Africa's Coffee Sector: Status, Challenges and Opportunities for Growth

AFRICAN DEVELOPMENT BANK GROUP

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Foreword

Achieving faster as well as inclusive economic growth are the overarching economic objectives of African countries. There is also a growing consensus that countries achieve more rapid and inclusive growth when growth originates in the sectors that intensively utilise the abundant resources of the economy.

Considering that coffee production and harvesting are labour-intensive activities, growth in the coffee sector is arguably promising in terms of how it can help Africa meet the challenges of gen-erating higher and inclusive growth. Africa is well endowed with other natural resources that coffee production requires. It thus has an enormous comparative advantage in the production and export of high-quality coffee.

But climate change and population growth are pushing Africa towards its natural resource limits, and as a result, in the face of a steady decline in the global price of coffee, Africa's global competitiveness is fading fast. While other coffee exporting regions are coping with the adverse international price movements by improving productivity, lack of technological progress and high technical inefficiency in coffee production are eroding Africa's ability to remain globally competitive.

African coffee has significant export potential and an important impact on overall growth and poverty reduction. But due to a steady decline in the real price of coffee, the incentive for coffee production is declining over time, and coffee farmers are gradually abandoning coffee production. As a result, Africa's global share in coffee production and export is shrinking.

One lesson we can draw from Africa's current coffee sector is that in the face of rapid technological progress and growing global competition, cheap and abundant labour and natural resources, although necessary, are insufficient conditions to offset the adverse effects of a decline in coffee price. It is not possible to do so or remain globally competitive. To maintain competitiveness on a continuous basis, innovation and technological upgrading in Africa's coffee sector are necessities rather than options.

The dividends from supporting the coffee sector are enormous. This is a sector that can generate growth and reduce poverty. Africa is home to the highest quality coffee varieties, both in terms of value and flavour. It is the region where the yield gap is still large and the potential to further im-prove quality is tremendous.

Since most of the constraints that locked the coffee sector into the low performance-trap are associated with market and policy failure, as well as under-provision of critical public goods and ser-vices, the African Development Bank has an immense role to play in addressing these constraints and putting the sector on a higher growth trajectory. This study provides vital information for informed decision-making by the African Development Bank, its Regional Member Countries as well as other development stakeholders interested in developing Africa's coffee industry.

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African Development Bank

Preface

Currently, coffee is one of the important export commodities in Africa. It is grown in 25 African countries. For some of these countries, it is the primary source of export revenues, and on average, accounts for more than 30 percent of their total export earnings. It is also a vital contributor to GDP and tax revenue for some African countries (ICO, 2015). Moreover, a significant number of people derive their livelihood from coffee production. Despite its social and economic significance, the coffee sector in Africa has been underperforming and the continent's share of world output and export has steadily declined.

Despite its micro and macroeconomic significance, the support of the African Development Bank to the African coffee sector has been limited. However, under its Feed Africa Strategy, the Bank plans to support strategic commodities in which Africa has significant comparative advantage and value addition opportunities. Coffee is one of the strategic commodities selected for the Bank's support. To generate evidence-based interventions, the Agriculture and Agro-Industry Depart-ment of the African Development Bank commissioned this study with the specific objective of assessing the constraints of the African coffee sector, its economic potential, and identifying the support that the AfDB could provide to revamp the sector. To achieve these goals, the report used both primary and secondary data sources. While the secondary data mainly came from pub-lished reports and ICO data sets, the primary data was collected through the field visit to Uganda. The field data included quantitative as well as qualitative information. The latter one was collect-ed through interviewing key stakeholders that were drawn from both the public and private sectors.

The report is structured in six sections. After the introduction, the report outlines the theoretical framework that guides the study. Following that, in section three, the current situation and future prospects of the world coffee market are reviewed, focusing on the world supply and demand conditions as well as world coffee price trend and its drivers. In section 4, the status and trends of African coffee production, the size of area under coffee, achieved coffee yield level, volume and earnings from coffee are assessed. In order to identify the most binding growth constraints of the sector, in section five, the study postulates regression models for yield, area under coffee and ex-port volume. Based on the findings of the empirical analysis, in this section, the proximate causes for the weak performance of the African coffee sector are identified and the policy and institutional interventions needed to address them outlined.

In section 6, the untapped economic potentials from improving coffee quality are explored and the interventions needed to fully harness such potentials delineated. In section 7, the business case for supporting the coffee sector are identified and discussed. In section 8, the roles AfDB could play in revitalizing the coffee sector and the investment interventions that the Bank could support are outlined. In the final section, the study draws key binding policy conclusions.

Although the Bank commissioned the study to identify strategic interventions that it could support, the report is also intended to provide evidence-based information to policy makers and other development partners that have interest in revitalising the African coffee sector.

CHIJI OJUKWU
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Executive Summary

Achieving faster as well as inclusive economic growth are the overarching economic objectives of African countries. Although the direction of causation between exports and growth is contested, there is a consensus that higher export growth is associated with faster economic growth. Given this association, implementing policy and institutional measures that dismantle bias against export-ing will be growth enhancing .

Given Africa's enormous endowment of vast uncultivated land, immense untapped water, and labour resources, such measures are expected to boost the production of labour and natural resource-intensive products. Among the commodities for which Africa seems to possess a clear comparative advantage, coffee is a principal one. Currently, 25 African countries grow coffee. For some of these countries, it is the primary source of export revenues, and on average, accounts for more than 30 percent of their total export earnings.

Coffee is also a vital contributor to GDP and tax revenue for some African countries (ICO, 2015). A significant number of people also derive their livelihood from coffee production. In Ethiopia, Africa's leading coffee producer, close to a quarter of the population derive their liveli-hood from coffee production, marketing, and export.

In Uganda, the continent's second major coffee producer, half a million smallholders produce coffee, which is also the primary source of income for 2.5 million people or 8 percent of the population (FTF, 2012). In some countries, coffee is the only source of cash income for many farm households. Moreover, since smallholder farmers produce close to 95 percent of the coffee, the trajectory of coffee production and the world price of coffee will also have a significant impact on poverty reduction and growth.

If one measures the performance of the coffee sector in terms of production, export and the level of realised yield, the Africa coffee sector is underperforming. Although theoretically, Africa pos-sesses a significant comparative advantage in coffee production, the continent's share of world output and export has steadily declined. While the volume of global coffee production has been increasing annually by 1.3 percent and by 4.3 percent in Asia, African production has been steadily declining by an average annual rate of 0.1 percent.

Similarly, the volume of coffee exported from Africa has been declining by an average annual rate of 3.2 percent, while the volume of global coffee export has been increasing. As a result, while its production share fell from an average of 27.2 percent in the 1970s to an average of 10 percent between 2014 and 2015, its global export share dropped from 35 percent in 1974 to 8 percent in 2013 (ICO, 2014).

Africa's average annual earnings from coffee have also plummeted, and its annual average earn-ings in the last decade were 26 percent lower than the annual average earnings in the 1990's. In addition, the bulk share of coffee export from Africa remained raw coffee beans. Africa's share of the global production of fully processed (instant coffee), which accounts for 27 percent of worldwide consumption, is only 2 percent, and its share in roast and ground coffee production is 8 percent (ACET, undated).

The decline in the area under coffee production and the low level of productivity are the key drivers of weak performance of the Africa coffee sector. In the last 50 years, the area allocated to coffee production in Africa has been declining by an average annual rate of 0.7 percent. The av-erage rate of decline after the 1990s was 1.5 percent.

In contrast, the area under coffee production in Asia has been growing progressively at an average annual rate of 4.1 percent. Similarly, while global coffee yield has been increasing annually by an average of 1.3 percent, coffee yield in Africa was only growing at an average annual rate of 0.48 percent. As a result, the yield gap has been increasing at an average annual rate of 3.8 percent. Currently, the average yield in Africa is up to four to six times lower than the average yield real-ised in Latin America and Asian (Author's own calculation based on data from ICO). Despite the fact that coffee production is a natural resource and a labour-intensive activity, both being re-sources that Africa has in large quantities, the trend is inconsistent with the continent's factor en-dowments (Dube and Vargas, 2013).

To improve the performance of the coffee sector and fully harness its economic potential, in the 1980s and 1990s, all coffee exporting African countries implemented various reform measures. Despite such measures, the performance of the coffee sector has not been satisfactory. To make evidence-based interventions, the Agriculture and Agro-Industry Department of the African De-velopment Bank (AfDB) commissioned this study with the specific objective of assessing the con-straints and economic potential of the sector, and identifying the support that the AfDB could provide to revitalise the sector. The study used both qualitative and quantitative methods to ad-dress these issues. To establish whether domestic or external factors are key drivers of weak per-formance, assuming that yield, size of land area under coffee production and volume of export are key performance indicators, the study postulated econometric models for these variables.

The econometric analysis results consistently showed that although external market environments, such as the low and volatile global price of coffee, were contributing to the observed low coffee yield, a decline in the size of land under coffee production and export volume, the adverse ef-fects of unfavourable domestic conditions were more significant and prime contributors to weak performance of the sector. This conclusion was also substantiated by refereeing the performance of non-African exporters.

Despite similar adverse external market conditions, the area under coffee production and export, both in Asia and Latin America have been steadily increasing. Countries in these regions were able to offset the adverse effect of the fall in coffee prices and maintain their competitiveness, to a large extent by increasing yield. The report concludes that while weak and volatile coffee export prices are potential causes of the decline in areas under coffee production and volume exported, the domestic conditions have also hampered the growth in coffee yield. It notes that this, on bal-ance, explains the poor performance of the African coffee sector. The absence of significant yield improvement has also rendered Africa less competitive, and led to the loss of its global market share.

The main conclusion of the report is that in a world of high technology and global competition, cheap and abundant labour and natural resources, although necessary, are not enough to maintain competitiveness (Porter 1990). Innovation and technological upgrading are important to maintain competitiveness on a continuous basis (Ibid). When coffee prices fall for successive years, coffee farmers in locations where crop diversification is possible will shift to the cultivation of more profitable and less risky crops. In areas where coffee farmers have no alternative options or where the production of other crops is less profitable than coffee, they continue to grow coffee, but devote less labour time on husbandry of coffee trees.

Therefore, the key lesson that the report drew for policymakers as well as development partners is that unless the causes of low and widening yield gaps are identified and addressed, in the face of a steady decline in the real price of coffee, the incentive for coffee production will decline over time. Furthermore, as a result, coffee farmers will gradually abandon coffee production.

The report has investigated the key domestic drivers of low coffee yield in Africa and identified limited research capacity to generate, promote and disseminate new technical knowledge. It notes that other principal contributors to low yield are: failure to respond in a timely manner to the de-mands of the coffee industry; inadequate and ineffective extension services; and lack of research and extension linkage. Other significant contributors in the decline of coffee yield are: coffee tree disease; aged coffee tree stock; erratic rainfall distribution and increased frequency of dry seasons; the loss of soil fertility and limited application of fertiliser.

The report categorises these causes into market, policy and state failures. The state failure is asso-ciated with the failure of the public sector to fully discharge its role as a public goods provider. An example of this is failure to provide efficient public agricultural research and extension ser-vices, as well as public investment in transport and market infrastructure, which are necessary to reduce transaction costs, minimise risks and improve the incentive for private investment.

The policy failures, on the other hand, emanate from the dismantling of state parastatals and pro-ducers' cooperatives. These institutions used to play a coordination role and reduce transaction costs. They also reduced and shared market risks (through guaranteeing fixed minimum prices) and increased the bargaining power of producers. The key specific market failures that have sig-nificantly contributed to the weak performance of the sector, on the other hand, are missing in-surance markets and imperfectly competitive financial, inputs and output markets.

The report shows that the combined effect of the policy, state and market failures locked the sec-tor into a vicious cycle of low yields. These low yields lead to low investment and low demand for yield-increasing inputs. These, in turn, ultimately resulted in low yields. The report also argues that the effect of low yields is not only confined to the farm sector but also reduces the level of investment and returns in the downstream activities, and ultimately created a low-level equili-brium trap.

The report contends that unless governments fully discharge their traditional roles and also as-sume additional functions to address the coordination failure and reduce market and transaction risks, the sector will remain locked in the vicious cycle of low yields. Detailed discussions related to this are presented in relevant sections of the report.

The report also assesses the structure and the fairness of the global market for coffee. The analysis shows that while the supply end of the market is highly competitive, the processing and retail ends are characterised by oligopolistic competition. Due to variations in market power, coffee prices and the share of producers' price from the retail price of coffee are not only low (range from 15 to 18 percent), but the share also remained stagnant despite a consistent increase in the retail pric-es of processed coffee.

The report further estimates the annual average income loss or net resource leakage that Africa suffered due to imperfect competition in the global market for coffee. The estimation result shows that between 1990 and 2013 alone, Africa on average experienced an annual income loss close to $268 million. For the periods between 2000 and 2002, the annual net loss ranged from $0.93 to 0.98 billion, and if the 1970s prices are considered, the annual average loss is close to $2 billion.

In addition to those that are involved in the processing end of the coffee value chain, Africa's loss is partly captured by consuming country governments in the form of taxes. Estimates suggest that the amount of tax revenue which developed countries collect from coffee is equivalent to the export earnings of exporting countries.

Considering this situation, the report suggests that, in addition to addressing domestic constraints that contributed to low yield and encouraging domestic consumption of coffee, there producing countries must also make a concerted effort by to address global coffee market imperfections. To reap the full benefit of an increase in productivity, exporting countries need to find ways to tackle the unfair distribution

of the value-added generated in the coffee value chain. In this regard, the report suggests a two-pronged approach, i.e., domestically improving yield, quality and promoting domestic consumption, while simultaneously making concerted pitches jointly with other exporting non-African exporting countries towards making global market conditions more favourable to them. An example might be through restoring an International Coffee Organisation (ICO) ad-ministered quota scheme and lobbying importing countries to be the party to such a scheme. Promoting domestic consumption is also suggested as one of the mechanisms to protect farmers from a decline and from volatility of the global coffee price. It also helps create a market to pro-duce fully processed coffee. An increase in domestic demand for coffee shifts the demand curve and makes it more elastic, so that when the global price of coffee declines, high domestic demand will counteract and diminish the drop in the farm gate prices of coffee.

The report also explores the business cases to support the coffee sector. It concludes that Africa has favourable supply and demand conditions. Not only is Africa the home of the best varieties that fetch the highest price in the world market, but also, unlike other regions, it has huge un-tapped potential. Besides vast land resources that are suitable for coffee production, the yield gap in Africa is up to six times lower. There are also adequate markets that could absorb additional production from Africa.

Global demand for coffee is expected to grow. To meet growing demand by 2020, export from Africa should grow by 52 percent. Similarly, given that production of washed coffee is a labour-intensive activity, other exporting countries are losing competitiveness. As Africa is a low-cost producer, it is well placed to increase washed coffee export and capture additional premiums. The share of coffee exported to specialty markets, which offers premium prices, amounts to only 3 percent. While other exporting regions struggle to meet the specialty market conditions, the bulk of coffee production in Africa is undertaken in more socially and environmentally friendly condi-tions. By increasing coffee yield and promoting domestic consumption, the potential of increasing earnings from the roasted and fully processed coffee production is also significant.

