The Challenges to Agricultural Development in Sub-Saharan Africa

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Abstract: We study how commodity terms of trade affect agricultural transformation in countries where farming is carried out predominantly by the nonelite population. The mechanism we explore works through the industrial organization of the intermediate good sector that supplies technological solutions to the problem of soil fertility management. We analyze the political economy of the choice of the institution that sets the rules of the game in this sector. We link this political economy to the elite gains from securing the implementation of monopoly-right arrangements that preclude entry of technologically superior firms into the sector. We show that improvements in the terms of trade impede the elite’s ability to secure such arrangements, whereas poor terms of trade facilitate it. We thus conclude that poor commodity terms of trade may be an important challenge to agricultural transformation in countries where farming is predominantly a source of livelihood for the nonelite population.

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1. Introduction

Why is farming still an undeveloped activity in sub-Saharan Africa? This paper develops a theory that proposes poor terms of trade as an answer, in a context where farming is an activity undertaken predominantly by the nonelite population— as in most sub-Saharan Africa (SSA).

Despite accounting for 70% of the labor force, African agriculture continues to lag behind other regions in performance. According to the *Economic Report on Africa 2009* published by the United Nation Economic Commission for Africa (UNECA), Africa ranks the lowest in the world in terms of yield-enhancing practices, mechanization, use of agrochemical and irrigated land. African countries also use on average only 125 grams of fertilizer per hectare compared to the world average of 1020 grams per hectare. In the case of agricultural mechanization, reported figures are equally dismal at only 13 tractors/100 km2 of arable land in Africa, compared to 200 tractors/100 km2 for the world average (UNECA 2009).

These problems have been known for quite some time now, and studies and special reports exist that spell out the pillars of agricultural transformation in SSA. They include investment in rural infrastructure (World Bank Group, 1997), promotion of the use of yield-enhancing technologies (Evenson and Gollin, 2003), privatization to enhance competition in agricultural input markets (Baxter, 1989; Pickering, 1989), and the creation of an enabling environment (UNECA 2009). But providing a catalog of public actions needed to transform African agriculture, while helpful, does not explain why African political leaders are yet to implement them on a sustained basis.

Take privatization of agricultural input markets, for example. Agricultural inputs (agrochemicals, high-yielding seeds, machineries) are viewed as technological solutions to soil fertility management in SSA. Prior to the 1980s, in most SSA, the state had a monopoly in the supply, marketing and distribution of these inputs. But the system was dimmed largely inefficient, which led to it being dismantled in the context of privatization initiated in the 1980s and 1990s under the Structural Adjustment Programs supported by the IMF
and the World Bank Group (IFDC 2001). Yet in most SSA, the private sector has been slow or ineffective in taking over after government withdrawal. Privatization has neither enhanced efficiency, nor has improved the effectiveness of markets in reaching small farmers (Akeredolu 2008). Instead, as a study by the Sécurité Alimentaire Durable en Afrique de l’Ouest Centrale (SADAOC) reveals, privatization appears to have swapped state control systems for private and inefficient monopolies (SADAOC Foundation, 2000). In other words, privatization has failed to enhance the well-functioning of agricultural input markets in SSA. Arguably, this failure is an important challenge to agricultural transformation in SSA and therefore needs to be addressed.

This paper sets out to explore the sources of inefficiency in SSA’s agricultural input markets. Our model builds on a number of stylized facts related to SSA. First, in most SSA there is social stratification featuring two distinct classes of citizens: the economic elite who control former state-owned companies and enjoy considerable economic power, and the nonelite population composed of households that derive their livelihood from smallholder farming (UNECA 2009). Second SSA’s exports face poor terms of trade (Ocampo and Parra 2006). Third, unlike industrialized countries—which are net exporters of manufactures—, African states which exports mostly primary commodities or minimally processed goods typically occupy the lower rungs of measures of institutional quality like the World Bank’s Doing Business Index and Transparency International’s Corruption Perception Index, reflecting the prevalence of inefficient states—understood as those that consistently implement pro-elite policies. Our paper thus connects these three phenomena: farming as the source of livelihood for the nonelite, poor terms of trade, and inefficient institutions in the agricultural input sector.

We articulate this connection in a two-sector general equilibrium model of a small open economy comprising two sectors, a primary sector and an intermediate good sector. The primary sector produces a cash crop solely for export (e.g., cocoa, coffee, cotton, tea leaves) while the intermediate good sector supplies technological solutions to the problem of soil fertility management, in the form of agrochemicals, high-yielding seeds, machineries, and
extension services. The economy uses foreign exchange earning by exporting the cash crop to pay for imports of an essential manufacturing good (e.g., health-care products, automobiles, etc.). Under balanced trade, the country’s capacity to pay for its imports is limited by the value of its cash crop exports. Thus, expanding production in the primary sector becomes critical for improving living standards in this small open economy. Whether or not this sector expands, in turn, may depend on the nature of the institution prescribing the rules of the game in the intermediate good sector, as this institution affects the efficiency of the sector at supplying yield-enhancing technologies to farmers.

