equations of change, we can write:--

$$\theta_{LF}\hat{w} + \theta_{VF}\hat{R}_F = \beta > 0 \qquad (9')$$

$$\theta_{LA}\hat{w} + \theta_{VA}\hat{R}_A = \beta(\eta_1 + \eta_2) \qquad (10')$$

$$\theta_{LM}\hat{w} + \theta_{KF}\hat{r} = 0 \qquad (11')$$

Using Cramer's rule, we get from the matrix:

$$\begin{pmatrix} \theta_{LF} & \theta_{VF} \\ \theta_{LA} & \theta_{VA} \end{pmatrix} \begin{pmatrix} \hat{w} \\ \hat{R}_A \end{pmatrix} = \begin{pmatrix} \beta \\ \beta(\eta_1 + \eta_2) \end{pmatrix} \qquad (28)$$

$$\hat{w} = \frac{\beta\theta_{VA} - \beta(\eta_1 + \eta_2)\theta_{VF}}{|\theta|} \qquad (29)$$

And $\hat{R}_A = \dfrac{\beta(\eta_1 + \eta_2)\theta_{LF} - \beta\theta_{LA}}{|\theta|}$ (30)

Here, under certain factor-intensity assumption, $|\theta| = \theta_{LF}\theta_{VA} - \theta_{LA}\theta_{VF} = \theta_{VA} - \theta_{VF} = \theta_{LF} - \theta_{LA} < 0$.

Thus, when lands are more into CF-arrangements, $\theta_{VF} > \theta_{VA} \Rightarrow \theta_{LA} > \theta_{LF}$, from (29) we can say

$$\hat{w} > 0 \ \text{iff} \ \beta\theta_{VA} - \beta(\eta_1 + \eta_2)\theta_{VF} < 0 \Rightarrow (\theta_{VA}/\theta_{VF}) < \eta_1 \Rightarrow \ \text{iff} \ (\eta_1 + \eta_2) > 1.$$

[18] This is important for considering differential rates of technical progress in land and labor, as well as for different skill categories in heterogeneous labor types. In that case, the skilled labor can facilitate more spillovers via symmetric information sharing or contribution to productivity.

Similarly, from (30), $\hat{R}_A > 0$ *iff* $\beta(\eta_1+\eta_2)\theta_{LF} - \beta\theta_{LA} < 0 \Rightarrow$

$(\eta_1+\eta_2) > (\theta_{LA}/\theta_{LF}) > \Rightarrow$ *iff* $(\eta_1+\eta_2) > 1$.

In all these above cases, welfare improves as both sector expands, real wage increases.

This reinforces *Proposition 4 and Lemma 1* that with magnified spillover effects, wage increases, so does the return to the owners of agricultural land-holders *even without* being directly under the privilege of CF.

Lemma 4: With ***uniform technical*** progress, we can show the **'Price effects'** of such technical progress are similar in nature, such that: $\hat{P}_A < 0$ *and* $\hat{P}_F < 0$. However, under certain conditions, $P_A > 0$ might occur. Also, magnified spillover causes returns to labor to rise more than that of land.

Proof: Here, $\hat{a}_{LF} = -\beta_2 = \hat{a}_{VF} = -\beta_1 = -\beta(say), \beta > 0$ and hence, given $\beta_i > 0, \eta_i > 0$

$\hat{a}_{LA}\hat{w} + \hat{a}_{VA}\hat{R}_A = \hat{P}_A = -\beta(\eta_2\hat{w} + \eta_1\hat{R}_A) = \hat{P}_A < 0$ *and* $\beta(\hat{w} + \hat{R}_F) = \hat{P}_F < 0$ (QED).

With price fall, welfare improves as given budget share of consumption items in the basket, real income improves causing decline in relative poverty.

Now, in ***Lemma 2 (both cases),*** we have proved that $\hat{P}_A < 0,$ when $\eta_i > 1 \forall i = 1, 2$ (magnified tying impact). Also, in both cases, $\hat{P}_A - \hat{P}_F > 0$, or $\hat{P}_A > \hat{P}_F$ when $0 < \eta_1 < 1, 0 < \eta_2 < 1$ (damped tying effect) with extent of rise in $P_A > 0$ being much less.