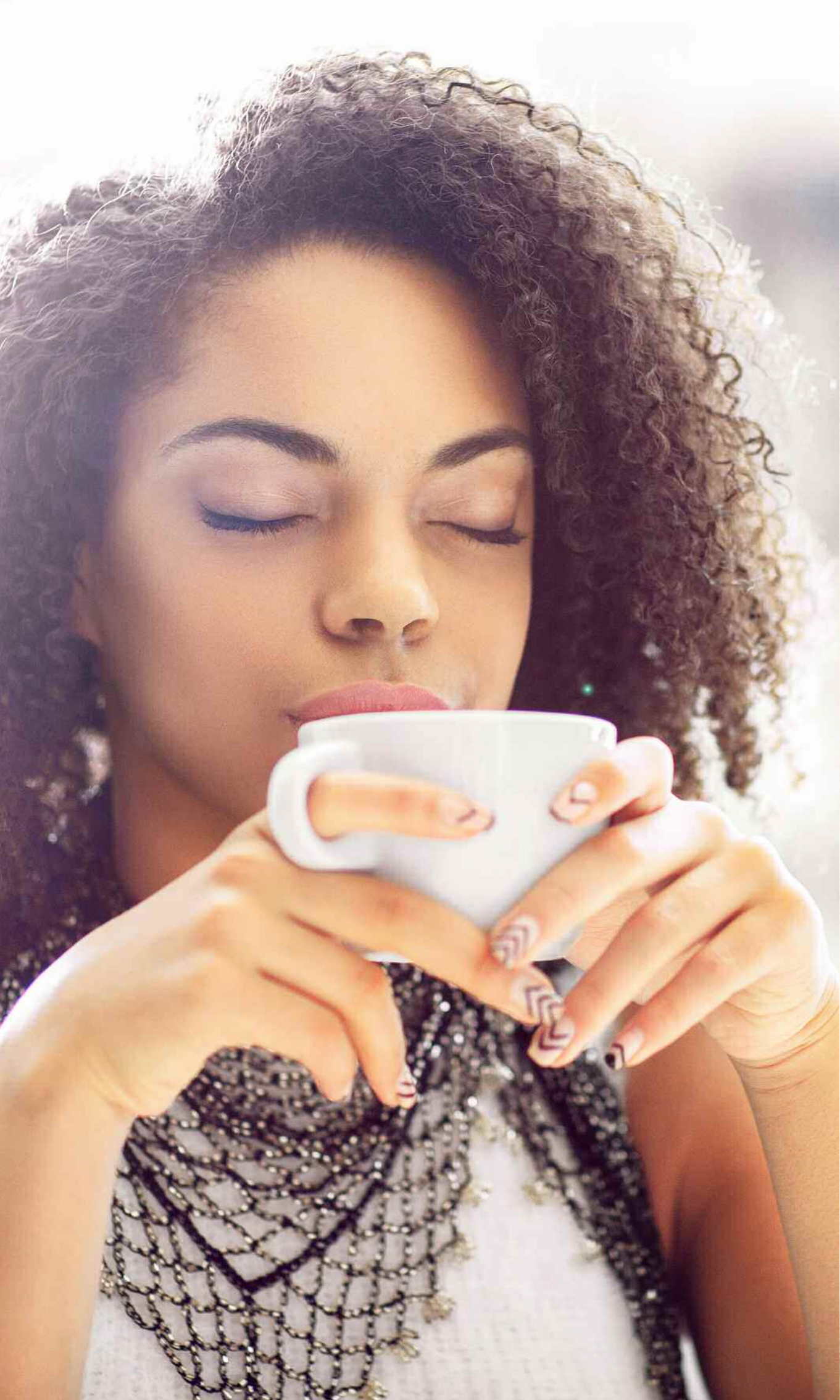
The study also explores potential support interventions by the African Development Bank to revi-talise the African coffee sector. It identifies such potential support areas as enhancing the capacity of research institutions and extension services, facilitating access to finance, irrigation develop-ment, and helping with the formation of new producers or strengthening existing producers' co-operatives.

The report argues that the AfDB's support in these areas will generate a "big push" and help the sector break out of the vicious cycle of low performance. Enhancing the capacity of coffee re-search institutions is necessary to expedite the technical change needed to address the growing yield gap. In addition, increasing such capacity will enable these institutions to respond in a timely way and at the required scale to the demands of the coffee industry. It will further help tailor technology to the agro-ecological and resource circumstances of the farmers.

Strengthening extension service provision is also expected to increase farmers' awareness of new technologies, adoption and efficient use of such technologies. In addition to reducing the tech-nology and management gaps of farmers, effective extension services will play a major role in helping research institutions tailor their technology to the local context and the skill and resource constraints of the farmers.

The report argues that the AfDB's support for the formation of cooperatives is expected to im-prove farmers' bargaining power, reduce transaction costs of inputs and finance as well as lower the risks for financial service providers (information asymmetry and risk of loan default).

The Bank's support in developing the irrigation infrastructure should also have a significant im-pact on the sector. Irrigation development addresses the necessary water needs. It enhances the effect of fertiliser and reduces the risk of crop failure. Ultimately, by increasing yield per hectare, irrigation improves the capacity of farmers to maintain their competitiveness in the face of a de-cline in the world market price of coffee. This is a strategy that Vietnam has pursued. Providing short-term and medium-term loans for establishing small-scale washing stations, as well as com-missioning a study to develop a marketing system that ensures traceability and reward quality are other intervention areas that could bring substantial performance improvement to the coffee sector.



I. Introduction

Coffee is one of the most valuable commodities in Africa. It is currently grown in 25 countries on the continent. For some African countries, coffee is the primary source of export revenues and on average accounts for more than 30 percent of total export earnings. Coffee is also a vital contrib-utor to GDP and tax income for several African countries (International Coffee Organization [ICO], 2015).

Coffee production is a labour-intensive activity, and a significant number of people derive their livelihood from it (Dube and Vargas, 2013). In Ethiopia, which leads the continent in coffee production, close to a quarter of the population derive their livelihood from coffee production, marketing, and export. In Uganda, the second largest coffee producer in Africa, half a million smallholders produce coffee, and it is the primary source of income for 2.5 million people, or 8 percent of the population (FTF, 2012).

In some countries, coffee is the only source of cash income for many farm households. Small-holders are responsible for close to 95 percent of coffee production in Africa, and given the sig-nificance of the crop, the trajectory of coffee production and price will have significant impacts on rural poverty reduction and economic growth.

Despite its economic importance, the African coffee sector has been underperforming. While global coffee production has been increasing annually by 1.3 percent and 4.3 percent in Asia, production in

Africa has been declining by an annual average of 0.1 percent. In absolute terms, coffee production in Africa declined from a yearly average of 1.25 million tons in the 1970s to 1.06 million tons in the 2000s and an average of 1.02 million tons in recent years, from which 63 percent was accounted for by two countries (Ethiopia and Uganda) .

Similarly, while the volume of global coffee export has been increasing by 2.3 percent per an-num, and those of Asian exporters by 4.3 percent, the volume of coffee export from Africa has been annually declining by 3.2 percent. While the global yield level of coffee was increasing an-nually by an average of 1.3 percent, coffee yield in Africa was stagnant, and as a result, the yield gap has been increasing by an average of 3.8 percent per annum. The current realised yield to the potential level is up to six times lower.

Africa's average annual earnings from coffee in the last decade were also 26 percent less than the annual average earnings in the 1990s. In addition, the bulk share of coffee export from Africa remained in the form of raw green coffee beans. Africa's share of the global production of in-stant coffee, which accounts for 27 percent of worldwide consumption, is only 2 percent, and its share in roast and ground coffee production is 8 percent.

At the global market level too, the conditions have not been favourable to the coffee sector. This is particularly after the International Coffee Agreement (ICA)-administered quota system was abandoned in 1989, following which the subsequent fierce competition among suppliers de-pressed the price to the historically lowest level of $0.45cts/lb in 2002. As a result, coupled with declining volume of coffee export, earnings from coffee declined to their lowest level, £0.5 bil-lion in 2002. Although the market price recovered after 2002, and earnings from coffee consist-ently increased, the highest earnings registered in most recent years have been still substantially lower than average earnings during the quota years.

To increase production and export, and benefit from an improved global coffee price, almost all coffee-exporting countries implemented several reform measures. Despite various reform measures, and the recovery of coffee prices, coffee sector performance in Africa, remained very weak. Unfavourable global market conditions, such as high price volatility and the low relative price of coffee, are still contributing to poor performance of the sector. This is mainly by reduc-ing the returns of coffee producers, increasing the risk and thereby offsetting the potential impact of the reform measures to boost supply. However, despite a similar hostile global market envi-ronment, other exporting regions registered significant improvement in terms of yield, quality and volume of export. This suggests that unfavourable domestic conditions must be having a greater impact on the poor performance of the African coffee sector.

Therefore, to improve the performance and fully realise the economic potential of the African coffee sector, it is critical to identify the sector's binding constraints and the appropriate policy, institutional and investment interventions needed to address constraints. This study aims to do that. To achieve these objectives, the study identified a conceptual framework that would guide the assessment. It identified as critical success factors or performance for the coffee sector, such indicators as yield level, size of land under coffee production, volume, and quality of coffee ex-ports.

To determine the key drivers of growth of the coffee sector - namely yield, the area under coffee production and volume of export, and the appropriate interventions needed to improve growth - the study postulated econometric models for yield, area under coffee and volume of export. In these models, guided by relevant theories, we identified variables that represent the domestic and external factors that are believed to influence yield, the area under coffee and export volume. Based on the results of the econometric analysis, we identified the policy and investment interven-tions necessary to close the existing yield gap, and increase the volume and quality of coffee ex-ports. For empirical estimation of the models, we used the panel data of six major coffee export-ing African countries, namely Ethiopia, Côte d'Ivoire, Kenya, Madagascar, Tanzania, and Ugan-da.

The remaining sections of the report are structured as follows: The first section discusses the con-ceptual framework that guides the research. Following this, the status and prospects of the global demand, supply, the level and volatility of coffee prices, as well as the structure of the world market for coffee are assessed. Subsequently, the performance of Africa's major coffee exporting countries is reviewed. The empirical models are then postulated, empirically estimated, and their results discussed. Next, the business case for supporting the coffee sector is presented, followed by discussions on the potential areas in which the African Development Bank (AfDB) can inter-vene to revitalise the coffee sector. The report ends with a concluding statement.

II. Conceptual Framework for the Study

The primary objectives of this study are to assess the performance of the coffee sector, identify the most binding constraints, and suggest what support the African Development Bank could provide so that coffee producing 'Regional Member Countries' of the Bank could be able to harness the full economic potential of coffee.

Since coffee is an exportable commodity where a significant share of its production is destined for export, the coffee sector performance is significantly influenced by domestic as well as exter-nal market conditions. To identify the binding constraints of the coffee sector, therefore, using trade theory as a conceptual framework would be appropriate. This framework will guide our analysis as well as subsequently identify the appropriate interventions that are needed to invigorate the sector.

There are alternative trade theories that can be considered for the purpose. The choice will de-pend, among other things, on the type of good being traded (homogeneous versus differentiated goods), on the end-use to which the traded commodity is being put (final consumption or inter-mediate input), the structure of the market, and sometimes on the availability of data (Goldstein and Khan, 1985). Since coffee is a differentiated commodity, we consider different alternative trade models that potentially capture the key features of the coffee trade.

We measure the performance of the coffee sector through three indicators, namely by the trend of the land area under coffee, the realised yield level, and the volume of coffee export. For these indicators, we postulate empirical models to identify their key determinants and include variables that are believed to capture both the domestic and external factors, which could influence these performance measures.

In modeling the area under coffee and yield and identifying their key determinants, we use a sim-ple farm household model. For the purpose, we assume that farmers maximise expected profit subject to production and market constraints. The detailed derivations and the variables that are included in the area under coffee and yield models will be discussed in the relevant section of the report. In specifying the coffee export model, although we still assume that exporters are max-imising profit, we use a relevant trade theory that captures the salient features of African coffee exports. The brief discussions of these theories are presented below.

To specify the African coffee export, the Ricardian and the Heckscher–Ohlin-Samuelson trade models can be considered. These models explain the determinants and potential gains from trade, and assume that prices depend on comparative costs. They further assume that products are ho-mogenous and both suppliers and consumers behave competitively.

Coffee, however, is not a homogenous commodity, and buyers exercise some degree of monop-sony power. As a result, these models may not enable us to identify the key determinants of coffee exports, and the measures needed to improve performance. The generalised geographical product differentiation trade model suggested by Armington (1969) and by Hanink (1989) are the other potential candidates. The Armington (1969) differentiated goods trade model assumes that the country's demand for imports is determined endogenously, based on nationally generic prefer-ences, such as Danish furniture, French wine, and Japanese automobiles, etc. (Hanink 1989). This model was used by Usman and Savvides (1994) to estimate the export function of coffee and cocoa in the CFA franc zone. However, this model assumes constant cross elasticity, which is inconsistent with the theory of product differentiation.

The Hanink (1989) model extends the family of existing product differentiation trade models to address the limitations constant elasticity assumption and include products that are differentiated by their country of origin. Since products are differentiated geographically, the model predicts that each country can enjoy some degree of market power (Ibid). Even in situations where there is a marginal price increase, if the price increase does not exceed the reservation price, which is a price difference that consumers are willing to pay for a variety, the exporter still maintain its mar-ket share. This assumption also implies that exporters could differentiate the product to appeal consumer and capture additional market share.

To check if this is valid for coffee export from Africa, we tested if Africa in general and Ethiopia which has a relatively high global market share and exporter of premium coffee quality, enjoy some degree of market power. However, the test results, which is discussed in box 2, showed that neither Africa as a group nor Ethiopia individually has the market power to influence the price it is getting for its coffee varieties. However, the current world coffee market differentiates coffee by their quality or coffee price differs by coffee varieties. The insignificance of the test, therefore, implies that although the price Africa gets for its coffee varies by the quality of coffee it exports, it has no market power in the respective market segment that its coffee quality belongs. It also sug-gests that the Hanink (1989) model is still inadequate to capture the key features of the African coffee export market.

For our purpose, we opted to assume that exporters face a different demand curve, which differs by coffee quality. However, unlike the Hanink (1989) model, we also assume that exporters have no market power in the market that their coffee belongs to. In that case, the small country as-sumption, which our test has also confirmed, may be an appropriate framework. Based on this framework, we assume that African exporters face infinitely elastic demand curves that differ by type of coffee and quality exported. It is also assumed that they take market prices as given, and only vary the quality and volume of coffee that they export.

Under these assumptions, there are three viable strategies to maximise earnings from coffee. First, the height and elasticity of the demand curve which exporters face differ by quality. Thus, one viable strategy is to focus on maintaining or improving the quality of the coffee that they are al-ready producing and exporting. In tandem, they must also promote the uniqueness of their coffee varieties, diversify towards coffee qualities that are more appealing to consumers, and increase their share in niche markets. In so doing, they must strive to add value to their coffee, such as through further processing.

Secondly, since African exporters are price takers, and their volume of supply has no significant impact on the global market price, the second strategy could be to bring about a downward shift in the average cost of coffee supply. An example could be through technical change, improving the technical, scale and scope efficiency of coffee production.

Thirdly, the price that African exporters are getting diverge from what consumers are willing to pay. In other words, the prevailing global market price of coffee is not necessarily the outcome of competitive market equilibrium. In order to maximise earning from coffee, therefore, the third strategy would be to collaborate with other non-African exporters and demand fairer global mar-ket conditions or increase their share from the retail price of coffee.

In the following sections, therefore, we aim to evaluate the performance of African countries along these directions. In other words, we assess to what extent Africa has been successful in pur-suing these strategies. We examine to what extent the malfunctioning of the coffee sector is at-tributed to Africa's failure, and what portion of this is attributed to unfavourable external factors. Next, we shall identify key binding constraints and the interventions needed to put the African coffee sector on a higher growth trajectory. Following this, we shall determine the potential ways the African Development Bank could help revamp the African coffee sector. AfDB's interven-tions are assumed to focus on improving efficiency (static and dynamic) as well as equity. Its sup-port is also justifiable in a situation where the bargaining power of different actors in the coffee value chain is unequal, as well as when rents are inequitably shared. Again, on efficiency grounds, the AfDB's interventions could also be justifiable in situations where some gains are not realised due to coordination failure, and due to low social capital or lack of trust.

Box 1 Limitations of Alternative Theoretical Models

Among the potential models that can be used for our purpose, as discussed in the text, the Armington (1969) model is one of them. Among other limitations of this model, its assumption of constant elasticity of substitu-tion is the major one. It assumes that that the elasticity of demand for geographically differentiated products is identical and constant (Alston, et al. 1990). This constant elasticity assumption is inconsistent with empirical evidences. As consumers are actually exhibiting different preferences for goods that originate from different regions, the price elasticity of substitution across all pairs of products, regardless of country of origin cannot be constant (Hanink 1989).

The Hanink (1989) suggested trade model is the other potential candidate. Some of the strengths of this model are that, unlike the classical and neoclassical trade models, it introduces product differentiation and capture the price-quality relationships. In addition, it assumes that importers are not producing the product domestically. This adequately captures one of the key features of the current global coffee market, where export competition takes place in the third country market. One main limitation of this model is that it assumes buyers are acting competitively. This is inconsistent with the evidences reported by several empirical studies, which reported that, in the global coffee market, buyers are exercising some degree of oligopsony power (Karp, and Perlof. 1993). Similarly, it assumes that exporters exercise some degree of market power. This assumption has not been sub-stantiated by previous empirical studies. For instance, even Brazil and Colombia, which have significant global market share, Karp and Perlof (1993) reported that they are acting as price takers than setters.