In our model, control of the supply of the intermediate good to farmers pits an elite group of households—the economic elite— against potential new entrants endowed with exclusive rights over the used of a more efficiency technology for producing the intermediate good. The economic elite are the owners of privatized former state corporations, with a vested interest in maintaining monopoly rights over the supply of the intermediate good. To protect their monopoly rights, the elite resort to patronage politics to secure the adoption of licensing system that makes it costly for potential new entrants with superior technologies obtain the license to supply the intermediate good. We follow Parente and Prescott (1999) by linking the elite resistance to free enterprise to the cost of entry potential technological innovators must incur to break into the sector. Because potential innovators can offer higher wages to nonelite households, the elite may be compelled to reach out to some nonelite workers (as in Bandiera and Levy 2011), offering them a share of the pie in the bid to form a coalition strong enough to resist entry of these superior rivals. Therefore, the mechanism through which institutions lead to input market inefficiencies that impede agricultural transformation is strategic.

The political economy of the functioning of agricultural input markets in SSA can thus be construed as a two-stage game. In the first stage—the coalition game—, the elite must decide whether or not to protect their monopoly rights over the supply of the intermediate good. This decision depends on whether there are enough nonelite households willing to join the coalition. The optimal strategy at this stage is the size of the coalition needed to
effectively bar entry by the potential innovator, as this size determines the level of the entry
cost the potential innovator must incur to break the elite’s resistance to free enterprise. In
the second stage game, the potential innovator decides whether or not to incur the cost
needed to break the elite’s resistance to free enterprise. We define the optimal coalition size
as the size that pushes the entry cost to a prohibitively high level, thus effectively barring
the potential innovator from entering the market. This leads two a double inefficiency: in
addition to the allocative inefficiency generally associated with monopolies, the economy
also experiences efficiency losses due to the use of the inferior technology.

For nonelite households, the decision to coalesce with the elite to protect their monopoly
rights thus has a trade-off. Since potential innovators would have raised labor wages,
joining the coalition that bars these innovators from entering the market has an opportunity
cost for nonelite households— the forgone wage from well-functioning agricultural input
markets. Stability of the coalition thus depends on whether the gains from forming a
coalition that impedes technological change exceed its opportunity cost. We model the net
gain to nonelite households from joining the coalition protecting the elite’s monopoly rights
as the difference between the utility payoff from sharing in on the monopoly rents and the
opportunity cost of doing so. The opportunity cost of coalescing with the elite is the utility
payoff a typical nonelite household would attain under free entry in the intermediate good
sector. While this opportunity cost is determined by non-strategic elements only, and
essentially rises with the commodity terms of trade, we show that, by contrast, the utility
payoff from sharing in on monopoly rents depends on both strategic and non-strategic
elements. Strategic elements are imbedded in the two-stage game played between the elite
and a potential rival endowed with exclusive rights over a more efficient technology.

The elite know that nonelite households invited to join the coalition must weigh the
benefits of joining the coalition against its costs. On one hand, the strength of the coalition
depends on its size: the larger the size, the higher the barrier to entry potential rivals must
break. On the other hand, since the monopoly rent must be shared by all coalition members,
a higher coalition size reduces the per capita rent each member can claim as a reward for
supporting the implementation of monopoly-right arrangements that bar technologically superior competitors from entering the intermediate good sector. Therefore, the utility payoff from supporting this inefficient institution decreases with coalition size. We show that forces that destabilize the coalition are factors that raise the optimal coalition size above a certain threshold beyond which the net gain from supporting the protection of the elite monopoly rights tied to the use of inefficient technologies become negative. We also show that the optimal coalition size rises with commodity terms of trade.

In combination, these two results have important implications for the functioning of agricultural input market. In particular, they imply that poor commodity terms of trade impede the development of well-functioning agricultural input markets, by facilitating the formation of coalitions of households with vested interests in the maintaining inefficient institutions. We therefore conclude that poor terms of trade may be an important challenge to agricultural transformation in countries where farming is predominantly a source of livelihood for the nonelite section of the population, as is the case in most SSA.

The paper contributes to the debate on the relative merits of developing countries specializing in agriculture versus manufactures as a development strategy. This literature consists of two opposing groups. The first —to which our paper belongs— is pessimistic about the idea of a country basing its development strategy on export of primary commodities (Singer 1950; Prebisch 1950; Findlay and Kierzkowski 1983; Matsuyama 1992; Stokey 1996; Ocampo and Parra 2006). Unlike this literature, however, our pessimism stems from the nature of farming as a source of livelihood for the nonelite population. The other group is optimistic (Cartiglia 1997; Echers 1999; Ranjan 2001; Dessy, Mbiekop, and Pallage 2009). Our contribution to this literature is to link commodity terms of trade to the process of agricultural transformation.

Our paper also contributes to the literature on institutions and development which links economic stagnation to poor institutions. Parente and Prescott (1999) highlight monopoly-rights arrangements in poor countries as the main barrier to their long term prosperity. Baland and Francois (2000), Vicente (2006), and Robinson, Torvik and Verdier (2006)
emphasize the institutional foundations of economic stagnation in resource-rich countries. We build around this literature, by provide an explanation for African leaders’ apparent lack of political will to enhance agricultural transformation, seen by many as vital to their long term prosperity. Overall, our main contribution is to integrate the trade and development literature with the institutions and development literature, by linking terms of trade to institutional quality in SSA.