From (29), we can infer that:

$$\hat{w} > 0 \text{ iff } \beta\theta_{VA} < \beta(\eta_1+\eta_2)\theta_{VF}$$
$$\Rightarrow (\eta_1+\eta_2) > \frac{\theta_{VA}}{\theta_{VF}}, \text{ where } \frac{\theta_{VA}}{\theta_{VF}} < 1$$

Also,

$$\hat{R}_A > 0 \text{ iff } \beta(\eta_1+\eta_2)\theta_{LF} < \beta\theta_{LA}$$
$$\Rightarrow (\eta_1+\eta_2) < \frac{\theta_{LA}}{\theta_{LF}}, \text{ where } \frac{\theta_{LA}}{\theta_{LF}} > 1$$

Conjointly, therefore, $\hat{w} > 0, \hat{R}_A > 0$ when $\hat{P}_A > 0$ *iff* $\frac{\theta_{VA}}{\theta_{VF}} < (\eta_1+\eta_2) < \frac{\theta_{LA}}{\theta_{LF}}$, which means the values of the 'tying parameters' should lie between the ratios of cost-shares of labor and land. It's a weighted average of the shares of the factors. (QED)

We also show that:

$$\hat{w} - \hat{\bar{R}}_A = \frac{\beta\theta_{VA} - \beta(\eta_1 + \eta_2)\theta_{VF} - \beta(\eta_1 + \eta_2)\theta_{LF} + \beta\theta_{LA}}{|\theta|}$$

$$= \frac{\beta(\theta_{VA} + \theta_{LA}) - \beta(\eta_1 + \eta_2)(\theta_{VF} + \theta_{LF})}{|\theta|} = \frac{\beta - \beta(\eta_1 + \eta_2)}{\|\theta\|}$$

Thus, given $|\theta| < 0$, $\hat{w} - \hat{\bar{R}}_A > 0$ *iff,* $\beta - \beta(\eta_1 + \eta_2) < 0 \Rightarrow (\eta_1 + \eta_2) > 1$

Analogously, we can prove that the same condition holds for the case of $\hat{w} - \hat{\bar{R}}_F > 0$. Importantly, this is valid for $\hat{r}_p \geq 0$ where $\hat{\bar{R}}_F = \hat{\bar{R}}_A + \hat{r}_p$.

Corollary 4: With more CF, when $\eta_1 > 1$ (magnified spillover) as share of land going to CF increases $() \lambda > 0, \hat{r}_p > 0$ (incentivising more CF via premium), the SOE effect will outweigh the negative SSB per se, iff λ in such a way that $\beta > \eta > 1 > \lambda > 0$. It follows directly from other results and Rybczynski effect (1952) via Jones (1965).

Corollary 5: With Uniform technical progress, *tied spillover* but without incentive or premium $\hat{w} > \hat{\bar{R}}_A = \hat{\bar{R}}_F$ and $\hat{\bar{P}}_A < 0$ and $\hat{w} > \hat{\bar{R}}_A$ when $\eta_1 > 1, \eta_2 > 1, (\eta_1 + \eta_2) > 1$. This happens due to tied spillover of technical progress improving homogenous labor's productivity. But as no incentive or premium is paid, engaging in CF is not so lucrative. The contractual arrangement might peter out as contract farming is no longer offering higher returns. This might cause gaps in wage and returns to land to improve, so that inequality improves.

But $\hat{\bar{P}}_A > 0$ and $\hat{w} > \hat{\bar{R}}_A$ when $\eta_1 < 1, \eta_2 < 1, (\eta_1 + \eta_2) < 1$ and $\frac{\theta_{VA}}{\theta_{VF}} < (\eta_1 + \eta_2) < \frac{\theta_{LA}}{\theta_{LF}}$

With $\hat{r}_p > 0$ where $\hat{\bar{R}}_F = \hat{\bar{R}}_A + \hat{r}_p$, $\hat{w} > \hat{\bar{R}}_F > \hat{\bar{R}}_A > \hat{\bar{P}}_A < 0,$ when $(\eta_1 + \eta_2) > 1$ and $\hat{w} > \hat{\bar{R}}_F > \hat{\bar{R}}_A > \hat{\bar{P}}_A > 0,$ when $(\eta_1 + \eta_2) < 1$