III. Trends and Prospects of the Global Coffee Market

3.1 Supply

The global supply of coffee, like other agricultural products, is sensitive to climatic conditions, input costs, access to credit and government policies. A shift in any of these variables could have a significant impact on the trajectory of the global supply of coffee. Historically, coffee supply has been significantly influenced by weather shocks, mainly in Brazil (Lewin et al., 2004). However, by the late 1990s, since Vietnam emerged as the second major global supplier, factors that affect Vietnam's coffee production and export have also been significant determinants of the trajectory of the world market price of coffee.

The global coffee supply in the last half-century showed 1.7 percent annual growth, but the rate of growth after 2001 substantially increased to 2.7 percent. The increase in most recent years also showed less variability. The significant increase was primarily attributed to improved performance in Asia (Vietnam, Indonesia, and India) and South America (Brazil, Peru) (International Coffee Organization, 2013). In absolute terms, the global supply (export) of coffee increased from 74 million bags in 1990 to 114.9 million bags in 2013/14. As indicated earlier, due to an increase in supply primarily from Vietnam, the total supply after 1989 was 54 percent higher than the level of export in the period before 1989. From total exports, Robusta coffee accounts for about 40 percent of global production. The remaining 60 percent is accounted for by Arabica coffee.

The degree of suppliers' concentration has also increased in recent years. In the 1990s, while the share of the three largest exporters (Brazil, Vietnam, and Colombia) was 44 percent, their share in the 2000s increased to 55 percent, and in 2013/14 rose to 61 percent. Calculating the concentra-tion ratio of the four suppliers, we observe that the ratio increased from 51 percent to 68 percent. Although further research needs to be undertaken to establish whether these suppliers exercise their oligopoly power against the interest of small exporters, the structural change in supply could exert an adverse impact on small producers. For instance, Lewin et al., (2004) notes that in-creased access to financial and futures markets by large exporters enable them to manage risk better and maximise their benefit, while small producers that have no such privileges suffer loss.

3.2 Demand

In response to population growth and an increase in per capita income, world coffee consump-tion also continued to show an increasing trend, both in the traditional (America and Europe) as well as in emerging markets (Inter-African Coffee Organisation, Coffee Market Review, 2013). Coffee consumption in 2012 was 8.5 million tons, which is 7.35 percent higher than the level in 2009. During the last decade, particularly between 2000 and 2011, annual global consumption of coffee was increasing by an average of 2.5 percent, which is higher when compared to a 1.8 per-cent growth rate a decade ago.

While consumption in traditional markets increased by an average annual rate of 2.5 percent over the last five years, average annual growth in emerging markets was 2.93 percent. The highest growth rate of coffee consumption was observed in Russia (8 percent), Ukraine (29 percent) and China (34 percent). Among countries in the Middle East and North Africa, coffee consumption has increased by 19 percent in Algeria; by 59 percent in Egypt and by 45 percent in Tunisia.

In all scenarios, the increase in demand is also expected to continue in the future (IACO, 2013). Even in a low case scenario, global consumption is expected to exceed 9.42 million tons by the year 2020 (Ibid). The largest increase in coffee demand is expected to occur in emerging markets, in producing countries, and in the Middle East (Ibid). As one market diversification strategy, Af-rican coffee producing countries should attempt to position themselves to take advantage of the growing demand in emerging markets.

3.3 Prices

Despite an average annual increase in demand of 2 percent, coffee prices in 2001 declined to U.S. 45.59 cents per pound, which is the lowest in the last four decades. Although prices in-creased consistently since 2002, the highest price realised, which was 194.5 cts/lb, was 15 percent lower than the highest price realized in 1977. When one considers inflation, it suggests that the real price of coffee has been showing a sharp and persistent decline (Lewin et al., 2004).

There are some major reasons behind the decline in coffee prices. They include the collapse of the quota system in 1989 and the oversupply of coffee in the global market. This was driven, primarily, by the entry of new coffee producers. Other factors are the introduction of yield-enhancing technologies, and partly, the increased power concentration in the retail end of the market, were the major contributors to the decline in prices.

As Figure 1 shows, after the formation of the International Coffee Organization in 1963, alt-hough prices in the early 1960s were below their predicted value, which is represented by a hori-zontal line, they, however, showed an increasing trend, and reached their highest level in 1977. Although coffee prices declined in the 1980s, they were, however, still above the trend. During this period, farmers and exporters were on average getting from a third to half of the total value added (Ibid).

The quota created rent and allowed producing countries to fully appropriate the rent. Igami (2012) noted that the Coffee Agreement (ICA, 1965–89) raised the price by 73 percent, annually transferring approximately US$ 8 billion from consumers to exporting countries. However, since the collapse of the ICA administered quota, except for brief periods, in most years, the prices were below the trend. It is argued that the collapse of the quota system offers an explanation for four-fifths of the subsequent price decline, and a net transfer of resources from coffee producing to coffee consuming countries (Ibid).

The reallocation of rent from producers to consumers was partly made possible by the increase in the market power concentrated at the processing and retail ends (Kaplinsky, 2004; Talbot, 1997). For instance, the top five importers account for over 40 percent of total global trade in green coffee, and the top 10 for more than 60 percent.

Similarly, for processed coffee (instant coffee), which accounts for 25 percent of the coffee con-sumed, two firms, Nestle and Kraft Foods, account for 75 percent of the market. An important source of these firms' market power is branding, which is a critical barrier for new entrants.

While the share of coffee producers has been declining, from 23 percent in the 1980s to 6 per-cent in most recent years, processors are making large profits. Nestlé's operating margin on instant coffee is estimated to be between 26-30 percent of the final retail price. By the early 1990s, the share of roasters and processors in consuming countries was close to 90 percent of the value add-ed (ECA, 2013). The margin in consuming countries is distributed between wage earners, service providers and government in the form of tax. For instance, Lewin, et al., (2004) noted that im-porting countries earn billions of dollars from coffee taxes, and these taxes alone are approxi-mately equivalent to the coffee revenue earned by producing countries.

Although the average price that Africa gets for its coffee exports improved in most recent years, it remains low and highly volatile. The average price that Africa received for its coffee in the 1990s was $63 cents/lb. In the 2000s this declined to $47.9 cents/lb, and showed some recovery in recent years ($ 80 cents/lb). Although prices showed some recovery, the share that Africa re-ceived from the retail price consumers pay remained low, and, dwindling overtime. For instance, the average roasted coffee price in 1990-2013 in US and EU markets, respectively, were $2.96/lb and $3.09/lb. During this period, the share of the price of green coffee to retail price in EU and US markets, respectively, were only 15.7 percent and 18.1 percent. Moreover, although not statistically significant, this showed a declining trend. In contrast, the retail prices in the US and EU markets were increasing by an annual average of 7.84 percent and 8.9 percent, respec-tively. As a result, while the price Africa received from its coffee remained stagnant, the average margin for roasters in the EU and US markets were increasing at an average annual rate of 8.2 percent and 7.2 percent, respectively (Table 1).

Table 1 Estimates of Trends for the Green and Roasted Coffee Prices, 1990 to 2013

Product Type	Markets	Variables	Coefficient	t-statistics
Green Coffee	World	Constant	0.51	5.82
		Trend	0.007	1.12
		R2	0.05	
Roasted Coffee	US market	Constant	2.63	9.33
		Trend	0.075	3.82
		R2	0.40	
Roasted Coffee	EU market	Constant	3.09	10.17
		Trend	0.089	4.19
		R2	0.44	
Roasters' Margin	US market	Constant	2.10	9.70
		Trend	0.072	4.65
		R2	0.51	
Roasters' Margin	EU market	Constant	2.58	10.28
		Trend	0.082	4.67
		R2	0.50	
Africa's Share- Roast	US Market	Constant	0.18	11.75
		Trend	-0.001	-1.24
		R2	0.07	
Africa's Share- Soluble	EU market	Constant	0.05	10.04
		Trend	-0.001	-1.74
		R2	0.12	

* The price data is US$/lb. The model is estimated based on the data from FAO and ICO.

For soluble coffee, Africa's share of the retail price is 5 percent, and it has also been declining over time. When one carefully examines the regression results, one can see that Africa's share is not only low and falling, but African exporters also face more volatile prices compared to roasters and processors. For instance, the magnitude of the coefficient of determination of the two regres-sions, i.e., R2, significantly diverges. The size of R2 for producers' price is very small, but for roasters' margin, it is very high. This suggests that while the price Africa gets for its green coffee export is less predictable or highly volatile, the roasters' margin is predictable and relatively more stable. A similar picture emerges when we calculate the coefficient of variation. The coefficient of variation for the price of growers is 35 percent, while for roasters' margins in the US and EU markets were 23 percent and 24 percent, respectively.

3.4 The nature of the decline in coffee prices

Price movements reflect the changing demand and supply conditions. The drop in the global market prices of coffee is mainly attributed to the significant expansion in global supply against sluggish growth in demand, coupled with low price elasticities of the demand for coffee. The price declines have been particularly dramatic after the suspension of International Coffee Agreement (ICA) administered quota system in 1989. Following the collapse, the average Interna-tional Coffee Organization composite price fell by 21 percent in 1999, 25 percent in 2000, and 29 percent in 2001, which is also the historically lowest annual average since 1971 (Hallam, 2003).

In real terms, the current prices of coffee are substantially less than their 1960 level. Various ex-planations have been given for the decline in coffee prices. The major ones are oversupply due to the emergence of Viet Nam as a major coffee producer and exporter; devaluation as well as mar-ket liberalisation induced supply expansion in some exporting countries; expansion of planting into frost-free areas; productivity improvements in Brazil; exploitation of market power by roast-ers and retailers; and technological change in roasting (Ibid).

Moreover, since the fall in the world prices of coffee is not transmitted in the form of a fall in the retail prices of coffee, demand could not rise to absorb increasing levels of supply and thus fur-ther contributed to supply-demand imbalance, and hence, the price decline (Ibid).

There has been an internationally coordinated effort to influence market fundamentals by regulat-ing supply and promoting demand. Even after the collapse of the International Coffee Agreement administered quota, the Association of Coffee Producing Countries (ACPC) was established to control supply. The association promoted a retention scheme from the 1st of October 2000 to retain 20 percent of exports. This was to maintain prices above 95 cents/lb and release supplies onto the market when prices exceeded 105 cents/pound (Ibid). However, only a few ACPC member countries cooperated and curtailed supply. While the scheme would have entailed a 6.5 percent revenue loss to participating countries, for non-participating countries maintaining their export volume, it would have increased their revenue level by 17 percent (Ibid). As a result, the scheme could not be sustained. The prospects for success were also found to be bleak, particular-ly as coffee-consuming countries were unwilling to be a party to the agreement. This would have been necessary to control cheating and the problem of free-riders.

However, it is unlikely that consuming countries, which reflect the interest of coffee roasters, processors, and consumers, would favour such a scheme (Ibid). As a mid-term solution, there-fore, diversifying towards other activities and expanding domestic consumption of coffee are necessary to protect the income of coffee farmers. Exploiting the opportunities offered by the growing specialty market is another avenue to improve earnings from coffee.

The effects of the fall in coffee prices are especially severe in Africa, where productivity growth has been lagging. The decline in prices entailed significant welfare cost to the region. Africa is a continent that is least able to afford this. To estimate the magnitude of the welfare loss suffered by coffee exporting African countries, we generated the predicted value of the composite prices and calculated the revenue loss as the difference between the actual and predicted coffee prices. Be-tween 1990 and 2013, the annual average revenue loss or the magnitude of net resource transfer from Africa to consuming countries was $268 million. The 95 percent confidence interval of the net resource transfer ranges from a minimum of $17 million to a maximum of $0.52 billion. Between 2000 and 2002, the net loss ranged from $0.93 to 0.98 billion. These were levels that were very close to the $1.1 billion ODA commitments to Sub-Saharan Africa's agriculture sector (FAO, 2009).

In Africa, the social and economic welfare impact of such adverse movement of prices is substan-tial. Since 95 percent of coffee is produced by smallholder farmers, who are less able to cope with price shocks, the effect of the price decline will have a significant adverse impact on in-comes, unemployment, and rural poverty. As these farmers are liquidity constrained and lack access to market-based price risk management instruments or viable alternative livelihood oppor-tunities, the income loss due to the market power exercised by retailers causes them severe hard-ship.

Coupled with this, the relative decline in state support to the agriculture sector and skyrocketing inflation in most African countries will further undermine the incentives for coffee production. In response, farmers either switch their productive resources to other more profitable and risky activities or use fewer inputs and less labour in coffee husbandry. This is expected to have an adverse impact on production, export, and coffee quality.

Although negative external price movement would disproportionately affect Africa and is thus one of the potential causes of the weak performance of the coffee sector in Africa, it may not be, however, a prime one. It is because, despite a similar adverse global market environment, other exporting countries registered continuous improvement in yields, in the size of land allocated to coffee production and volume of coffee export. This suggests that there were favourable domes-tic conditions in non-African coffee countries that counterbalanced the adverse effect of low and volatile world market prices, which are absent in Africa. As a result, although both domestic and external factors are expected to be key drivers of weak coffee sector performance in Africa, it is not clear which factors are more important.

Establishing which factors are more significant drivers is essential to design effective interventions and also minimise the policy cost of such interventions. The following sections aim to do that. They postulate econometric models for yield, the area under coffee and export volume, and pre-sent the outcomes of statistically conducted tests. But before this, we briefly assess the perfor-mance of the African coffee sector, focusing on yield, area under coffee production and export volume.

IV. Performance of the Coffee Sector in Africa

4.1 Coffee Production

Despite its importance for economic growth and poverty reduction, coffee production and export in Africa remain dismally low. With the exception of some countries, there has been a declining trend. Production declined from an annual average of 1.18 million tons in the 1980's to 0.98 million tons in 2013/14. Of this, 63 percent came from only two countries - Ethiopia and Ugan-da. Although only at 8 percent level of significance, coffee production in the last half-century showed an average decline of 0.18 percent per annum. After the 1990s, the decline was highly significant, and the average annual decline was faster, i.e., 0.78 percent.

When performance is viewed in terms of individual countries, there are marked differences. Ex-cept for Ethiopia and Uganda, production and export in most of the other exporting countries was either stagnant or showed a sustained decline. For instance, although in 1972/73 Angola was the fifth largest producer of coffee, its rank in most recent years declined sevenfold, and produc-tion level was less than 1 percent of its level in the 1970s.

Production in the Democratic Republic of Congo and Cameroon also declined substantially, and as a result, these countries lost significant market share. In Côte d'Ivoire, although coffee produc-tion has been recovering, after it was badly affected by country's civil war in the late 1990s, the level is still well below that of the 1980s. In Kenya, although coffee was the leading foreign ex-change earner in the 1980s, production showed a steady decline from an annual average of 1.5 million bags between 1970 and 2000 to 756,000 bags in 2013/14.

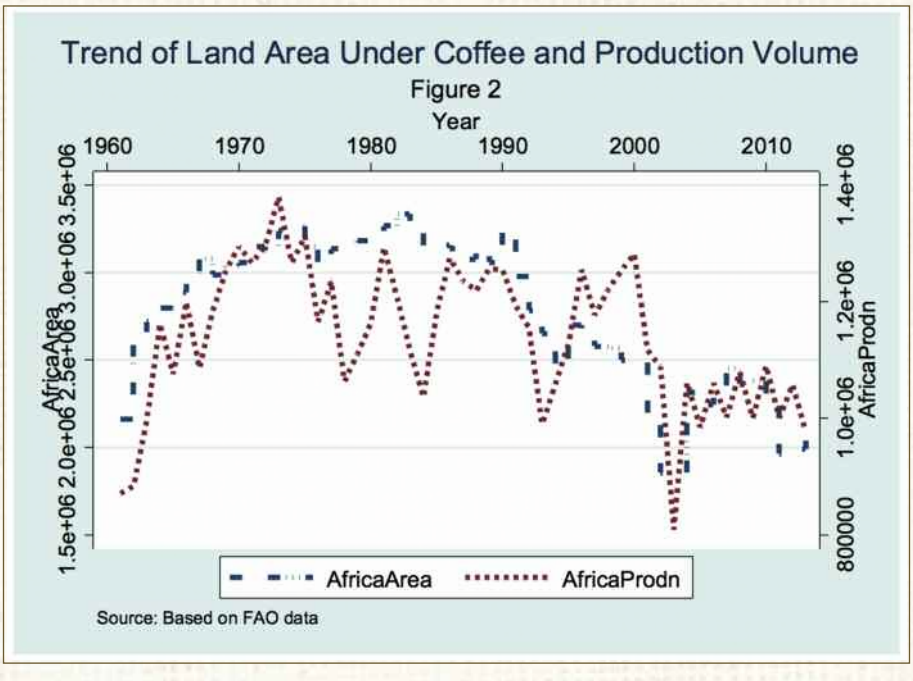
Similarly, in Tanzania, which is the fourth largest coffee producer in Africa, production showed a significant decline in 2006, but has been recovering. A decline in yield and the switch to other more profitable and less risky crops have been attributed as the major causes of the decline in coffee production. The most dynamic production growth was observed in Ethiopia, where pro-duction since 1990 showed an annual average growth rate of 5.5 percent, which is twice the aver-age annual growth rate observed in the last four decades. Production in 2013/14 is estimated to be 6.6 million bags, and Ethiopia currently ranks fifth in global coffee production. To a lesser extent, Uganda has recorded sustained production growth. While average annual production in the 1970s fluctuated between 2.7 and 2.9 million bags, production level in 2013/14 was above 3 million bags. Nevertheless, even in these countries, in most recent years, yields have started to plunge. Similarly, although there was recovery in terms of area of coffee cultivated, this is sub-stantially below the highest level achieved in the 1980s.