The rest of the paper is structured as follows. Section 2 gives an overview of the model. Section 3 discusses the effect of improvements in the terms of trade on elite net gain from securing monopoly-rights arrangements. Section 4 concludes.

2. The Setup

Consider a small open economy with two sectors: a primary sector and an intermediate good sector. The primary sector’s output is entirely exported. The intermediate good sector provides technological solutions to the problem of soil fertility management in the primary sector, including agrochemicals (fertilizers and pesticides), high-yielding seeds, and machineries, all of which are inputs in the primary sector. The economy also comprises a measure one of households. A household derives income from selling labor to firms either in the primary or the intermediate good sector, or from membership of a strategic coalition enjoying protected monopoly rights over the use of a particular technology in the intermediate good sector. Each household is endowed with one unit of labor. The composite imported good is the unique consumption good in this environment. We take the imported good as the numeraire, and measure all other prices in units of this numeraire.

2.1. The intermediate good Sector

Initially, the elite — a small minority of former state-owned corporations’ employees— own a production technology with level of productivity $\theta_0$ say, as a legacy of a privatization process that transferred assets of former state-owned enterprises to some former employees.
This technology is operated by firm 0— the elite firm.\(^5\) But a potential innovator (firm 1) endowed with exclusive rights over the use of a superior technology, \(\theta_1\) (with \(\theta_1 > \theta_0\)), may break into the sector and compete against the elite firm for the production and supply of the intermediate good to farmers. Without loss of generality, assume that for each firm \(i\) in the intermediate good sector, output is constant-return-to-scale to labor, and is described as follows:

\[
Q^i_x = \theta_i N^i_x, \quad i = 0, 1, \tag{2.1}
\]

where \(N^i_x \in [0, 1]\) denotes total labor used by firm \(i\), with

\[
\sum_{i=0,1} N^i_x \leq N_x.
\]

Here, \(N_x\) denotes total labor force employed in the intermediate good sector.

There are two candidate institutions for organizing production in the intermediate good sector. One is a licensing system allowing the state to screen entry into the sector (hereafter denoted as LS, for licensing system), and the other is free enterprise (hereafter denoted as FE). Since \(\theta_1 > \theta_0\), under free entry, arguably, perfect competition will drive the elite firm out, and the elite know that, which is why they may resort to patronage politics to protect their monopoly rights in the sector. They do so by securing the adoption of licensing system for regulating entry in the intermediate good sector, a process they will then attempt to capture in order to bar entry by the potential innovator. But such capture need not succeed. Indeed, the potential rival, with its superior technology, has the opportunity to tap into the nonelite workforce and attempt to force its way into the sector, by paying a bribe to obtain a license. If the elite cannot influence the level of this bribe, the firm 1 will break in and rival firm 0 for the supply of the intermediate good to farmers.

To make matters interesting, let any bribe paid by the potential rival be entirely cap-

\(^5\)The best (but no the only) way to think about the elite firm is as a legacy of privatized former State-owned enterprises.
tured by the elite say, as a compensation for losing their monopoly rights. The political economy of the industrial organization of the intermediate good sector can thus be construed as involving a two-stage game. In the first stage, the elite decide whether to secure the adoption of LS or to leave access into the sector unrestricted—an institution we refer to as FE. Adoption of LS allows the elite to capture the licensing process so as to bar potential rivals from obtaining a license giving them the right to produce and supply the intermediate good. The second stage game takes place if and after the licensing system is adopted. In this second-stage game, the potential innovator must decide whether or not to break the elite’s resistance to free entry in the intermediate good sector. In the affirmative, the innovator will pay a bribe, $\phi N_c$, as a compensation to the elite for a breakdown of their monopoly power, where $\phi > 0$ and $N_c$ denote the coalition size.

The realized industrial organization of the intermediate good sector thus depends on whether or not the elite can form a stable coalition to fend off the potential innovator’s attempt to break their firm’s monopoly power. This coalition consists of the elite—the actual owners of firm 0—and some nonelite households drafted in strategically for the purpose of consolidating the elite’s control of production and marketing operations for the intermediate good. If the elite can form a stable coalition with some nonelite households capable of pushing the level of the bribe to a prohibitively high level, only then will their potential rival keep out, thus leading to the elite’s consolidation of monopoly power in the intermediate good sector. We will characterize this political economy further below.

### 2.2. The Primary Sector

Firms in the primary sector are perfectly competitive. They combine intermediate good $(X_a)$ and labor $(N_a)$ to produce $A$ units of a commodity according to a standard Cobb-Douglas technology given by

\[ A = X_a^\psi N_a^{1-\psi}, \tag{2.2} \]

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\(^6\)A general expression of the farming technology is as follows:

\[ A = (Z X_a)^\psi N_a^{1-\psi}, \]
with

\[ X_a \leq Q_x \]  \quad (2.3)  \\
\[ N_a \leq 1 - N_x, \]  \quad (2.4)

where \( \psi \in (0, 1) \) denotes the factor share parameter. This production technology implies that the level of soil fertility, as proxied by \( X_a \), is essential for production, as is labor, \( N_a \).