4. Effects of Policy Alternatives: Regression Analysis on Spill Over Effects

The above theory has evaluated two aspects of FDI in agriculture: effect on returns to factors of production and effect on agricultural output. In this section we take a look at the available evidence regarding the second issue. In what follows we first define spillovers into a simple production function framework and then report the results of estimating such a spillover augmented production function. The main objective of this section is to estimate the SOE as there are paucity of such analysis despite prevalence of empirical literature supporting its existence in the context of Africa and Asia. Main result: Food Security has been less severe for countries that have witnessed spill over effects.

We estimate the following empirical model as below:

4.1 Methodology

We assume a simple Cobb-Douglas production function of the following form:

$$Y = AL^{\beta_1}K_d^{\beta_2}K_f^{\beta_3}T^{\beta_4}(Pe)^{\beta_5}(Fe)^{\beta_6} \quad (1)$$

Where L = Labour, K_d = Domestic Capital, K_f = FDI, T = Land, Pe = Pesticide usage and Fe = Fertilizer usage.

Following Javorcik (2004) spillover effects of K_f are estimated by including the following variable in addition to K_f in the production fumction:

$$SpillY_{it} = \frac{Y_{it}}{\sum_{i=1}^{n} Y_{it}} K_f$$

The variable puts higher weightage to FDI higher the country's agricultural output. We can think about different weight structures for the FDI variable. For instance the weights can be redefined in terms of one of the factors of production and interpret the coefficient of the variable as the effect of FDI flowing through the channel of the relative factor intensity/employment of the country compared to other countries in the sample. Thus, for example, if the labour weighted FDI is statistically significant but the capital weighted FDI is not then we can predict that FDI works better if agriculture in the country is more labour intensive but does not work if the country is relatively more capital intensive compared to the sample countries. Keeping this in view we report intensities to capital, labour and land. We therefore define the following three additional spillover mechanisms:

$$SpillL_{it} = \frac{L_{it}}{\sum_{i=1}^{n} L_{it}} K_f$$

$$SpillK_{it} = \frac{K_{dit}}{\sum_{i=1}^{n} K_d} K_f$$

$$SpillT_{it} = \frac{T}{\sum_{i=1}^{n} T_{it}} K_f$$

Given the above set of equations the estimated production function with spillover effects is:

$$y_{it} = \alpha + \sum_{j=1}^{6} \beta_j v_{it} + \gamma_F SpillF_{it} + \varepsilon_{it} \quad (2)$$

Where, $\varepsilon_{it} =$

Where lower case variables denote natural logs, V = L, K, T, Pe, Fe and F = Y, L, K, T. Thus there are four estimated spillover equations in (2).

To model spillover of FDI to unit factor requirements we simply rewrite the independent variable (2) in terms of average productivities:

$$(y/f)_{it} = \alpha + (1 - \beta_f)v_{ft} + \sum_{j \neq f}^{6} \beta_j v_{it} + \gamma_F SpillF_{it} + \theta_{it} \quad (3)$$

Where the second term in the RHS of (3) comes from dividing equation (1) by F and f is the natural log of F defined above. There are 16 equations in (3) (four spillover equations for each y/f) that has to be separately estimated.

The entire data on all these variables was downloaded from the FAO website for all available countries and years. Thus the potential data set is huge. However data on all the variables are simultaneously available only for 360 observations spread across 60 countries that includes the 42 countries reported in table 1. The rest are High Income Countries (according to the World Bank classification). The panel is heavily unbalanced with minimum group size of one year and maximum group size of 13 years between 1970 and 2017. The average group size is 6 years. With minimum group size being just one year methods that extensively model for time dependence, such as the dynamic panel model, or the cointegration model is not feasible in this study. Hence the fixed/random effects estimation procedure is carried out. Table 3 reports the results. The Hausman test accepts the null hypothesis of fixed effects. Hence country and or time fixed effects are used wherever appropriate. The first row of table 1 reports the exact estimation method used for each model.