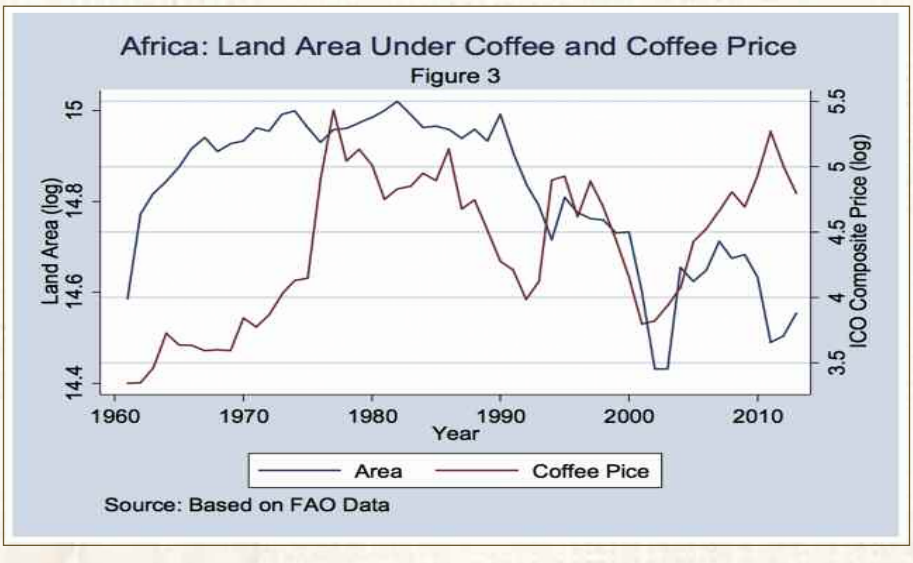
4.2 Area Under Coffee Production

The decline in coffee production, particularly after the 1990s, has been attributed to a decline in the size of land under coffee production, as well as stagnation, and in some cases, a decline in yield. In 2013, the total land size under coffee production was 65 percent of its average level in the 1990s (Figure 2).

The decline in the land size under coffee was very sharp, particularly after 1990, and it reached its lowest level in 2010. If there was no yield improvement in some years, the decline in produc-tion and export would have been much worse. This trend corresponds well with the decline in world coffee prices following the collapse of the ICA quota system in 1989. As one can observe from Figure 3, the area under coffee production started to decline immediately after the price declined. The price decline must have increased the opportunity cost of land, and as a result, farmers rationally seemed to have shifted the land to the production of other crops. Although the price recovered to the level of pre-quota years, the land under coffee production continued to decline.

Since 2007, although the size of the land area under coffee production showed some signs of recovery, its level in 2013, however, was 12 percent lower than its level in 2009. In contrast, during the same period, globally the area under coffee has been increasing by an average rate of 2 percent per annum and by 4 percent in Asia.





4.3 Coffee Yield

When coffee sector performance is assessed in terms of the realised yield level, it shows an in-creasing trend, albeit marginally. Although the trend varies among the major coffee producing countries, coffee yield in Africa registered an average increase of 0.48 percent per annum and reached its highest level in 2002 (figure 4 and 5). However, the average yield realised started to decline sharply after 2002. Although starting from a low base, the bulk share of the yield increase is primarily attributable to yield improvement in Ethiopia, while yield in other countries was ei-ther stagnant or declined. Conducting further analysis on what contributed to inter-country differ-ences in yield will generate valuable lessons for policy. An example could analysing how a con-sistent increase in yield in Ethiopia, in the face of a decline in Kenya and Tanzania, may have contributed to such inter-country yield differences.

When performance is benchmarked against successful global coffee exporting countries, the cof-fee yield achieved in Africa is very low. While the average yield realised in Africa is at least 50 percent below the world average (close to 1.7 tons/hectare), the gap in some countries is up to six times lower. The gap has also been consistently increasing over time. If we consider the period from 1960 to 2013, the gap has been growing at an average annual rate of 3.8 percent, with a 95 percent confidence interval ranging between 3 percent and 4.6 percent. When the trend in recent years is considered, i.e., from 2009 to 2013, the average annual increase in yield gap was 8.4 per-cent. Because of the decline in area under coffee production and stagnation in coffee yield, Afri-ca's share of global production dropped from an average of 27.2 percent in the 1970s to an aver-age of 16 percent in the 1990s. It currently stands at 11 percent of global production.

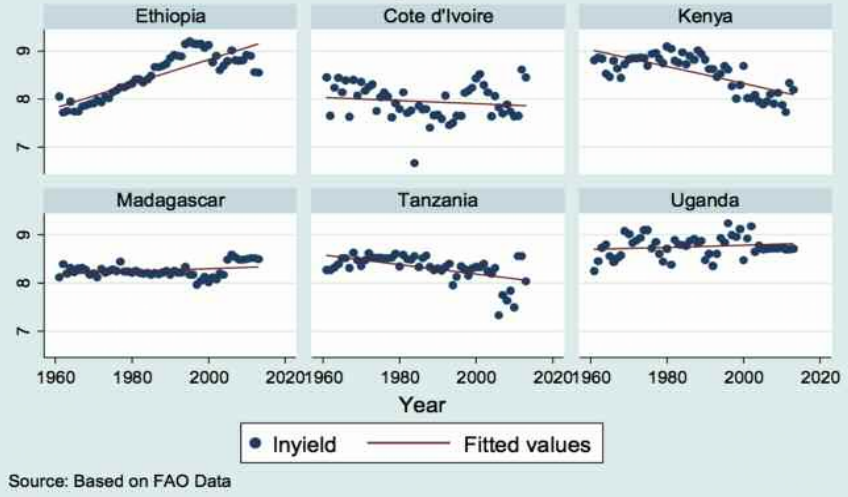
4.4 Volume of Coffee Exported and Earnings

Over the last 50 years, the volume of coffee exported from Africa has shown a consistent decline in an average rate of 0.8 percent per annum. This has been a result of the decline in coffee pro-duction, together with other domestic and external factors that turned the incentive structure against coffee exportation. After the collapse of the ICO administered quota, the decline was sharp, i.e., 2.3 percent. For instance, the volume of coffee exported from Africa in 2011 was 560,000 tons, and this level was 47 percent lower than the highest volume of export achieved in 1973. As a result, despite an increase in world demand for coffee, Africa's share in global coffee export declined from 35 percent in 1974 to 8 percent in 2011.

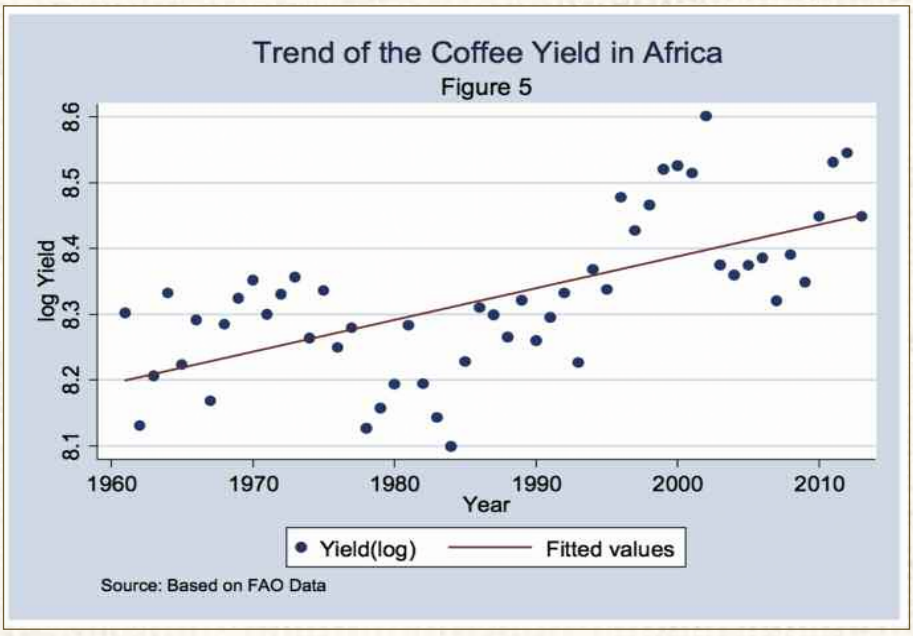
In the same way, the bulk share of coffee exported from Africa remains in unprocessed form, and its share of the export of fully and semi-processed coffee remains low. Currently, Africa's share of global production of instant coffee, which accounts for 27 percent of worldwide con-sumption, is only 2 percent. Africa's its share of roast and ground coffee production is 8 per-cent.

Coffee Yield trend of the Major Coffee Exporters in Africa (kg/ha)

Figure 4



Source: Based on FAO Data



Although Africa's earnings from coffee over the last 50 years had increased by an annual average of 1.2 percent, it has shown a declining trend in recent years. The highest earnings from coffee were registered during the periods where the ICO administered quota was in place, i.e., $3.5 bil-lion in 1977 and $3.42 billion in 1986. After the collapse of the quota system in 1989, earnings declined to the lowest level of $0.5 billion in 2002. While earnings from coffee consistently in-creased after 2002, the highest earning realised in 2011 amounted was $2.1, which was still sub-stantially below the average earning during the quota years.

Given the significance of coffee export earnings as part of total foreign exchange earnings of some African countries and their contribution to farm income, the impact of the decline of these coffee earnings on growth and poverty reduction would be substantial. If we use real prices, the loss of revenue suffered by coffee farmers would be much higher.

We also checked whether the decline in earnings is more elastic to the volume of coffee exported or coffee prices. We calculated the elasticity by classifying the data into pre- and post-1989, which is the year the quota system collapsed. During the quota years, the elasticity of earnings to the volume of export was 0.9, with a decline to 0.8 during the post-quota periods. However, the elasticity of export earnings to price showed a drastic change. The elasticity increased from 0.49 in the quota periods to 0.7 under the post-quota or free market periods. Higher elasticity under the non-quota years suggests that the impact of coffee price changes on earnings became stronger. This shows that the coffee market is becoming more competitive, and the marginal increase in the supply will depress earnings more than before.

Whether or not coffee suppliers are competing on equal grounds is an issue. The competition is expected to push inefficient suppliers out of the market, while increasing the share of efficient suppliers. This is what is happening in Africa. The consistent decline in Africa's export share sug-gests that coffee production and export in the region is becoming less competitive. But the ques-tion is whether the loss of competitiveness is the outcome of the unfair global market competi-tion, the outcome of unfavourable domestic conditions or a combination of these factors. Which factors, i.e., domestic or external adverse conditions would best explain the weak performance of the coffee sector? The empirical analysis section will examine these issues.

V. Empirical analysis

We argued earlier that unfavourable domestic and world market conditions contributed to the weak performance of the African coffee sector. In this section, we aim to assess the significance of each factor with the objective of determining which of the two factors are the most binding constraints to the growth of Africa's coffee sector.

For the purpose, we identified yield, the area under coffee production and export volume as key growth determinants or performance indicators. For these indicators, we postulate simple econo-metric models and introduce explanatory variables that are believed to represent domestic and external factors. To derive the yield and area under coffee models, we use the Agricultural Household Models suggested by Singh et al. (1986).

Accordingly, we assume that coffee farmers, who are henceforth represented as "i," aim to max-imise expected profit from coffee production subject to cost and production condi-tions. We further assume that coffee production in each country is defined by technology set, , where V is a vector of variable inputs (such as labour, fertiliser); Z is a vec-tor of fixed and quasi-fixed inputs and is a vector of bio-physical characteristics, such as soil, climate, topography, etc (Antle and Capalbo, 2000). Accordingly, the coffee production func-tion can be written as: . As farmers are maximise the expected profit, which is , on the basis of Hotelling lemma, the reduced form of the optimum coffee output will become .

Similarly, the size of land area under coffee production , which is one component of at which expected profit is maximised will be , where is introduced to capture the opportunity cost of producing coffee, which is the price of other crops that could have been produced on the land. Similarly, considering the optimum level of production and area under coffee, the yield function can be represented as: . We will discuss the the empirical model of land area under coffee production in detail later. The next section will discuss the determinants of yield.

5.1 Coffee Yield and Its Determinants

To identify the key determinants of the coffee yield in Africa, we empirically estimate the yield model discussed above. For the empirical estimation of the yield model, assuming expected profit maximisation assumption, we assume that farmers form their expectations from past prices. Ac-cordingly, we included lagged farm gate coffee prices. Using the Akaike Information Criterion (AIC) and the Schwartz Baysian Information Criterion (SBIC), we first determined the number of lags appropriate for the data. The test showed that a maximum of two years lags was appropriate. We, therefore, use two-period lagged farm gate coffee prices (Lopez 1992; Yilmaz, 1996).

For the prices of inputs, such as labour, due to data limitations, we use a one-period lagged gen-eral rate of inflation. The one period lagged average rainfall level is also introduced to control for the effect of weather on yield. Following Robinson et al. (2015), we introduce the growth rate of yield as an additional explanatory variable to capture yield growth driven by technology im-provements, such as improved coffee varieties, better husbandry practices, and infrastructure. To capture the omitted factors that shift in the yield frontier over time, we introduce the trend term. In addition, due to significant cross-sectional differences in yield, we tested whether including time and panel fixed effect is needed for the yield model. The test showed that including country dummies is necessary. The need to include country dummies was also further justified by the fact that generalized least squares (GLS) estimator does not pick panel specific effect and only focuses on the error structure to correct the autocorrelation in the panel.

We therefore estimated two yield models, one excluding the country dummies and the other one including them. The results are reported under model I and model II. The coefficient estimates of the variables that are included in both models are almost similar, both in terms of sign and signifi-cance. However, due to relatively better fit, we use model II for result interpretation. In the model, the variable that represents the level of the previous two years farm gate coffee price is significant determinant of the yield level, but the previous year farm gate price of coffee, although has the expected positive sign, it is not significant.

According to the result, a 1 percent increase in price leads to close to a 0.15 percent increase in yield. Although the yield level is highly inelastic to price change, its significance suggests that price matters, and low farm gate price was one significant contributor to the decline or stagnation of the coffee yield level. The level of farm gate price, through its effect on the marginal revenue productivity of yield-enhancing modern inputs, such as chemicals and fertilisers, influence the optimum mix and level of inputs and ultimately reduce yield.
We also know that the farm gate price level is influenced by domestic market structure, the trans-action cost level, tax, and supply chain efficiency. All these factors are reflected on the share that farmers get from the export price.

In the African context, the average percentage share of farm gate price to export price was 55 percent, which is significantly lower that the share of more than 85 percent that farmers get in Vietnam and Brazil. In addition, in most of the sample countries, except in Uganda where the share showed a significant positive trend, the share of the farm gate price was either stagnant or declining. This was the case of Ethiopia and Côte d'Ivoire. Therefore, although the unfavourable external market price could be a contributor, supply chain inefficiency and higher export tax must have further limited the impact of recent world market prices improvement on yield.

The rate of inflation is negatively associated with yield level. As noted earlier, this variable is meant to capture the effect of the prices of inputs, including labour or other price-related factors that influence the opportunity cost of coffee production. The result suggests that increase in the cost of living reduces the relative profitability and real income of coffee farmers. The effect could be felt either through reducing the incentive to allocate more labour time for coffee husbandry or reducing the financial capacity of the farmer to purchase yield-increasing inputs.