Let \( p_a \) denote the export price for the commodity measured in units of the imported final good. Under the small-open economy assumption, \( p_a \) is exogenous and can also be interpreted as the commodity terms of trade. Firms in the primary sector are price takers. Profit-maximization thus yields the following factor pricing rules under market-clearing:

\[
\omega_a = p_a (1 - \psi) \left( \frac{Q_x}{1 - N_x} \right)^\psi \]  \quad (2.5)  \\
\[ p_x = p_a \psi \left( \frac{Q_x}{1 - N_x} \right)^{\psi-1}. \]  \quad (2.6)

Observe that since the production level of the intermediate good depends on the industrial organization of the intermediate good sector, the above factor prices will be affected by the elite choice of the institutional regime determining this industrial organization.

If the elite cannot form a stable coalition to secure the adoption of LS, free entry will be the institutional regime organizing firms’ operations in the intermediate good sector. In this case, perfect competition will drive out the low-technology firm (i.e., firm 0), as an implication of the assumption of a constant return-to-scale production process, implying that output will be given by

\[ Q_x^* = \theta_1 N_x^*. \]  \quad (2.7)

where \( Z \) denotes the quantity of arable land. The term \( Z X_a \) can be interpreted as efficiency units of land, which is total land available, \( Z \), times the level of soil fertility, \( X_a \). Expression (2.2) is therefore obtained by normalizing \( Z \) to unity.
The zero-profit condition under FE will thus generate the following pricing rule for labor services:

\[ \omega^* = p_x^* \theta_1. \]  

(2.8)

In equilibrium, labor will move from the primary sector to the intermediate good sector until wages are equalized across sector:

\[ \omega_a = \omega^*. \]  

(2.9)

Expression (2.9) gives the forgone wage to nonelite households from joining the coalition that protect the elite’s monopoly rights.

From (2.9), substituting in (2.5) and (2.8), rearranging, yields the intersectoral allocation of labor as follows:

\[ N_x^* = \psi \]  

(2.10)

\[ N_a^* = 1 - \psi. \]  

(2.11)

From (2.5), substituting in (2.7), using (2.10) and (2.11), rearranging, thus yields a household’s income under FE as follows:

\[ y^* = \omega^* = \delta p_a \theta_1, \]  

(2.12)

where

\[ \delta = \psi^\psi (1 - \psi)^{1-\psi}. \]

Expression (2.12) shows that the forgone wage from joining the coalition that impedes technological change in the intermediate good sector rises with terms trade and with the level of productivity of the new technology.

By contrast, if the elite can form a stable coalition to protect their monopoly power in the supply of the intermediate good sector, the LS institutional regime will be imposed,
giving to the elite the opportunity to capture the licensing process. Whether FE or LS will be the prevailing institutional arrangement in the intermediate good sector therefore depends on which of the two yields the highest utility payoff to the nonelite households—those who determine the stability of the coalition. We characterize below each coalition member’s utility payoff, respectively under FE and under LS.

2.3. Payoffs

Each household has preferences over an imported good \( m \). The utility (\( u \)) representing these preferences is logarithmic:

\[
    u(m) = \ln m. \tag{2.13}
\]

A household’s earned income depends on (i) the industrial organization of the intermediate good sector, and (ii) whether or not it has elite status. Let \( y \) denote the income of a typical household. Each household’s budget constraint is thus given by:

\[
    m \leq y. \tag{2.14}
\]

In what follows, we restrict our attention to the indirect utility of a nonelite household invited to join the coalition that impedes technological change in the intermediate good sector. Under FE, a nonelite household earns \( y = \omega^* \). Using (2.13), (2.14), and (??), and rearranging, we obtain the indirect utility of a typical nonelite household as follows:

\[
    V^*(\theta_1, p_a) = \ln \delta p_a \theta_1. \tag{2.15}
\]

The above expression can be interpreted as the opportunity cost of joining the coalition that uses patronage politics to induce state implementation of the LS institutional regime in the intermediate good sector. Observe that this opportunity cost rises with the commodity’s terms of trade \( p_a \) as well as with the measure of the technological superiority of the rival
firm, $\theta_1$, as shown in (2.15).

Under LS, a nonelite household who joins the coalition receives the primary sector wage $\omega_a$ augmented with a share of the monopoly rent, $r_c$, if the coalition size, $N_c$, is sufficiently large to ensure the protection of the elite’s monopoly rights. Thus the total earning a nonelite household who joins the coalition is $y = \omega_a + r_c$, which makes him better off than a farmer under LS. The total level of monopoly rents generated by the coalition’s capture of the LS is given by

$$\Pi_0 = p_0^0 \theta_0 N_c - \omega_a N_c,$$

(2.16)

where

$$p_0^0 = p_a \psi \left( \frac{\theta_0 N_c}{N_a} \right)^{\psi-1}$$

(2.17)

is the monopoly price of the intermediate good supplied by firm 0, and which is obtained by making use of (2.6) along with the market-clearing condition $X_a = \theta_0 N_c$. Given the coalition size, $N_c$, under full-employment in the primary sector, we know that $N_a = 1 - N_c$. Therefore, using (2.16), and (2.6) it can be shown that total monopoly rent is

$$\Pi_0 = p_a \psi \left( \frac{\theta_0 N_c}{1 - N_c} \right)^{\psi-1} \theta_0 N_c - \omega_a N_c.$$  

(2.18)