Referring back to equation (1) note that the theoretical values of factor β_j (j≠ f) and γ_F in equation (3) are the same as in equations (2) however the estimated values are expected to be different as θ_{it} is different fromε_{it}. The differences as we see in tables 3 and 4 are minimal implying that the functional form of the production function in (1) is appropriate for the data. Similarly all 16 equations in (3) have the same theoretical values of β_j (j≠ f) in equation (1) and turn out to be almost identical in actual estimation. Hence in table 4 we report only the results for average productivity for labour.

4.2 Results

In table 3 we first estimate the production function without spillover effects. Two versions of the production function are estimated. Column 1 to 3 report the estimates of the coefficients with only four factors of production: Labour, domestic and foreign capital and land. Only estimates reported in column 3 are statistically robust as the data has heteroscedasticity. In column 3 we find all these factors are significant *except land*. Comparing these results with columns 1 and 2 we find that *the significance of land is lost due to the correction for heteroscedasticity.* One possible reason for this result can be that variability of output changes with the size of a country's agricultural sector. To investigate this possibility sub-samples were drawn by bifurcating the sample at the median. Though this reduced the statistical significance and magnitude of estimated heteroscedasticity, it failed to eliminate it. However land became statistically significant for the countries below the median though it was not so for countries above the median[19]. This will be further investigated.

The most important point that emerges from the first four columns of table 3 is that foreign direct investment has a statistically significant effect on agricultural output. However the magnitude of influence is extremely small. This suggests that though foreign direct investment influences agricultural production its influence is weak (at least seven (coefficient of L/coefficient of FDI) times smaller than the other factors of productions used). The nature of this relationship is further investigated by the spillover term estimated in the fifth column of table 3. There is clear evidence of positive spillover of FDI into agricultural production, however the magnitude of spillover is extremely small.

[19] These results are not reported here but is available to the authors and can be provided on request.

Further investigation (last three columns of table 3) reveals that FDI is effective in countries where the agricultural sector employs more land and/or capital but not where agriculture employs more labour. This then can be interpreted as one of the reasons for the higher volume of agricultural FDI in relatively developed among the developing countries noted in figure 1. Since most of this FDI comes from developed countries of the world, their effectiveness increases in countries where (1) there is abundance of land assigned to agriculture and (2) where agricultural practices are more capital intensive. Developing countries with highly labour intensive agricultural processes are less likely to achieve success through foreign capital in agriculture. Finally, as expected, the influence of the FDI term reduces drastically with the introduction of the spillover terms but remains statistically significant when its interaction with other factors of production are included as additional variable in the regression equation (last three columns in table 3). Thus FDI not only works directly to augment agricultural output but it also works through the indirect channel of land and capital augmentation. This latter information appears to throw additional light on the positive spillover effect captured in SpillY.

Table 4 contain results of the effect of FDI on labour productivities. First let us note that, similar effects on capital and land productivities are not reported in the table as the nature of the results are similar. Thus the discussion below, which is based on labour productivities alone, is equally true for capital and land productivities. The main result of the table is in column 1. FDI has a statistically significant effect on the average labour productivity of countries. This clearly is further evidence on the existence of positive spillover effects. Interestingly, the influence of FDI on productivities follow the same pattern as their influence on aggregate output. It occurs more strongly in countries that employ more land and capital in their agricultural sector, but not labour. Thus not only does FDI have a positive spillover effect on agriculture, the spillovers are more pronounced in countries where capital and land usage is high. *The results are:*

Table 3: Estimating the Production Function of Agricultural Products with Spillover Effects (All Countries)

Variable	Country Effects	Random Effects	Country Effects (White Corrected)		Country and Time
Labour	0.04	0.05	0.04	0.04	.04
	[3.3]	[4.0]	[1.44]	[2.66]	[3.00]
Domestic Capital	0.23	0.28	0.23	0.16	.11
	[4.77]	[8.10]	[4.2]	[3.84]	[3.01]
FDI	0.01	0.01	0.01	0.01	.005
	[2.5]	[2.35]	[2.4]	[3.07]	[1.69]
Land	0.36	0.04	0.36	-0.01	.32
	[2.76]	[9.65]	[1.2]	[-0.10]	[1.67]
Constant	9.27	8.2	9.7	11.96	9.60
	[6.48]	[19.23]	[3.23]	[5.75]	[4.54]
Pesticide				0.03	.009
				[2.10]	[.60]
Fertilizer				0.1	.098
				[2.49]	[2.79]
SpilllY					.00009
					[2.22]
SpillL					
SpillK					
SpillT					
R2 Within	0.12		.12	.35	
R2 Between	0.8	.83	.80	.78	
Total	0.81	.83	.81	.83	
No. of Obs.	360	360	360	296	296
No. of Groups	60	60	60	52	52
Fraction of Variance Due to Cross Section Heterogeneity		0.97			