The variable could also capture the impact effect of the real exchange rate movement on the cof-fee sector. We found a significant correlation between the inflation rate and the real effective exchange rate (REER). In fact, when we dropped the inflation variable and replaced it with the lagged real effective exchange rate, although at 7.4 percent, the variable was significant and nega-tive. The significance and the sign of the other variables of the yield model also remained the same. The negative sign of the inflation variable, therefore, implies that policies that appreciate the REER or increase production cost would have an adverse impact on yield and coffee pro-duction. The appreciation in real exchange rate usually arises when there are large inflows of for-eign currencies, either in the form of development aid or from increased export, particularly oil.

Under such conditions, unless countries are cautious and implement measures that would nullify such adverse effects, it will significantly undermine the productivity and competitiveness of their export. For instance, although not included here due to its low share in Africa's current coffee export, Angola is a prime example. Until petroleum took over the economic landscape, in the 1970s, coffee was Angola's main export, and the country was the fourth largest producer of cof-fee in Africa (Economist, 2013). However, in 2013/14, Angola's rank declined to 16th, and the current volume of coffee export is less than 1 percent of its export in the 1970s. This suggests the importance of maintaining exchange rate policy or taking additional measures to nullify any such bias is necessary to increase coffee yield in Africa.

Table 2 Parameter Estimates of the Yield model*

	Model 1			Model 2		
Variables	**Coeff.**	**t-stat**	**p-value**	**Coeff.**	**t-stat**	**p-value**
Producer Price $_{(t-2)}$	0.08	2.5	0.01	0.095	2.95	0
Producer Price $_{(t-1)}$	0.04	1.16	0.25	0.04	1.26	0.21
Annual Inflation	-0.036	-2.73	0.01	-0.05	-3.49	0
Annual Rainfall	-0.014	-0.15	0.89	-0.03	-0.29	0.77
Growth in Yield	0.04	10.34	0	0.004	9.53	0
Trend	-0.018	-1.99	0.047	-0.017	-4.6	0
Cote d'Ivoire				-0.83	-3.43	0
Kenya				-0.72	-7.44	0
Tanzania				-0.7	-6.95	0
Uganda				-0..43	-0.61	0.5
Constant	8.71	14.21	0	9.29	18.82	0
Wald chi2 (6= (10)		124.46	0		240.96	0
Number (Group)	105(5)			105(5)		

* The model is estimated after correcting for heteroskedasticity and panel specific autocorrelation

The average rainfall level, which is used to represent environmental factors that influence yield, was not significant and did not have the expected positive sign. However, when we checked the data, we found that a three-period lag rainfall level is positively and significantly related with yield level. This result though is not intuitive or immediately apparent for such an association because the yield level is influenced by the rainfall level pattern before harvest. The annual percentage rate of growth in yield, which is assumed to capture yield growth driven by technology improve-ments, is positive and significant. However, the magnitude of the coefficient is very small, and as a result, the shift to in-yield curve as a result of technological progress is not substantial.

The trend variables are negative and highly significant. Although the proxy for technological pro-gress was captured by the percentage of yield growth variable, we believe that the trend variable captures time-varying omitted variables, such as input prices and climate change and its adverse effect on yields, such as by causing increased incidences of pest and disease. It could also capture the decline in the

soil or land quality. Over time, as the fertile land is shrinking, people cultivate less productive land, and as a result, the rate of increase in output would not be as fast as the mar-ginal change in the land size. This will lead to a decline in average yield. The result implies that investments on small-scale irrigation development and technologies that enable farmers to cope up with the effect of climate change are critical to minimize the adverse effect of climate change on Africa's coffee production.

All the country dummies, which captures all other country specific omitted factors that affect yield, are significant except that of Uganda. The dummy for Uganda, although negative, it is not significant. Since the constant term of the regression represents Ethiopia, it suggests that there are no systematic differences in yield performance between Ethiopia and Uganda. The significance of the dummies of all the other countries suggests that omitted country-specific factors are important determinants of yield, and are potential causes of the observed significant cross-country differ-ences in the level of realising yield. Although the level of world market price of coffee and the farmers' share of the world price matters, the bulk of the variations in yield level in Africa is ex-plained by country-specific factors. Thus, exploring these contributors will provide valuable in-formation for policy and investment interventions. The next section will be devoted to that pur-pose.

The overall conclusion that can be drawn from the above result is that both domestic and external factors are contributors to the stagnant and widening yield gap. However, since the elasticity of yield to farm gate price is relatively low, it suggests that non-price related factors are more im-portant.

Since the impact of world market price on farmgate price is also mediated by supply chain ineffi-ciency, export tax, and domestic market power, the direct effect of adverse movement of the world market price of coffee on yield may not be substantial. However, its indirect effect that works through reducing government revenue and subsequently on the magnitude of government budget allocated to coffee research and extension services might be more significant. Neverthe-less, when one consider the yield trend in non-African coffee exporters, it appears that unfavora-ble world market price hardly had an impact on yield. This is because although they were facing similar world market prices, these countries managed to achieve higher coffee yield. This means domestic factors are more responsible for low level of coffee yield in Africa. Therefore, while collaborating with other non-African exporters to secure better prices for their coffee export is necessary, African coffee exporters' main focus should be on identifying and addressing the most binding domestic constraints. Based on the literature review, and information obtained from the field visit to Uganda, we shall discuss the main drivers of low coffee yield in Africa. We also dis-cuss the required actions to address these constraints.

5.1.1 Weak Capacity to Generate and Disseminate Technical Knowledge

Based on the information from the field, one of the main factors that contributes to low coffee yield in Africa is the lack of capacity to generate technical knowledge on high yielding, drought, and disease resistant varieties promptly and at the scale required. Due to inadequate research in-frastructure, facilities and staff, research institutions are unable to respond to the demands of the coffee industry. Examples might be demands for improved seedlings, pest, drought, and disease resistant varieties. At present, Africa continues to rely on out-dated and often unproductive coffee varieties. Most varieties that are grown at present in different countries are susceptible to coffee leaf rust, coffee berry borer or coffee twig borer.

Despite the crucial role in technology generation, and providing technical backstopping to the coffee sector, in many countries coffee research has not been given adequate priority. Conse-quently, national coffee research institutions are ill-equipped to address critical production and allied challenges. Some of the main constraints in coffee research include inadequate facilities, inadequate skilled human power, and insufficient funding for research.

Coffee exporting African countries are still considered as marginal developers of new technolo-gies. Their share of the world research and development effort is very tiny compared to produc-ing countries in Asia, Central and South America. Recent improvements have been recorded in research institutions such as the Centre National de Recherche Agronomique in Côte d'Ivoire, the Jimma Agricultural Research Center in Ethiopia, the Coffee Research Foundation in Kenya, the in Tanznia Coffee Research Institute in Tanzania, and the National Coffee Research Institute in Uganda. These institutions have succeeded in developing new high yield and disease resistant planting materials, even though their research method is still of a classical type and based on field experiments.

Varietal dissemination and adoption by farmers has, however, been limited. Even if the required varieties are available at research stations, due to limited capacity to multiply them at scale, im-proved varieties are not promoted and disseminated to farmers. As such, farmers' needs in some countries are not always met. Therefore, enhancing the capacity of the research institutions and addressing other constraints are critical to increase yield, to improve competitiveness, and ensure the long-term sustainability of the African coffee sector.

5.1.2 Poor Agronomic Practice due to Weak Extension Service

The other serious challenge to coffee farming in Africa is the inadequate provision of extension services to small-scale coffee farmers. As a result, coffee production in Africa is characterised by poor agronomic practices. Better agronomic practices constitute one key source of success for Vietnamese farmers, who by varying farm management inputs alone, are able to achieve higher yield (Marsh, 2007). Adopting proper production and processing methods has also been found to be a major contributory factor to improving coffee quality, as with aroma, taste, and cleanness. These are all important to earn premium prices (You and Bolwig, 2003).

In most coffee growing African countries, farmers lack such skills, and their production, and pro-cessing methods are mainly based on traditional knowledge (Alex and Byerlee, 2002; IDH, 2013, IDH, 2007). This is costing Africa in lost benefits. Improved agronomic practices alone are found to double coffee yields in Africa (You and Bolwig, 2003). For instance, in Uganda, through im-proved agronomic practice, the yield of Arabica coffee could increase from 474 kg/ha to 1000 kg/ha, and the yield of Robusta could increase from 656kg/ha to 1500 kg/ha (Ibid). Similarly, in Côte d'Ivoire, yield could increase from 150-200kg/ha, under the traditional system, to up to 300 or 400 kg/ha through improved agronomic practice (CITA, 1992).

Although improved agronomic practices are within reach of African farmers, they have so far failed to adopt them just because extension or advisory services on improved agronomic practices are in short supply. While all African countries have extension systems that provide advisory services, they are underfunded and understaffed and as a result, fail to offer adequate support to the coffee sector. For instance, based on information obtained during field visits, in Uganda, there is only one extension agent for each coffee producing district. This means that each agent is serving an average of 200,000 farmers.

Inadequate advisory services also hamper the link between research and farmers, and thus limits the dissemination and hence the potential impact of the already existing knowledge. Although there are

improved technologies (coffee varieties) and improved agricultural practices at research stations, due to weak extension systems or lack of coordination between research and extension advisory services, such information is not effectively disseminated to farmers (Evenson and Mwabu, 1998; CITA, 1992).

Poorly informed production decisions by farmers will not be confined to themselves, but will also generate negative externalities, as they entail a resource allocation pattern that is sub-optimal. As a result, the provision of extension services to coffee farmers has a public good nature and must be provided by the state, until such a time that the delivery of such services on a commercial basis becomes viable.

Although farmers are direct beneficiaries from higher yields, governments, which currently derive between 18 to 30 percent of their export earnings from coffee, as well as individuals who are directly or indirectly involved in the coffee industry, will also benefit. Furthermore, given that the option of pushing the land frontier in some African countries is limited, future production in-crease should come from intensification and efficient use of inputs, for which the supply of advi-sory services is paramount.

The second reason for poor agronomic practices is associated with weak incentives and lack of resources. In some cases, farmers may not have the resources for pruning and stumping coffee trees. With a few exceptions, small-scale farmers are poorly equipped or lack the requisite equipment. In some cases too, the labour and time allocated to such activities may not be eco-nomically rewarding. For instance, coffee production and processing are labour intensive (Dube and Vargas, 2013). In most coffee growing countries, family labour is used for coffee mainte-nance, with the assistance of hired labour. However, since the return from coffee is dwindling, the younger family members are either migrating from rural farming areas in search of better op-portunities in towns and cities, or they allocate their labour to potentially more rewarding other rural livelihood activities.

Since most farmers are liquidity constrained, they are unable to hire the required labour. As a result, the total amount of labour allocated to coffee production is likely to decline. The interac-tion between low returns from coffee (both due to low yield and declining price for coffee) and an increase in the opportunity cost of labour further contributes to low yields and a decline in coffee quality. We refer to this as a vicious cycle of low yield. For instance, the pruning and careful processing of coffee are labour intensive activities, but they significantly improve the quality of the coffee. However, if price is based on volume and if a traceability system in the cof-fee market is absent or ineffective, it means the market does not reward quality, and as a result, the incentive to improve quality will be low.

If the market price of coffee continues to decline for consecutive years, the opportunity cost of labour will increase. In response, farmers are more likely to reduce their labour inputs, which will reduce yield as well as quality. To test if this holds for our sample of countries, we introduced a dummy variable, with a value of 1 for the periods 1988-92 and 2000-2003, during which the coffee price declined continuously. Results show that although at a 6 percent level of significance, if the coffee price continuously declined for three years, yield would be 10 percent lower.

5.1.3 Ageing Farmers

Low return from coffee not only reduced yields by reducing labour inputs, but also made coffee production less attractive to the youth. Across all coffee producing countries, production is cur-rently dominated by aged populations (ICO, 2014; Tauer, 1984). As there is an inverse relation-ship between age and yield, particularly after 50 years, ageing farming population in coffee farm-ing has been claimed to be one cause of the decline in coffee yields in Africa. There is a vicious circle here. Low yields give rise to low returns, and low returns, in turn, made coffee production less attractive to the youth. Their limited engagement in coffee production, in turn, contributed to the decline in coffee yield. To break this vicious cycle, there must be a shift in the yield curve that would come from technological change (ICO, 2015).

5.1.4 Ageing Coffee Trees

Ageing coffee trees is the other contributor to low yields in Africa (Fleming and Fleming 2007). In almost all coffee growing African countries, the average age of the coffee trees is more than 30 years (Ibid). For instance, in Uganda, coffee farmers work with extremely old coffee trees, most of which are approximately 40 years old. Some trees, at 70 years old, are still being farmed (Hill, 2008). Are farmers unaware and irrational about harvesting old low yielding trees instead of re-placing them? Farmers are rational and quite aware of the costs and benefits, but are constrained by imperfect and missing financial and insurance markets.

Replacing old with new coffee trees entails an income loss to farmers because it would take three years to harvest beans from new trees. Since coffee farmers in Africa are liquidity constrained, unless they have access to credit or other sources of income to meet their consumption expendi-tures, they will be unwilling to make such investment (Ibid). On the other hand, banks are reluc-tant to provide credit for such investments, which are deemed risky and take a long time to gener-ate returns. In some rare cases, even if the banks are willing to offer credit, they charge very high-interest rates, which makes such loans unaffordable.

Excessive risk perception by banks, not only constrains farmers' ability to respond to economic incentives but also has undesirable equity consequences. While liquidity constraint limits the abil-ity of poor farmers, wealthier households can afford and obtain better access to credit. They can thus replace old trees and become more productive. In the long-term, this will further widen the income gap between poor and wealthy farmers.

Although we cannot rule out the potential effect of low global market prices, it appears that lack of access to credit or alternative sources of income seems to be the major determinants of the willingness of farmers to replace old trees. For instance, although global coffee prices have re-covered in recent years, the yield in Africa remained low, and even declined in some countries. When we compare the situation in Africa with the successful global exporters, farmers in Africa are disadvantaged.

In Vietnam, which became the second largest coffee exporter in a very short period, the govern-ment, through its state-owned development bank, VBARD, supplied farmers with a large amount of needed credit (Marsh, 2007). The bank has 1,600 branches in rural areas, and delivered 75 percent of its credit to coffee farmers. In addition to providing credit, the Vietnamese government was also willing to adjust loan repayment terms according to market conditions and even showed leniency, freezing repayments for up to three years when coffee prices were very low. (Marsh, 2007) Despite low prices, Vietnamese farmers registered higher yield partly due to such public support, which is lacking in Africa. Therefore, addressing the adverse effects of financial market imperfections and providing farmers with short- and long-term support will be critical to improv-ing yield and competitiveness.

Apart from lack of finance, price volatility will also have a disincentive effect on the replacement of old coffee trees. Although not significant, in five of the six African coffee exporting countries reviewed, the yield is negatively associated with price volatility. Since rural insurance markets in Africa hardly exist, uncertainty about the future price will reduce the incentive to replace new trees or even to prune old trees. Due to the irreversibility of the investment (replacing old trees), farmers tend to hold a wait and see attitude. For instance, Fafchamps and Pender (1997) show that when a household faces an uncertain income stream, even if it has the savings to finance such an investment, it may decide to delay making an irreversible and indivisible investment.

Similarly, based on data drawn from rural households in Uganda, Hill (2006) claimed that risk has a significant influence on the production decisions of poor coffee farmers. She noted though, that risk

preference is only important to the extent that households cannot insure against income fluctuation. Therefore, to increase households' ability to respond to price changes, ad-dressing volatility, irreversibility, fixed costs and liquidity constraints are key. (Hill, 2008)

Interventions that facilitate medium- to long-term credit access to farmers would be crucial in enabling many poorer farmers to replace old trees and become more productive. Besides provid-ing credit, adopting a flexible credit policy that takes into account the changing market conditions is important. Interventions that allow households to be more certain of future returns from coffee production may encourage a more responsive investment strategy, Schemes that provide some form of insurance to farmers will also have a strong impact on yield.

5.1.5 Increased Incidence of Pests and Coffee Diseases

Increased incidence of pests and coffee diseases, particularly Coffee Wilt Disease (CWD), are the other causes of low and declining coffee yields in Africa. Flood (2010) claims that disease, on average, has claimed about 30 percent of coffee production in African countries. Coffee Wilt Disease is dominant in four African countries (Democratic Republic of Congo, Uganda, Tanza-nia, and Ethiopia). Among these countries, the effect of the disease was more disastrous in Ugan-da. For instance, while Uganda's robusta production reached its highest in 1996, production in most recent years is reported to be only 42 percent of the peak production level so far achieved (DFID, 2010).