Equal sharing of the rent among members of the coalition implies that the per capita rent is $r_c = \Pi_0/N_c$, which, using (2.18), yields per capita rent as follows:

$$r_c = \psi p_a \theta_0 \left( \frac{1 - N_c}{N_c} \right)^{1-\psi} - \omega_a.$$  

(2.19)

Using (2.19), we can therefore obtain total earning, $y_c = \omega_a + r_c$, for a typical member of the coalition as follows:

$$y_c = \psi p_a \theta_0 \left( \frac{1 - N_c}{N_c} \right)^{1-\psi}.$$  

(2.20)

Consequently, from (2.13), substituting in (2.20), yields the payoff to joining the coalition
as follows:

$$V_c(\theta_0, p_a, N_c) = \ln p_a \theta_0 \left( \frac{1 - N_c}{N_c} \right)^{1-\psi}. \quad (2.21)$$

Observe then that, just like its opportunity cost in (2.15), the payoff from joining the coalition is increasing in the commodity’s terms of trade, $p_a$, as can be seen from (2.21). But this payoff also depends on the coalition size, $N_c$. Indeed, a simple inspection of (2.21) reveals that the payoff from joining the coalition is decreasing in the size of the coalition, $N_c$:

$$\frac{\partial}{\partial N_c} V_c(\theta_0, p_a, N_c) < 0.$$

This property of the payoff function has implications for the political economy of the industrial organization of the intermediate good sector, as we will show further below.

2.4. The Net Gain from the Joining the Coalition

Under FE the surviving firm in the intermediate good sector is the one using the superior technology, $\theta_1$. Obviously this generates an efficiency gain compared to a situation where the inferior technology (i.e., $\theta_0$) is used instead. This efficiency gain, in turn, translates into a welfare gain for nonelite households, as shown in (2.15), where the common utility each household derives under FE is positively related to $\theta_1$.

By contrast, we showed above that the utility payoff of a nonelite household who joins the coalition decreases with the size of the coalition, $N_c$. Moreover, effective protection of the elite’s monopoly rights generates inefficiencies: in addition to the allocative inefficiency generally associated with monopolies, the economy also experiences efficiency losses due to the use of the inferior technology. This double inefficiency has implications for agricultural transformation.

We assume that nonelite households invited to join the coalition decide whether or not to accept this invitation by balancing between (2.15) and (2.21). Let us denote as $\vartheta(p_a, \lambda, N_c)$ the net gain to a nonelite household from joining the coalition that secure the adoption of LS, when the optimal size of this coalition is $N_c$, and the magnitude of the technological superiority of the potential entrant is given by $\lambda = \theta_1/\theta_0$. This net gain is
the difference between the utility payoff attained by a member of the coalition under LS (i.e., $V^c(\theta_0, p_a, N_c)$) and the level that he would attain under FE (i.e., $V^*(\theta_1, p_a)$):

$$\vartheta(p_a, \lambda, N_c) = V^c(\theta_0, p_a, N_c) - V^*(\theta_1, p_a).$$

Therefore using (2.15) and (2.21), and rearranging, we can write this net gain as follows:

$$\vartheta(p_a, \lambda, N_c) = (1 - \psi) \ln \left( \frac{1 - N_c}{N_c} \cdot \frac{\psi}{1 - \psi} \right) - \ln \lambda. \quad (2.22)$$

Several important observations can be derived from (2.22). First, since the potential entrant has a technological edge over the elite firm, $\ln \lambda > 0$. Second, if the coalition size, $N_c$, satisfies

$$N_c \geq \psi, \quad (2.23)$$

then a nonelite household who joins the coalition will incur a welfare lost from supporting the adoption of LS. However, as long as the coalition size, $N_c$, satisfies

$$N_c < \eta(\lambda), \quad (2.24)$$

it is beneficial for a nonelite household join the coalition if invited, where

$$\eta(\lambda) = \left[ 1 + \left( \frac{1 - \psi}{\psi} \right) \lambda^{\frac{1}{1-\lambda}} \right]^{-1}.$$

Hence the following result:

**Proposition 1.** The net gain to the a nonelite household from joining the coalition that secure the adoption of LS is lower the higher the coalition size, $N_c$. Furthermore, there exists a threshold coalition size, $\eta(\lambda)$, such that the net gain is positive if condition (2.24) holds, and negative otherwise.

In other words, a nonelite household will only turn down the invitation to join coalesce with the elite if the size of the coalition needed to secure these arrangements, $N_c$, violates
(2.24). We are interested in the nature of factors that can cause condition (2.24) to obtain. For this purpose, we must compute the optimal elite size, \( N_c \). The next section is devoted to this exercise.

3. The Political Economy of The Industrial Organization of The Intermediate Good sector

We argued above that to block entry of superior competitors in the intermediate good sector can be an attractive proposition to the elite, due to the prospects of earning monopoly rents. To earn monopoly rents, the elite must successfully deter entry into the intermediate good sector by a potential rival with exclusive rights over a more efficient technology. We argued that to achieve this goal, the elite resort to patronage politics to obstruct transparency and symmetry in the licensing system regulating entry into the intermediate good sector. We also assumed that the mechanism allowing the elite to capture the licensing system works through the size of the strategic coalition between the elite and a critical mass of nonelite households. Below, we describe the process that shapes this coalition.