Notes: 1. Hausman Chi Square Test favours Fixed Effects. 2. Modified Wald test for group wise heteroscedasticity in fixed effect regression model shows the presence of heteroscedasticity 3. Unbalanced panel: Minimum group length = 1 Maximum group length = 13, Average group length = 6.

Table 4: Spillover Effects of Foreign Direct Investment on Average Productivity of Labour

Variable	Country and Time Effects (White Corrected)				
Labour	-.95	-.95	-.95	-.95	-.95
	[-63.08]	[-62.17]	[-62.79]	[-62.21]	[-62.21]
Domestic Capital	0.11	.11	.11	.11	.11
	[2.95]	[3.01]	[2.94]	[2.99]	[3.00]
FDI	.007	.005	.006	.006	.005
	[2.02]	[1.69]	[1.80]	[1.80]	[1.70]
Land	0.33	.32	.32	.32	.32
	[1.72]	[1.67]	[1.69]	[1.68]	[1.68]
Constant	9.54	9.60	9.63	9.63	9.60
	[4.23]	[4.54]	[4.57]	[4.57]	[4.54]
Pesticide	.009	.009	.009	.009	.009
	[.63]	[.60]	[.61]	[.61]	[.60]
Fertilizer	.09	.09	.09	.09	.001
	[2.82]	[2.79]	[2.77]	[2.80]	[2.00]
SpillY		.00009			
		[2.22]			
SpillL			.0001		
			[1.19]		
SpillK				.00004	.00004
				[2.15]	[2.15]
SpillT					.0001
					[2.00]
R2 Within	0.98	.98	.98	.98	.98
R2 Between	0.73	.73	.73	.73	.73
Total	0.71	.70	.70	.70	.70
No. of Obs.	296	296	296	296	296
No. of Groups	52	52	52	52	

Notes: 1. Hausman Chi Square Test favours Fixed Effects. 2. Modified Wald test for group wise heteroscedasticity in fixed effect regression model shows the presence of heteroscedasticity and time dependence. All results reported in this table are heteroscedasticity corrected and with time dummies 3. Unbalanced panel: Minimum group length = 1 Maximum group length = 13, Average group length = 6.

4.3 Linking the Theoretical and the Empirical Observations

The main theoretical observation on spillover noted in this paper is that spillovers from foreign direct investment can significantly reduce any negative influences of these FDI flows. The literature has given particular attention on the FDI flowing into the contract farming sector. Since outputs produced by contract farms are exported, this leads to the possibility of food scarcity in the countries where such farming occurs. The manifestation of this food scarcity in the model is through the rise of prices of agricultural goods in these countries. Indeed we find clear evidence of such price rise in developing countries. The theoretical model predicts that such price rise can be mitigated through spillover effects of FDI but the spillovers need to be 'magnified' in the sense that average productivities of the non-FDI agricultural sector need to increase at a faster rate than the FDI sectors. The empirical part indeed finds strong evidence of spillovers of FDI on agricultural output but the magnitudes are nowhere near the magnitudes need to reverse price increase. Thus bringing theory and evidence to gather we can say that the spillovers are not strong and hence agricultural prices have continued to increase in these countries, leading to a decline in welfare for the country through this route.

5. Concluding Remarks and Further Works

Current rush for 'land-seeking' via CF has not been addressed analytically. While the academic literature is not capacious, this paper, first of its kind, models its effects in the context of a small open economy subject to exogenous shocks. In particular, it furnishes that: (i) technological progress or inducing technological efforts via skill, capacity building, infrastructure developments will have favorable effects; (ii) favorable policy climate to foster governance, and education for revitalizing agriculture would deter ill-designed deals and its pernicious effects.

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