Experts believe that most or all of the decline in Robusta in Uganda was likely due to Coffee Wilt Disease. (Ibid) Although these losses could have been prevented or minimised, due to lim-ited capacity, research institutions in Africa were unable to respond promptly and at the required scale. Failure to build research capacity is costing Africa a lot more than what it costs to build capacity. A conservative estimate shows that due to Coffee Wilt Disease alone, in the periods between 1997 and 2007, poor farm households in Uganda suffered an income loss of close to US$580 million. (DFID, 2010) Since the disease could be transmitted across regions, controlling it requires a regional effort. Adopting a regional approach to research and technology develop-ment might, therefore, be cost-effective and efficient.

5.1.6 Changing Weather and Climate

In most coffee growing areas, due to climate change and other extreme weather occurrences, there is an increase in the frequency of drought. Rainfall has become more erratic, with both greater unpredictability of occurrence and shorter periods of rainfall (Nsibirwa, undated). As cof-fee production depends on specific rainfall distribution patterns, erratic distribution and shorter rainfall periods will reduce the volume of coffee production. In some years, even in Uganda, extremely dry and prolonged drought had caused a production loss ranging from 44 percent to 50 percent. Rainfall distribution also directly controls cherry maturation, which determines bean size (coffee quality) and determines the prevalence of disease and the susceptibility of coffee trees to diseases and pests. Moreover, an increase in rainfall variability is also impinging on producers' ability to dry coffee properly, and thus, also affects coffee quality. Short rainfall and frequent dry season also undermine the effectiveness, and consequently, the returns from fertiliser.

The negative coefficient of the trend variable, which was discussed above, may reflect the effect of climate change. Under the current condition, the use of irrigation may be necessary to nullify the adverse effect of climate change. Although the use of irrigation in coffee production in Africa is very rare, except in the case of Kenya's estate farms, extensive use of irrigation is one key fac-tor that enables Vietnam to achieve a world-class yield level. Vietnam is one of the few countries to irrigate Robusta coffee systematically (Marsh, 2007).

Although the overall rainfall volume is sufficient for coffee production, due to its uneven yearly distribution, Vietnamese farmers have been using irrigation. The use of irrigation in Vietnam, particularly in dry season, breaks the flower bud dormancy. It stimulates the flower buds to grow in length three-to-fourfold, and induces flowering and then fruit (Ibid) The use of irrigation, bal-anced with the use of high levels of chemical fertiliser, enabled many Vietnamese farmers to achieve over 3.5 tons/ha. This achievement is quite a substantial one when compared even to Vietnam's Asian neighbours, such as 0.5 tons/ha in Indonesia, 0.4 tons/ha in Laos and 0.8 tons/ha in Thailand. In Vietnam, water for irrigation comes from human-made ponds and reser-voirs (20.8 percent), natural rivers, lakes and streams (28.5 percent) and ground water (56.6 per-cent). Box 4 provides details on how Vietnam achieved world-class yield.

5.1.7 Loss of Soil Fertility and Limited Fertiliser Application

Loss of soil fertility and limited application of fertiliser are the other factors that have been con-tributing to the decline in coffee yield. Continuous use of the land could lead to mining of soil nutrients, and as a result, unless there is an increase in the application of fertiliser to maintain soil fertility, yields will decline. (Gallup and Sachs 2000; Marsh 2007) For coffee production, ferti-liser is used to encourage coffee shoot, root growth, as well as to help increase berry produc-tion. In Africa, the average rate of fertiliser application for coffee production is very low. While Africa accounts for only 1 percent of global consumption of fertiliser, the region's leading fertiliser users (Egypt, Morocco, and South Africa) are not are not coffee-producing countries (ICO, 2009).

The low rate of application of fertiliser is one of the key contributing factors to the observed yield gap between Africa and globally successful coffee exporters. For instance, while Brazil and Vi-etnam together account for 25 percent of the global coffee cultivated area, they account for 50 percent of the global production. On the other hand, whereas Africa accounts for 33 percent of the world acreage under coffee, it produces only 11 percent of the global total. Variations in fertiliser application, therefore, partly explain such differences. Some claim that depending on soil and climatic factors, fertilisers applied at 200kg/ha can offer yield increases of 500 to 1500 kg/ha (CTA, 1992). Brazil and Vietnam achieved yields of around 1400kg/ha, while the average for the rest of the world is 550 kg/ha. Despite an improvement in coffee prices, fertiliser application in Africa remains low (Bayite-Kasule et al., 2011).

The causes of the limited application of fertiliser can be explained by both demand and supply-side constraints. On the demand site, the profitability, and hence, demand for fertiliser is under-mined by the low level and high volatility of coffee price, as well as by a continuous increase in the farm gate price of fertiliser (Morris et al., 2007).

A non-parametric analysis showed that yield is negatively associated with fertiliser price, but posi-tively with coffee prices. This suggests that fertiliser application is negatively associated with the relative prices of coffee (Winter-Nelson and Temu, 2005). For instance, in 2008, the price of potash, which is the main fertiliser usually used in coffee production, increased by 411 percent, compared to its level in 2000. In contrast, the price of coffee during the same period increased by only 93 percent. Although the return per hectare is more important than the price, the return from fertiliser is also determined by soil conditions and water availability. In addition, price volatility will further increase the risk of fertiliser application. If coffee prices are more volatile, farmers are less likely to apply fertiliser, or if they do, they apply it sub-optimally. Under rain-fed cof-fee farming in Africa, where weather shocks are common, farmers have fewer incentives to use yield-enhancing inputs.

The other important contributor to low fertiliser application in Africa is a lack of finance or li-quidity constraints of farmers. In some cases, as farmers are short of cash to buy fertiliser, they either do not apply or tend to apply less fertiliser. Despite the size and importance of agricul-ture, and of the coffee sector in

particular, because of both real and perceived risks, commercial banks operating in Africa are often reluctant to lend to coffee farmer cooperatives. As a result, credit to farmers in most African countries is in short supply, and if available, either requires col-lateral or the interest rate is prohibitive. Also, if there is government subsidy, it may not be deliv-ered promptly.

In some leading coffee producing countries, including Ethiopia, farmers' access to credit is fur-ther obstructed by several regulatory constraints, such as strict lending policies and government-mandated collateral requirements. Thus, although the relative prices of coffee and fertiliser are important determinants of fertiliser application, domestic factors seem to be more important. The most salient are particularly those that affect domestic costs, affordability, profitability and availa-bility of fertiliser, as well as risks of fertiliser application. The issue surrounding application of fertiliser is more of a vicious cycle of low production. A low level of production gives rise to low income, and low income leads to limited saving or financial resources. This, in turn, leads to weak demand for commercial inputs, and ultimately, low level of output. The only way to break the cycle is to provide subsidy or fertiliser credit.

On the supply side, fundamentally, fertiliser distribution is unprofitable in many parts of Africa because of the weak and dispersed nature of demand. In addition to the thinness of the market, which does not allow traders to capture economies of scale, high transportation costs stemming from inadequate road and rail infrastructure, and high-interest rates on bank borrowing for ferti-liser importation are also key supply-side constraints. This is supported by Morris et al., 2007. Again, we see the vicious cycle: low fertiliser and the high cost of fertiliser in Africa contributes to the low application of fertiliser. The low application means low demand, which, in turn, makes it impossible to capture economies of scale associated with fertiliser procurement and distribution. This thus inflates the cost of supply.

The high cost of finance is another supply-side factor that raises the cost of fertiliser. Therefore, one way out to break the vicious cycle of low fertiliser-low yield is to provide credit and irrigation facilities. The combined use of irrigation and fertiliser is a key strategy that helped Vietnam achieve a world-class yield level. To maximise the return to fertiliser application, it is also im-portant to first identify the nutrient deficiency of the soil of a particular area. To that effect, nutri-ent deficiency mapping or putting in place soil and tissue analytical services in each coffee grow-ing region is necessary to avoid blanket fertiliser application.

Box 2 Vietnamese Coffee Sector Success story

(Adapted from Marsh, 2007)

Coffee is one of the most important export commodity of Vietnam. Coffee production provides the livelihood for an estimated four million people in. Between 85-90% of planted area is cultivated by small farmers, each holding from 1 to 2 hectares, and the balance by large-scale commercial farms.

Vietnam's growth is unique in the history of coffee production and expanded at astronomical rate and grew in two decades to become the second largest global coffee producer. In 1989, Vietnam held a global market share of only 1.2%. Ten years later Vietnam surpassed Colombia to become the world's second largest coffee exporter with a market share of 12.4% and by 2015 its share has increased to 22%. The massive increase in Vietnam's coffee supply was particularly occurred after 1989. We postulated a simple trend model (correcting for autocorrelation) to check if this year was a significant year in terms of shift. The trend term for the yield is significant but for the area under coffee is weakly significant, suggesting that area increase was already occurring before 1989, but the large increase in yield mainly occurred after 1989. Between 1990-2014, the yield was increasing at 4% per annum, area by 5.9% and production by 10%. In absolute terms, the yield curve shifted more than three folds and the area under coffee 20 folds. As a result, production increased from the average of 10159 tons, to 726199 tons. The minimum production level during the post 1989 period was 920000 tons and this level was more than 200% of the maximum production level of 42000tons attained before 1989.

What contributed to the burgeoning Vietnam coffee sector and what lessons Africa could learn? The growth of the coffee industry in Viet Nam is attributed to a range of factors.

Adequate supply of labour due to mass migration: One key contributor to the development of coffee in Vietnam was the mass migration programmes undertaken by the government in the late 1970s and early 1980s. The initial objectives of the program were to solve unemployment and social unrest, mostly in urban areas. Accordingly, New Economic Zones (NEZs) were established and people were encouraged to move from populated to sparsely populated areas. The newly settled areas were also very fertile and suitable for coffee production. However, during the 1970s and 1980s resettlement program, expansion of coffee production was not the main objective and it came only to the scene by the late 1980s when the government institutions found out the possibilities of coffee production (Jones 2002 cited in Marsch, 2007).

Conducive policies and institutions:

The Vietnam coffee industry was initially state owned, with government guidance and subsidy. However, following the liberalization, many of these publicly owned coffee producing and trading agencies have been gradually moved over to the private sector. The knowledge and understanding of Robusta coffee production gained by public institutions provided adequate knowledge base to small farmers and private large-scale commercial farms. The other key success was the willingness of government to change and tailor its support according to the global market condition of coffee.

Incentives: A move from a collective farming model to a private farming system created the needed incentives to farmers. In 1988, Viet Nam established a new system that gave farmers rights to keep and sell some of their farm production and later, they were no longer constrained by production quotas and could benefit from a more free and liberalized market. By maintaining controls on basic food prices and commodities like rice, the government created incentives for farmers to move to export crops, such as coffee. The incentive structure further improved following the land reform that allowed farmers the land use right, which provided farmers tenure security and ability to access credit for farm production using their land as collateral. The collapse of the International Coffee Agreement (ICA) in 1989 provided Vietnamese coffee producers market and relatively better price and as a result, between 1990-200, coffee production grew by 11.4% per annum. Near zero export tax and indirect subsidies further made coffee production more attractive. The share of farm gate price to world market price is globally the highest, more than 84%.

Adequate Access to Credit: The government, through its state-owned development bank, VBARD, supplied farmers with a large amount of needed credit (Marsh, 2007). It also showed flexibility and willingness to froze loans or extended the lending periods in times of hardship and lower coffee prices.

Adequate and timely supply inputs: Key agricultural inputs were provided from local sources, when it was not sufficient, the government was willing to import large quantities of inputs on time. The deregulation of import restrictions in 1991 allowed chemical fertilisers prices to drop by 50 percent and this resulted in increased chemical fertiliser application and increased yields (World Bank 2004).

Technology: High input models were developed on state farms and these were gradually improved over time and farmers emulated and used them well. Mar-ket access: Marketing channels were developed by the state farms and state marketing enterprises were involved in exporting coffee, but gradually the private sector has taken them over.

Natural Resources: The growth of the coffee development in Viet Nam was aided by the availability of a large area of fertile soils that are well suited for Robusta coffee production. The moisture retention capacity of the soil is also very good. The climate is also ideal for Robusta production. Overall rainfall volume is sufficient for Robusta coffee production, with yearly average rainfall of 1600 to 1800 mm. Although the overall rainfall volume is sufficient for coffee

production, due to its uneven yearly distribution, Vietnamese farmers have been using irrigation intensively (Marsh, 2007).

Irrigation and Agronomic management practices: The combined intensive use of irrigation and fertiliser is the key source of success for Vietnam. Viet Nam is one of the few countries to systematically irrigate Robusta coffee. Although Robusta is grown in most South East Asian countries, irrigation is hardly used because it is generally assumed that the return from Robusta is not high enough to warrant intensive production and irrigation. The use of irrigation, balanced with the use of high levels of chemical fertiliser, enabled many Vietnamese farmers to achieve over 3.5 tons /ha. The use of irrigation in Vietnam, particularly in dry season, breaks the flower bud dormancy, stimulates the flower buds to grow in length three-to-fourfold and induce flowering and then fruit set (Ibid). Better agronomic practices was also one key source of success for Vietnamese farmers. By varying farm inputs alone, they can achieve higher yield (Marsh, 2007). Despite the fall in the world coffee price, Vietnam managed to increase its share because most Vietnamese growers appear to be sufficiently efficient to continue producing coffee even at relatively depressed price levels. They have adopted many successful strategies in order to maximize profits from Robusta. The can control yield can by varying the water and fertiliser inputs and farm management inputs like pruning.

Intensive production system: The key factor to the industry's success is that the coffee industry has embraced a very intensive production system. The Viet-namese industry has taken the view that even a lower value commodity can be profitable if grown intensively. As a result, many Vietnamese farmers actually achieve over 3.5 tonnes /ha, which the highest globally and more than four times of the yield achieved by its Asian neighbours, such as Thailand, 0.8 tonnes /ha.

5.2 Area under Coffee Production and Its Determinants

In the previous sections, we identified the decline in the size of the land area under coffee pro-duction as one key driver for the decline in the volume and export earnings of coffee in Africa. We have also argued that the key drivers are both price and non-price related factors, which are contributed by unfavourable domestic and world market conditions.

To ascertain whether weak incentive structure or other factors are key drivers for the decline in area under coffee production, we postulated a long-run model for the area under coffee. Based on the assumption of expected profit maximisation, in section V, we identified the size of land area under coffee production , where is the price of coffee export for a specific quality of coffee, is introduced to capture the opportunity cost of producing coffee, which is the price of other crops that could be produced on the land, and is a vector of bio-physical characteristics, such as soil, climate, topography, etc (Antle and Capalbo, 2000). Since the size of land allocated to coffee production is an investment that generates return at least after three years, farmers normally aim to maximise the net present value of such investment. The net benefit streams of the investment also depend on input prices, the price of coffee, the discount rate and the price of other crops that can be grown in the land. The higher the cost of inputs, the discount rate and the price of other crops, the lower the incentive to use the land for coffee pro-duction. However, higher coffee price will increase the incentive.

For investment decisions, we assume that farmers take the expected price. As argued before, farmers form their price expectation based on historical prices. Since investment on coffee gener-ates returns after three years, the current size of land under coffee production is assumed to be influenced by the expected price of coffee three years before. Assuming farmers adjust their ex-pectation based on market changes, following previous empirical studies, we introduce three- year lagged measures of expected prices. For this, we reference Lopez 1992 and Yilmaz, 1996.

Since a higher expected price increases the incentive to invest, these variables are expected to have a positive sign. To capture the opportunity cost of land under coffee production, we used the rate of general inflation as a proxy for the prices of alternative crops that can be grown on the land. As most of the alternative crops cultivated by coffee farmers are food crops, and since food price inflation is

also a major component of the general inflation, the inflation index is believed to be a good proxy. As the increase in the prices of the other crops reduces the incentive to allo-cate additional land for coffee production, the variables are expected to have a negative sign. We also introduce lagged rainfall level as a proxy to capture factors represented by . Since the rain-fall level is a key determinant of the productivity of land, and hence one key decision variable, we also introduce three period lags of the average rainfall level. The variables are expected to have a positive sign, as higher rainfall increases the potential return from land and hence increases the incentive to allocate more land to coffee.