3.1. The Entry-Deterrence Game under LS

Just to recall, the political economy of the industrial organization of the intermediate good sector features a coalition between the elite and some nonelite households so as to secure monopoly rights tied to the use of the inferior technology, \( \theta_0 \). The stability of this coalition is key to the implementation of LS, and depends on the relative magnitude of outside opportunities provided to nonelite households by the potential innovator aiming to rival the elite firm for the supply of intermediate good to farmers. Therefore, the outcome of the entry-deterrence game is the optimal coalition size, \( N_c \)— understood as the size needed for the effective implementation of LS.

When LS is adopted in the intermediate good sector, it provides the elite with the opportunity to capture the licensing process, by barring potential rivals from obtaining a license. Any potential entrant then must pay a bribe, \( \phi N_c \), to break the elite’s resistance
to free entry into the intermediate good sector. Just to recall, we assumed above that the bribe thus paid is captured by the elite. If the potential entrant can afford to pay such a bribe, entry will occur, and the industrial organization of the intermediate good sector will become a duopoly, characterized by the following allocation of profits across firms:

\[
\Pi_0 = p_x \theta_0 N^0_x - \omega^0_x N^0_x + \phi N_c \tag{3.1}
\]

\[
\Pi_1 = p_x \theta_1 N^1_x - \omega^1_x N^1_x - \phi N_c \tag{3.2}
\]

where \( \phi N_c \) denotes total bribe paid by the potential entrant and captured by the elite as compensation, \( N^i_x \) denotes the number of workers employed by firm \( i \), \( \omega^i_x \), the wage rate paid to workers employed by firm \( i \) (\( i = 0, 1 \)), and

\[
p_x = p_a \psi \left( \frac{N_a}{\theta_0 N^0_x + \theta_1 N^1_x} \right)^{1-\psi} \tag{3.3}
\]

Since workers are assumed to be perfectly mobile across sector, and between firms, it follows that wages will be equalized across sectors:

\[
\omega_x = \omega_a = (1 - \psi) p_a \left( \frac{\theta_0 N^0_x + \theta_1 N^1_x}{1 - N^0_x - N^1_x} \right)^{\psi} \tag{3.4}
\]

where

\[
\omega_x = \max \{ \omega^0_x, \omega^1_x \}.
\]

Since \( \theta_1 > \theta_0 \), the highest wage in intermediate good sector will be \( \omega_x = \omega^1_x \).

For this duopoly game, it is common knowledge that if the elite adopt the hiring strategy, \( N^0_x \), the potential entrant’s best response, \( B (N^0_x) \), will satisfy:

\[
B (N^0_x) = \arg \max_{N^1_x} \Pi_1 (N^1_x, N^0_x),
\]

where

\[
\Pi_1 (N^1_x, N^0_x) = p_a \psi \left( \frac{1 - N^0_x - N^1_x}{\theta_0 N^0_x + \theta_1 N^1_x} \right)^{1-\psi} \theta_1 N^1_x - \omega^1_x N^1_x - \phi N_c \tag{3.5}
\]
is obtained from (3.2) by substituting in (3.3), and

\[ 1 - N_x^0 - N_x^1 \equiv N_a. \] (3.6)

Assuming an interior solution, the best response, \( B(N_x^0) \), is the value of \( N_x^1 \) that solves the following first order necessary and sufficient condition for a maximum:

\[
\left( \frac{1 - N_x^0 - N_x^1}{\theta_0 N_x^0 + \theta_1 N_x^1} \right)^{-\psi} \left[ \frac{1 - N_x^0 - N_x^1}{\theta_0 N_x^0 + \theta_1 N_x^1} + \frac{(1 - \psi)(\theta_1 - \theta_0) N_x^0 - \theta_1}{[\theta_0 N_x^0 + \theta_1 N_x^1]^2} N_x^1 \right] = \frac{\omega_x^1}{\theta_1 p_a \psi}
\]

Using (2.5) and (3.6) combined with the wage equalization condition (3.4), and rearranging, we can rewrite the above first order condition as follows:

\[
\frac{\lambda}{\psi^2} (N_x^1)^2 + \left( \psi (\lambda - 1) + \frac{2}{\psi} \right) N_x^0 - \psi \lambda \right) N_x^1 - \left[ 1 - \left( \frac{(1 - \psi)}{\psi \lambda} N_x^0 \right) \right] N_x^0 = 0,
\] (3.7)

where, just to recall, \( \lambda = \theta_1/\theta_0 \) is a measure of the magnitude of the technological superiority of the potential entrant. Clearly, equation (3.7) is a second-degree polynomial in \( N_x^1 \), and thus can be shown to admit two distinct roots. We argue that the best response, \( B(N_x^0) \), is its unique positive root:

\[
B(N_x^0) = \frac{\psi}{2\lambda} \left[ \psi \lambda - \mu N_x^0 + \sqrt{\left( \psi \lambda - \mu N_x^0 \right)^2 + \frac{4\lambda}{\psi^2} \left[ 1 - N_x^0 - \left( \frac{(1 - \psi)}{\psi \lambda} N_x^0 \right) \right] N_x^0} \right],
\] (3.8)