The other key factor that affects investment decision is price risk. Price volatility introduces out-put price-risk and has a detrimental impact on producers' resource allocation and investment de-cisions (Moschini & Hennessy, 2001). In a situation where there is no crop insurance and where farmers' incomes are at a subsistence level, it is unrealistic to ignore at least price risk. There-fore, we introduce a proxy for price risk. To measure price risk, using the fixed effect regression model, we regress the current price volatility measure, which is measured as the standard devia-tion of farm gate coffee price, on its two periods lags. The predicted value will be used as a proxy for price risk. Since higher price risk reduces the incentive to invest or allocate more land under coffee, the variable is expected to have a negative sign.

In addition to price-related factors, the land allocation decision could also be influenced by non-price related factors, such as population pressure or conversion of land to non-agricultural uses. To capture the effects of these non-price factors, following Robinson et al. (2015), we will intro-duce the growth rate of land under coffee. The sign of the coefficient of this variable cannot be determined a priori as it depends on whether land expansion or contraction trend was dominating in a country. We also introduced the trend variable to capture the effect of other omitted varia-bles.

The estimation results are reported in Table 4 under Model I, which exclude country dummies, and Model II, which includes country dummies. The signs of the variables in Model I are con-sistent with our prior theoretical expectation. When the country dummies are included, except the two-period lagged inflation variable, the signs of all the other variables remain the same. Howev-er, the magnitude estimates of all these variables, except two of the farm gate lagged coffee prices, showed significant change. For our purpose, we use the result of Model II, because it controls the country-specific effects.

Box 3 Estimation and Testing of the Area Under Coffee Model

We estimate the area model using the panel data of six major coffee exporting countries, namely Ethiopia, Cote d'Ivoire, Kenya, Tanzania, Uganda and Madagascar. Before the model estimation, we tested for mul-ticollinearity, autocorrelation and heteroscedasticity. The multicollinearity test suggested that there are no serious multicollinearity problems. The presence of autocorrelation and heteroscedasticity were also tested using the Wooldridge (2002) suggested autocorrelation test and the Likelihood-ratio test for a panel data. Both the null hypothesis of no autocorrelation and homoscedasticity are rejected at less than 1 percent. As a result, while correcting for the heteroscedasticity problem, we fitted the model using the feasible GLS method. Since the GLS fails to pick the country fixed effects, we tested for the need to include country and time specific effects. The result showed that country specific effect is significant, but time specific effect is not. Accordingly, we fitted the model by including as well as excluding country dummies.

The results of the model suggest that both price and non-price related factors were important de-terminants of the size of land under coffee. Although the coefficients have the expected sign, only the first two period lags are significant. Therefore, while controlling for unobserved country and time-specific factors, the result confirms that farmers' price expectation is an important determi-nant of land area under coffee. Thus, any shocks or policy changes that influence farm gate pric-es, such as a change in the global market price of coffee, export tax and supply chain inefficiency and market power will have a significant impact on the size of the land area under coffee produc-tion. However, the elasticity of land to a price change is very low, which suggests that although price matters, non-price factors were more important determinants of land area.

The variables that represent the rate of inflation were significant, but only the first and the third lags have the expected sign. The significance of the inflation variable indicates that in locations where crop diversification is possible, the continuous decline in the relative farm gate price of coffee tend to induce farmers to replace coffee by other crops that are more profitable and less risky. For instance, anecdotal evidence suggests that in Kenya, farmers substitute coffee for horti-culture, tourism, and real estate. In Tanzania, farmers are shifting from coffee to cashew; in Ethi-opia, Harrar coffee is being substituted by Chat. In areas where coffee farmers have no alterna-tive option, or the production of other crops is less profitable than coffee, they continue to grow coffee but devote less labour time to coffee tree husbandry.

The percentage rate of growth of land under coffee, which captures non-price factors, such as population growth or other factors that increase the demand for land for non-production purpos-es, is also significant and has a positive sign. Again, although the magnitude of the coefficient estimate is very small, the indications suggest that during the period covered by the data, irrespec-tive of the return to coffee, coffee exporting countries were expanding the land under coffee production to attain some policy objectives. This includes increasing employment, resettlement and foreign exchange earnings. This trend, however, was only observed in Ethiopia, and to a limited extent in Tanzania and Uganda. There was a substantial decline in the size of land in Côte d'Ivoire, in Madagascar, and in most recent years in Kenya. The country dummies, except for Cote d'Ivoire and Uganda, are significant. This suggests that country-specific historical factors in Kenya, Tanzania and Madagascar are the main contributors to the observed variations in the av-erage land size under coffee production.

Table 3 Parameter Estimates of the Model for Area Under Coffee

	Model 1			Model 2		
Variables	**Coeff.**	**t-stat**	**p-value**	**Coeff.**	**t-stat**	**p-value**
Producer Price $_{(t-3)}$	0.01	0.67	0.50	0.01	0.58	0.56
Producer Price $_{(t-2)}$	0.02	2.40	0.02	0.02	2.54	0.01
Producer Price $_{(t-1)}$	0.04	3.40	0.00	0.03	2.70	0.01
Annual Inflation$_{(t-3)}$	0.00	-1.61	0.00	-0.01	-3.05	0.00
Annual Inflation$_{(t-2)}$	0.00	1.82	0.04	0.00	4.33	0.00
Annual Inflation$_{(t-1)}$	0.00	-3.27	0.00	0.00	-5.46	0.00
Annual Rainfall$_{(t-3)}$	0.15	4.58	0.00	0.21	6.32	0.00
Annual Rainfall$_{(t-2)}$	0.08	2.18	0.03	0.17	4.73	0.00
Annual Rainfall$_{(t-1)}$	-0.01	-0.22	0.83	0.03	0.81	0.42
Area Rate of Growth	0.01	18.16	0.00	0.01	22.77	0.00
Trend	-0.01	-6.52	0.00	-0.01	-2.08	0.04
Price Risk	-0.11	-5.02	0.00	-0.10	-5.00	0.00
Cote d'Ivoire				0.35	0.41	0.68
Kenya				-0.64	-3.29	0.00
Madagascar				-0.88	-4.19	0.00
Tanzania				-0.73	-2.86	0.00
Uganda				-0.26	-1.59	0.11
Constant	11.84	35.07	0.00	11.12	30.25	0.00
Wald chi2 (12)= (17)		738.20	0.00		186.74	0.00
Number of	126(6)			126(6)		

The trend variable is significant and has a negative sign. The variable captures unobserved time-varying factors, such as changes in macroeconomic and exchange rate policies that might affect the relative profitability of coffee production, and thus the size of land allocated to coffee cultiva-tion. The price risk variable is also negative and highly significant. The elasticity of area to price risk is relatively higher than the estimate concerning the level of market price. This suggests that public interventions that reduce price volatility will have a positive impact on the long-run supply of coffee.

To conclude, although the result confirmed that adverse movement in the global coffee prices is one contributor to the decline in the land area under coffee in Africa, it is not the major one. Alt-hough the international market condition has a significant impact on land size under coffee culti-vation, through its impact on the farm level incentive and risk, the elasticity of land under coffee concerning farm gate price is not as high as generally expected.

In addition, the relation between the two is mediated by the domestic conditions that influence the share of farm gate price to export price. Although the level of farm gate price is correlated with the global price of coffee, its average share is 61 percent, which is substantially lower than the level in non-African coffee producing countries. The share also showed significant variation among the sample countries and the highest was 82 percent in Madagascar; 72 percent in Kenya; 63 percent in Uganda; 61 percent in Ethiopia; 55 percent in Cote d'Ivoire and 35 percent in Tanzania. The share was increasing only in Uganda at a rate of 1.4 percent per annum, but re-mained stagnant in the remaining countries. It did show a declining trend in Ethiopia at the rate of 0.7 percent and 1.6 percent in Côte d'Ivoire.

This suggests that domestic factors, such as competitiveness of the domestic market, supply chain efficiency, and transaction cost level, are significant determinants of farm level incentive. As indi-cated before, the same argument also holds here, namely despite similar world market conditions, the area under coffee in non-African coffee growing countries has been consistently increasing throughout the periods considered. Despite unfavourable market environments, they managed to sustainably increase the area under coffee just because they were able to increase productivity and offset the decline in price on earning. This suggests that improving yield is an essential condition in making coffee production gainful to coffee farmers and improving the global competitiveness of Africa's coffee production. In fact, studies show that increasing yield not only protects farmers' income when there is a decline in prices but also enables them to reallocate land to other profita-ble activities (CTA, 1992).

If yields could be raised from an average of 200kg/ha to 800 kg/ha, 75 percent of the land area presently under coffee production could be released to grow food crops (CTA, 1992). The key issue, therefore is not increasing the size of land under coffee production, but raising productivity on existing land. However, just like Vietnam, where there is sparse land, expanding the area un-der coffee production could be used to create additional employment, particularly for the youth. This though, requires developing the necessary infrastructure and creating conditions that make coffee production attractive to the youth. In this regard, the Ugandan government intends to ex-pand coffee production in the north of the country, which is currently a non-coffee growing area. The African Development Bank could support this effort. However, conducting additional stud-ies will be necessary to establish the economic and technical feasibility of such interventions.

5.3 Volume of Coffee Export and Its Determinants

The volume of coffee export is the other performance indicator that we have selected to assess the performance of the coffee sector and establish whether external or domestic factors were more important constraints. In the theoretical framework section, the test showed that the small country assumption is the appropriate framework to assess African coffee exports. Under this assumption, African exporters face infinitely elastic demand curves that differ by the quality of the coffee. This means, assuming that exporters are maximising profit, they will take the global market price of coffee as given, and only alter the volume of coffee exported and costs that they can influence.

One of the major costs of export is the domestic cost of coffee or the price they pay to farmers. Determining whether exporters are price takers in the domestic market or not is essential in postu-lating the export model. We found a strong inverse relationship between the volume of produc-tion and farm gate price. Since the share of domestic consumption of coffee is very small, except in Ethiopia, unless the government set minimum prices, this suggests that exporters have some degree of market power. In that case, estimating the oligopsony power of exporters in the domes-tic market and introducing as one variable of the export supply model is necessary. However, to focus on our immediate objective, namely to establish whether it is domestic or external factors that were important for poor export performance, we will not estimate the market power.

In addition, as discussed below, since the deviation of production from its trend will be intro-duced as one explanatory variable of the model, we believe this variable partly captures the effect of market power. This is because, since the market power is introduced as a deflated value of the quantity of domestic coffee purchase, where the deflator is the inverse elasticity of demand at farm gate level, failure to introduce another variable will not lead to significant bias.

We derive the export supply function based on the assumption that exporters maximise current profit subject to domestic supply and cost constraints. Accordingly, we assume that export supply will be a function of price-related factors and domestic productive capacity. This is supported by Islam and Subramanian, 1989,

and Bond, 1985. Goldstein and Kahn (1985) note that the price-related factors are represented by the export price of coffee and the current or most recent pre-vailing real exchange rate.

Since African exporters are price takers, the export price is assumed to be exogenous. The real exchange rate captures the effect of the exchange rate, trade, and macroeconomic policies as well as tax and other domestic policy measures that alter the relative profitability of tradable vis-à-vis non-tradable. Following Bond (1985), we measure domestic productive capacity by a trend term as well as by the deviation of coffee production from its trend. The trend term captures changes in technology and infrastructure and other factors that sift the export supply curve of the country, such as changes in factor supplies and factor productivity.

The deviation of production from its trend captures the effect of random supply shocks on export volume, such as climate change-induced change in the pattern and level of rainfall as well as the frequency of incidences of disease and pests. We also introduce country dummies to capture unobserved country-specific factors. Assuming that exporters' export decision is influenced by their experience of price volatility, to capture the impact of risk consideration on export volume, we introduce lagged price volatility. Similarly, to assess to what extent export volume could be increased by improving technical efficiency alone, the technical inefficiency parameter for each country is estimated and introduced as an additional explanatory variable (see box two below on the derivation of technical efficiency).

The sign of the global price of coffee is expected to be positive because the higher export price makes export more profitable and attractive. The real exchange rate, which measures the relative price of tradable to non-tradable, should have a negative sign. This is because appreciation, or an increase in the index, increases the price of the non-tradable sector relative to the tradable sec-tor. This will eventually lead to a resource reallocation from tradable to non-tradable sector and subsequently, lead to an increase in the domestic cost of export. If exporters are price takers in the world market and they cannot pass the increased cost onto buyers, the increase in domestic cost will squeeze out their profit and reduce the incentive to export. Ultimately export volume will decline (Goldstein and Khan, 1985).

The sign of the trend term cannot be determined a priori, and it depends on whether there were significant technical changes or growth in factor productivity. If there were improvements, the production frontier and thus export volume will shift, and hence the trend term will have a posi-tive sign. The deviation of production from trend is expected to be positive. This is because posi-tive deviation, which is when the actual is above the trend, will lead to higher export. The one period lagged measure of export price volatility is expected to have a negative sign because higher price volatility tends to make exporters risk averse and motivate them to adopt a "wait and see" attitude, which would reduce the volume of current export.

The inefficiency term is expected to be negative as a higher level of inefficiency reduces the vol-ume of production that can be generated from a given resource and ultimately export supply. The sign of the country dummies cannot be determined a priori and depends on whether the favoura-ble conditions dominate the anti-export bias prevailing in the country. The estimation of the effi-ciency frontier and the various tests we have conducted are briefly reported in Box 2. The param-eter estimates of the export supply function are reported in Table 6. The results reported under model I exclude country dummies, but under Model II country dummies are included. Since the Generalized Least Square (GLS) does not pick country-specific effects and considering very high Wald chi2 statistic, we use Model II for result interpretation.

The estimation result shows that most of the coefficients are at least significant at 5 percent and above, except the real effective exchange rate, which is not significant at all. The output deviation from trend, which captures the supply capacity of the economy, is highly significant and obvious-ly suggests that productive capacity matters. The magnitude of the coefficient suggests that a bulk share of export performance is strongly influenced by domestic supply capacity. However, exter-nal conditions both in the form of the level and volatility of the global market price of coffee also matter. Although inelastic, the result confirmed that export supply is significantly influenced by the magnitude of global market price of coffee. A 1 percent decline in export price leads to a 0.3 percent decline in coffee export. The price volatility variable is also negative and highly signifi-cant. The significance of both variables confirms that unfavourable global market conditions were important contributors to the decline in the volume of African coffee exports. But since the export volume is more elastic to productive capacity and unobserved country-specific effects, on balance, domestic adverse factors are more important.

It appears that the real effective exchange rate variable is significantly related to unobserved country-specific effects. Not only is this variable significant in Model I, but also when model II is estimated, excluding the Ethiopian and Tanzanian data, the coefficient is highly significant at less than 1 percent. When we inspect the data, the trend of the real effective exchange rate of Ethio-pia and Tanzania, and to some extent Kenya, is somewhat quite different when compared with the data of the other countries. This is in terms of its direction, the rate of change, persistence and dispersion. While further investigation is required as to why the real effective exchange rate is insignificant in these countries, the result is inconsistent with the empirical evidence from Africa, as well as elsewhere (Mulwa and Mariara, 2016).

Table 4 Parameter Estimates of the Export Model

	Model 1			Model 2		
Variables	**Coeff.**	**t-stat**	**p-value**	**Coeff.**	**t-stat**	**p-value**
Output Deviation from Trend	0.67	9.89	0.00	0.62	9.47	0.00
Export Price$_{(t-1)}$	0.19	3.57	0.00	0.30	8.80	0.00
REER$_{(t-1)}$	0.00	-1.80	0.07	0.00	-0.27	0.78
Export Price Volatility$_{(t-1)}$	0.00	-4.74	0.00	-0.01	-6.01	0.00
Trend	-0.01	-2.00	0.05	-0.01	-4.75	0.00
Technical Inefficiency	-0.21	-1.98	0.05	-0.17	-1.70	0.09
Cote d'Ivoire				0.34	1.60	0.11
Kenya				0.14	0.54	0.59
Madagascar				-1.53	-4.21	0.00
Tanzania				0.00	-0.02	0.99
Uganda				0.50	2.35	0.02
Constant	11.41	35.33	0.00	10.56	38.02	0.00
Wald chi2 (12)= (17)	165.95	0.00		709.03	0.00	
Number of Observations (Group)	114(6)			114(6)		

Several previous studies reported that macroeconomic policy changes that appreciate the real ex-change rate have a negative impact on the volume of coffee export. This is also consistent with the experience of some African countries, such as Nigeria and Angola. For instance, in the 1970's, Angola was the largest coffee exporter in Africa. The discovery of oil and the subsequent large inflows of oil revenue caused an appreciation in the real exchange rate, and this significantly reduced the relative profitability of the non-oil export sector, including the coffee sector. Conse-quently, the coffee sector has been declining, and Angola's current export is now just 1 percent of its export level in the 1970s. This suggests that taking additional measures is necessary to nullify the adverse effect of domestic policy changes that undermine the relative profitability of the ex-port sector.