where

\[
\mu = \left[ \psi (\lambda - 1) + \frac{2}{\psi} \right] > 0,
\]

since \( \lambda > 1 \). We can therefore re-write the potential innovator’s duopoly profit as follows using (3.5):

\[
\hat{\Pi}_1(N_c,p_a) = \frac{[\Upsilon(N_c) \psi \theta_1 - (1 - \psi)] B(N_c) p_a - \phi N_c}{[\Upsilon(N_c)]^\psi},
\] (3.9)

where \( B(N_c) \) is obtained from (3.8) by substituting in \( N_x^0 = N_c \), and

\[
\Upsilon(N_c) = \frac{1 - N_c - B(N_c)}{\theta_0 N_c + \theta_1 B(N_c)}
\]
Recall that the potential innovator must incur a cost $\phi N_c$ to bribe its way into the intermediate good sector. In that sense, expression (3.9) above gives the elite all the information needed to ascertain the implications of their choice of size for the industrial organization of this sector. Indeed, to the extent that for the potential competitor, expending own resources to break barriers to entry is rational only when $\hat{\Pi}(N_c, p_a) > 0$ after entry, the coalition size, $N_c$, needed to successfully deter entry can be obtained as the solution to the following equation:

$$\hat{\Pi}(N_c, p_a) = 0,$$  \hspace{1cm} (3.10)

We refer to this solution as the optimal coalition size, $\hat{N}_c = \xi(p_a)$.

**Proposition 2.** There exists a function $\xi(.)$ such that

$$\hat{\Pi}[\xi(p_a), p_a] \equiv 0$$

where $\hat{N}_c = \xi(p_a)$. Furthermore $\xi' > 0$.

**Proof.** The proof follows in three claims. First consider expression (3.9). Taking its partial derivative with respect to $N_c$ and $p_a$, respectively, making use of the *envelop theorem* yields:

$$\hat{\Pi}_{N_c} = \frac{\partial \Pi_1(N_x^1; N_c; \omega_a)}{\partial \omega_a} \left[ \frac{\partial \omega_a}{\partial N_x^1} B'(N_c) + \frac{\partial \omega_a}{\partial N_c} \right] + \frac{\partial \Pi_1(N_x^1; N_c; \omega_a)}{\partial N_c}$$

$$\hat{\Pi}_{p_a} = \left[ \frac{1 - N_c - N_x^1}{N_c + \lambda N_x^1} \lambda \psi - (1 - \psi) \right] \left( \frac{1 - N_c - N_x^1}{N_c + \lambda N_x^1} \right)^{-\psi} (\theta_0)^{\psi} N_x^1$$  \hspace{1cm} (3.11)

where $N_x^1 = B(N_c)$.

**Claim 1.** $\hat{\Pi}_{N_c} < 0$.

To prove this claim, first, observe from (3.5) that

$$\frac{\partial \Pi_1 [B(N_c); N_c; \omega_a]}{\partial \omega_a} = -B(N_c)$$
so that (3.11) reduces to
\[
\hat{\Pi}_{N_c} = -B(N_c) \left[ \frac{\partial \omega_a}{\partial N_x^1} B'(N_c) + \frac{\partial \omega_a}{\partial N_c} \right] + \frac{\partial \Pi_1}{\partial N_c} \left[ \frac{B(N_c) - N_c \omega_a}{\partial N_c} \right].
\] (3.13)

Second, it can be shown from (3.9) that
\[
\frac{\partial \Pi_1}{\partial N_c} = -p_a \psi (1 - \psi) \left( \frac{1 - N_c - B(N_c)}{\theta_0 N_c + \theta_1 B(N_c)} \right)^{-\psi} \left[ \frac{\theta_1 B(N_c) + \theta_0}{[\theta_0 N_c + \theta_1 B(N_c)]^2} \right] \theta_1 B(N_c) - \phi < 0.
\]

Third, from (3.8), taking a first order Taylor series expansion of the function \(B(.)\) around \(N_c = 0\), and rearranging, yields:
\[
B(N_c) \approx \psi^2 - \alpha N_c,
\] (3.14)

where
\[
\alpha = \frac{1}{\lambda} \left[ \psi^2 (\lambda - 1) + 2 - \frac{1}{\psi} \right].
\]

Therefore, using (3.4) and (3.14), it can be shown that
\[
B(N_c) \left[ \frac{\partial \omega_a}{\partial N_x^1} B'(N_c) + \frac{\partial \omega_a}{\partial N_c} \right] = \psi p_a (1 - \psi) \left( \frac{1 - N_c - B(N_c)}{\theta_0 N_c + \theta_1 B(N_c)} \right)^{-\psi} \left[ \frac{\theta_1 B(N_c) + \theta_0}{[\theta_0 N_c + \theta_1 B(N_c)]^2} \right] F(N_c),
\]

where
\[
F(N_c) = \frac{1}{\theta_1 \lambda} \left[ 1 - \alpha [\lambda (1 - N_c) + N_c] + (\lambda - 1) B(N_c) \right].
\]

Observe then, that we can always choose \((\psi, \lambda)\) such that \(F(N_c) > 0\) for all \(N_c \geq 0\).

Hence the result.

**Claim 2.** \(\hat{\Pi}_{p_a} > 0\).

We prove this claim by construction. From (3.12), we know that \(\hat{\Pi}_{p_a} > 0\) means that
\[
\frac{1 - N_c - N_x^1}{N_c + \lambda N_x^1} > \frac{1 - \psi}{\lambda \psi}.
\] (3.15)
Rearranging (3.15) yields,

\[
\lambda \psi - N_c \lambda \psi - N_x^1 \lambda \psi < [1 - \psi] N_c + [1 - \psi] \lambda N_x^1
\]

\[
\lambda \psi < N_c \lambda \psi + N_x^1 \lambda \psi + [1 - \psi] N_c + [1 - \psi] \lambda N_x^1
\]

\[
1 > \left( \frac{1 - \psi}{\lambda \psi} \right) N_c + N_c + N_x^1.
\]

Then, observe that \( N_c + N_x^1 < 1 \), otherwise the primary sector and the intermediate good sector do not coexist. Consequently, for \( \lambda \) sufficiently large,

\[
\frac{1 - \psi}{\lambda \psi} \to 0.
\]

Hence the result.

**Claim 3.** There exists a function \( \xi(\cdot) \) defined by \( N_c = \xi(p_a) \), such that

\[
\hat{\Pi}[\xi(p_a), p_a] \equiv 0
\]

and \( \xi' > 0 \).

**Proof.** The proof simply follows from the application of the *Implicit function theorem* given that \( \hat{\Pi}_{N_c} < 0 \) and \( \hat{\Pi}_{p_a} > 0 \). This completes the proof.

Proposition 2 states that a rise in the commodity terms of trade (i.e., a rise in \( p_a \)) raises the optimal coalition size necessary to protect the elite’s monopoly rights over the supply of the intermediate good. But how does an exogenous increase in the commodity terms of trade affect the net gain to a nonelite household from supporting implementation of LS?

### 3.2. The effects of terms of Trade on the Net Gain from Supporting LS

In section 2, we established that the net gain to a nonelite household from joining the coalition that secures the adoption of LS decreases with coalition size (Proposition 1). This implies that any factor that put the elite in a situation where they have to increase their
size so as to successfully exert their political power over economic activities will destabilize the coalition and thus bring about institutional reforms needed to support agricultural transformation.

In particular, we show that the net gain to a nonelite household from joining the coalition that bar entry by potential innovators in the intermediate good’s sector is positive if and only if

\[ \Delta(p_a) = N_c - N(\lambda) < 0. \]

From Proposition 2, we have that \( \Delta(p_a) = \xi(p_a) - N(\lambda) \). Therefore the coalition will be stable if and only if \( \Delta(p_a) < 0 \), but it will collapse if and only of \( \Delta(p_a) \geq 0 \) instead. As an implication of Proposition 2, we have that \( \Delta' > 0 \). Hence the following proposition:

**Proposition 3.** Poor commodity terms of trade enhance the adoption of LS, while better commodity terms of trade enhance the adoption of FE.

Proposition 3 implies that poor commodity terms of trade (i.e., a decrease in \( p_a \)) may be an important challenge to agricultural development in countries where farming is predominantly a source of livelihood for the nonelite section of the population. In such an environment, the decline in the opportunity cost of joining a coalition induced by poor terms of trade outweighs the corresponding decline in the payoff from joining this coalition. Because poor terms of trade lower the duopoly profit a potential innovator would have earned by breaking elite resistance to free enterprise, they lower the optimal coalition size needed to effectively secure monopoly power for the elite firm. This in turn tips the balance in favor of stability of the coalition.

4. **Concluding Remarks**

We have studied how commodity terms of trade affect agricultural transformation in countries where farming is carried out predominantly by the nonelite section of the population. We linked terms of trade to the industrial organization of the intermediate good’s sector that supplies technological solutions to the problem of soil fertility management in the
farming sector. We also related the industrial organization of this sector to the stability of the coalition that impedes technological change in the intermediate good sector. We showed that stability of this coalition depends on the net gain to a nonelite household from joining the coalition. The main feature of our model is the analysis of the political economy of institutional change in a context of exogenous commodity terms of trade. We articulated this political economy in two-stage game between the elite and a potential innovator in the intermediate good sector, and explored sufficient conditions for the elite to protect their monopoly rights over the supply of the intermediate good to farmers. Incorporating this two-stage game underlying the political economy of institutional change in a two-sector general equilibrium model allowed us to link the determinants of institutional change in the intermediate good sector to agricultural transformation, in the context of a small open economy specializing in the export of primary commodities. We showed that poor terms of trade may be to blame for the inability of this type of economy to adopt institutions supporting agricultural development. While institutions are important for all types of economic activity, we focused on the intermediate good sector following Parente and Prescott (1999), and Acemoglu and Robinson (2000), because of the sector’s critical importance to agricultural development.

Our aim has been to highlight poor terms of trade as an issue in the debate on the challenges to agricultural development in sub-Saharan Africa. Our paper complements the literature citing weak institutions as a cause of economic stagnation by focusing on the case of countries basing their development strategy on specialization in agriculture. Our analysis suggests that unless poor terms of trade are reversed, countries in which farming is carried out predominantly by the nonelite section of the population may continue to be plagued by inefficient economic institutions that undermine agricultural development.

References

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