The trend variable, which represents factors that shift export supply over time, is also significant, and carries a negative sign. Except in Ethiopia, where export and production were equally in-creasing, in other countries, particularly in Côte d'Ivoire and Madagascar, export was declining despite the fact that production was increasing or remains at the same level. This suggests that either the domestic consumption of coffee is increasing or they have started to domestically pro-cess coffee. Although we have no actual data to substantiate both, anecdotal evidence suggests that both are occurring in Africa. Such a trend would be a very welcome one by coffee farmers as it would counteract the effect of a decline in the global prices of coffee on farm gate prices. Moreover, it will create favourable market conditions for the emergence of domestic roasting and soluble coffee production, which would enable Africa to substitute the importation of processed coffee, as well as additional capture value added.

The technical inefficiency variable is also negative, but only significant at 9 percent. The result implies that by promoting the adoption of improved husbandry practices and farm management, and improved varieties and inputs, Africa could increase its export volume. In fact, this is a very conservative estimate. For instance, the average yield of the sample countries is close to 500kg/ha, and this is less than 300 percent that could be achieved under intensive cultivation. As reported in Box 6, 28 percent of the output variations among the sample countries are accounted for by technical inefficiency.

Box 4 Estimation of Technical Efficiency of Coffee Production

To generate the efficiency estimates, we postulated a production frontier. In estimating the frontier, we assumed that efficiency is time varying. In specifying the production frontier, we considered area cultivated, lagged prices of fertiliser and farm gate price of coffee. We also included rainfall level but the sign was negative and inconsistent with theory. When we inspect the data, in almost all of the countries, except in Ethiopia and Uganda, coffee production was negatively and significantly associated with the level of rainfall. Even when we use change in rainfall, the negative association still holds.

We believe that there are unknown country specific moderating variables that is influencing the relationship be-tween the two. To circumvent the problem, we used the standard deviation of the annual rainfall level, which is strongly correlated with the rainfall level but possibly uncorrelated or weakly correlated with the moderating varia-bles. We estimated the frontier using the fixed and random effect models. Using the Hausman Specification test, we also tested which of the two models is appropriate to the data.

The Null Hypothesis could not be rejected (chi2(4)=0.15, p=0.99), which means both models yield coefficients that are "similar". We chose the random effect model and with the assumption that inefficiency is also time vary-ing. The result suggests that technical inefficiency is a significant contributor to the observed output variations of the sample countries. The predicted average inefficiency for the sample was 28 percent with a standard deviation of 25 percent. The least efficient producers are Ethiopia and Uganda, with an average inefficiency level of 6 per-cent and 7 percent respectively, followed by Cote d'Ivoire by 17 percent.

The result also shows that 56 percent of the output variations among the sample countries is contributed by the level of inefficiency and it is also increasing over time. The result is not surprising for the fact that coffee yield in Uganda and Ethiopia is more than 50 percent of the other countries, except Kenya, which registered higher yield in some years. For the sake of brevity, we will report the estimation result in the appendix, but the inefficiency score will be used as one explanatory variable of the export supply model.

Before estimating the export supply model, we tested the time-series properties of the data. The test showed that, except for volume and REER, which are first difference stationary, all the other variables are stationary in

In conclusion, the result confirms that adverse external market conditions are significant con-tributors to the decline in export volume. It also suggests that although African governments have taken measures to improve returns to coffee farmers, adverse external conditions, both in the forms of low and volatile world prices of coffee, have been undermining the potential effect of these measures on supply and farmers income. Their effect, as normally expected, is stronger than their impact on yield and area under coffee production. However, export supply is more elastic to domestic supply capacity, incentive structure, and the technical efficiency level. Therefore, alt-hough adverse external conditions are important, the result points to the fact that domestic factors are more important determinants of export volume.

Therefore, while African countries should take a concerted effort to address global coffee market imperfections, increasing yield is the only viable option to increase the incentive for coffee pro-duction , reduce the adverse movement of the world coffee price on the income of coffee farm-ers, increase Africa's earnings from coffee and recapture its traditional market share. In addition to increasing yield, guaranteeing farmers get a fair share of export price is also necessary. Current-ly, Africa's coffee farmers' share of the export price is globally the lowest.

High transaction cost, export tax, and market power are significant contributors to low farm gate price of coffee. For instance, although farm level production cost in Ethiopia is about 12.3 per-cent of the production cost in Brazil, the farm to export cost is four times higher than the cost in Brazil. Similarly, wet mills in Ethiopia are operating at twice the cost of similar capacity mills in Latin America, even though labour cost in Ethiopia is very low. As a result, Ethiopian farmers receive the lowest share of the export price compared to other coffee producing countries. Alt-hough tax might be one factor, monopsony power of traders and processors might allow them to pass all the taxes and supply chain inefficiencies on coffee farmers. Therefore, in addition to im-proving farmer's bargaining power, reducing the transaction cost and export tax will also be criti-cal.

VI. The Economic Potential of Improving Coffee Quality

The focus of the previous sections has been on increasing the volume of coffee as a commodity. However, coffee is not a homogeneous commodity, and exhibits unique characteristics that attract different prices. It is differentiated by bean variety, processing method, geographic origin, by roasting and brewing methods.

Coffee bean varieties are broadly classified into two main groups, Arabica and Robusta. Within this broad classification, coffee can be further classified into washed and unwashed. Again, within this classification, coffee is even further grouped into conventional and differentiated coffee. Differentiated coffee can be determined usually by either quality or cultivation processes.

These coffees take different forms. There are estate coffees or certified organic coffee, and there are specialty coffees that typically share the commonality of being well-prepared, or processed, with some distinctive attribute in their cup quality and no discernible defects (Lewin et al, 2004). In addition to these characteristics, coffee quality can also be further differentiated in terms of whether it is produced in socially and environmentally responsible ways. Therefore, the potential of increasing earning from coffee can be increased through improving the intrinsic quality of cof-fee, how it is processed and through certification to one or more standards. These can be stand-ards such as "sustainable," which is organic, fair trade, and shade or eco-friendly. Standards in-clude Gourmet and Specialty, Private or Corporate Standards (Bolwig and You, 2007).

One option to improving the quality of coffee exports is to increase the share of wet-processed or washed coffee exports. As we demonstrate below, although there is substantial premium, current-ly, more than 50 percent of existing Arabica coffee output is sold as "natural" parchment (ECA, 2013). In Ethiopia, only close to 30 percent of coffee export is washed. Since there is sufficient market demand to absorb additional exports, there is a strong economic case to invest in expand-ing coffee washing capacity. However, the skill improvement required for wet processing of cof-fee and management is crucial to make the investments worthwhile. Furthermore, to avoid capac-ity under-utilisation, as in the case of large-scale washing stations in Uganda and Rwanda, it is necessary to make sure that the installed capacity is commensurate with the volume of local sup-ply.

There are several factors, such as genetic, origin, harvesting and post-harvest preparations, that influence the quality characteristics of the green bean. Among others, the bean size of coffee is another dimension of quality. Increasing the bean size could also be achieved by planting im-proved varieties and through improved agronomic practices. Reducing the incidence of wetness and extraneous matters through improved farm-level processing and storage will also improve quality. Although it is a labour-intensive process, it attracts a premium price. The potential of maximising earnings from coffee by improving the quality attributes, such as aroma, taste, and cleanness, is also huge. This can also be achieved through a low-cost method that is within reach of resource-poor farmers, such as through providing them with training on best practice produc-tion and processing techniques (You and Bolwig, 2003).

Aside from improving its physical and inherent qualities, quality may be raised by increasing the share of differentiated coffee. There is a fast-growing specialty market segment, with each seg-ment aiming to promote good agricultural, environmental and social practices. Each specialty coffee commands a significant price premium. For instance, gourmet coffees are easily earning twice the current market price of fair trade coffees. For instance, the supply of sustainable coffee to the North American market fetches an average premium of US$0.59 per pound for organic, US$0.62 for fair trade, and US$0.53 for shade-grown (Ponte 2002).

Africa has been producing different types of coffee. The market is also increasing. Globally, the North American market for these specialty or differentiated coffees is expanding, and similar growth rates are observed in Europe and Japan. The share of specialty coffee in the USA coffee market jumped from 43 percent in 2013, to 51 percent in 2014. In 2017, the total value of spe-cialty coffee market in the US is estimated to be $26.5, which is 55 percent of the $48 billion U.S. retail coffee market. Industry experts also predict that there is a foreseeable shortage of sup-ply for specialty or distinctive gourmet coffees and that the price premium for these will likely continue to be substantial. They believe it is unlikely that premiums will disappear soon (Lewin et al. 2004). The presence of such agro-ecological diversity provides immense opportunities for Africa to promote the production of varieties of specialty coffees with a distinctly different fla-vour profile. Therefore, the region has a unique competitive advantage and, if properly marketed, this can result in stronger demand and higher prices that may be somewhat more immune to mar-ket fluctuations (Lewis et al. 2004).

There are various challenges that come with improving quality, and these should be addressed. Coffee quality and consistency are considered to be the most important criteria for the decisions of both European and North American coffee companies (Giovannucci 2001; Giovannucci and Koekoek 2003). The relatively high value placed on consistency and predictability underscores the need to build the necessary capacity to meet those requirements in a sustainable manner. In this regard, it will be vital to improve local supply coordination and accounting as well as con-tracting and export procedures because these are key factors that prevent the satisfactory fulfil-ment of contracts (Lewis et al. 2004). It is also essential to improve agronomic and post-harvest handling practices at farm level through the provision of proper training and sensitisation.

It is also essential to put in place an effective regulatory and marketing system that rewards quali-ty. Currently, in most coffee growing countries, there is a lack of capacity and strict regulatory framework at primary and secondary levels. Instead, quality is regulated at the export level. The lack of a system that ensures traceability enhances opportunistic behaviour and reduces trust in the value chain. Lack of trust, in turn, also has a cumulative adverse effect on quality.

In some countries, particularly Uganda, the coffee value chain exhibits a low level of social capi-tal. Since farmers do not have an established buyer, and they sell to anyone that offers them a better price, coffee traders are likely to protect themselves from poor quality, or adulteration, by quoting low prices that may not reflect the quality of coffee supplied by a farmer. Since farmers do not see the link between quality and price, it reduces their incentive to maintain quality, and quality tends to deteriorate in the long-run, ultimately damaging the reputation of the country as a supplier of good quality coffee. Therefore, to avoid a decline in the quality of coffee, there is need to put in place a marketing system that ensures traceability and rewards quality. If such measures are not undertaken, countries could suffer significant damage to their reputation that would be costly to repair.

VII. The Business Case to support Africa's Coffee Industry

As we have already emphasised, coffee is an important commodity in Africa. It contributes a sub-stantial share of GDP, foreign exchange earnings and tax revenue. It also provides livelihood opportunities. On the grounds of equity and efficiency, therefore, there are compelling reasons to support the African coffee sector. From the equity perspective, since the bulk of coffee produc-tion in Africa comes from low-income farmers, any interventions that increase coffee production and price will have a significant impact on rural poverty.

Interventions that address the coordination failure and under-provision of public goods and ser-vices in the coffee sector will have significant economy-wide multiplier impact. Given that the African coffee sector is currently operating well below its potential, the social and economic re-turn of such interventions will be substantial.

African countries have ample fertile arable lands, such as in northern Uganda, that are suitable for coffee production. Investment for the expansion of coffee production in new areas not only increases the supply of coffee, but also allows the economy to effectively use its resources - both land, and labour. Vietnam, for example, did this in the 1970's and 1980's. The existing high youth unemployment problem can be tackled in part by attracting the youth to coffee production in sparsely populated areas. The Ugandan government is considering this, and has sought the Af-rican Development Bank's support towards achieving this objective.

Africa is endowed with a broad range of suitable agro-ecologies, under which coffee can grow with good economic returns (IDH, study undated). The presence of such agro-ecological diversity provides immense opportunities to promote the production of varieties of specialty coffees with a distinctly different flavour profile that could make Africa more competitive in the world market than any other coffee producing country in the world (Gentile, 2014). For instance, some indus-trial experts claim that "Ethiopia also has the largest genetic diversity of coffee varieties, many of which remain unclassified, which helps contribute to the uniqueness of the cup character. " (Ibid) Given the fact that the climate is highly suitable, unlike other coffee producing countries in the world, it is possible to maximise productivity and obtain economic yield with minimum input (der Put and Stewart 2014). If efficiently exploited, these are all compelling opportunities to in-crease production, productivity, and quality and enhance the competitiveness of Africa in the international coffee market.

Another comparative advantage of the coffee sector in Africa over the other producing regions is the relatively lower labour cost. Labour costs are relatively lower in Africa, especially in leading coffee producing countries like Ethiopia and Uganda, compared to many other coffee producing countries. In many of the coffee producing countries, the increase in the cost of labour is one of the main limiting factors for the development of coffee production. For instance, Ethiopia has a competitive advantage in Arabica as the world new low-cost producer (der Put and Stewart, 2014). For unwashed Arabica, its costs $1.29/kg to export from Ethiopia, which is less than the cost of $1.34/kg in Brazil for the same quality. However, production cost in Ethiopia is substan-tially lower, at $0.774/kg, than production cost in Brazil, which is $1.21/kg.

Most of the costs in Africa are inflated by supply chain inefficiency (Ibid). Similarly, Uganda is the second low-cost supplier of Robusta coffee. The total cost of Robusta export in Uganda was $0.95/kg, which is slightly higher than what it costs in Vietnam, which was $0.91/kg. Uganda has the lowest production cost though, at $0.71/kg, compared with the production cost of $0.86/kg in Vietnam (Ibid).

The global average costs of production are about $1.3 per kg, but production cost in Africa is relatively lower. Therefore, if Africa managed to reduce the supply chain inefficiency, in the face of increasing labour cost in Vietnam and Brazil, it has significant potential to be the least cost supplier of both Arabica and Robusta coffee.

In addition, the quality of coffee produced in Africa is among the best in the world. Africa is the home of the 'Arabica' varieties that fetch the highest price in the global market (Gentile, 2014). Currently, there is excess demand for these varieties. By increasing yield, Africa could capture additional Arabica markets. For instance, most producing countries are reaching their potential, both in terms of intensification and extensification (ACET, undated).

While other exporting countries are reaching their maximum, the currently realised yield in Africa is well below potential. While the average realised yield in Africa is 408kg/ha, the average Arabi-ca yield in Brazil is 1,200 kg/ha, and the highest achieved yield ranges from 2,400 kg/ha to 3,600 kg/ha. For Robusta coffee, while the average yield is 1,800 kg/ha, the highest achieved yield ranges from 3,000 kg/ha to 6,000 kg/ha. This suggests that there is a significant yield gap that is yet to be fully exploited (ICO, 2015).

An increase in domestic consumption in Vietnam and Indonesia and Brazil, which will further reduce global supply, as well as the increase in the cost of production in the other producing countries will put Africa in a more competitive position, if it could increase its yield.

There is also adequate market to absorb the additional coffee produced from Africa. Given Afri-ca's low level of global market share, in the face of growing global market demand for coffee, the region has a unique opportunity to expand its coffee production and export (International Coffee Organization, 2015). For instance, despite growing global demand, supply is not growing at the same rate and as a result, the carryover global stock of coffee in most recent years is dwindling. Furthermore, based on International Coffee Organisation projections, by 2030, the demand for coffee could increase by 20-30 percent.

Over the last 50 years, world coffee consumption increased by an annual average growth rate of 1.9 percent, from 57.9 million bags in 1964 to 145.8 million bags in 2013. Over the last 50 years, the perception of coffee as a healthy product has changed significantly, with a correspond-ing increase in scientific research into the positive health properties of coffee. This growth rate accelerated since 1990 to 2.1 percent, and to 2.4 percent since 2000. According to ICO (2012), by the year 2020, world coffee demand is projected to reach 9.6 million tons. Even if large pro-ducers, such as Brazil and Vietnam, are assumed to exploit their capacity fully, there is a 4.6 mil-lion ton gap that must be filled by other countries.

Even if Africa is assumed to maintain its current share, to meet growing demand, exports from Africa should increase by 52 percent (Ibid). As the econometric analysis also showed, unlike other regions, an increase in the volume of exports from Africa does not trigger a fall in price, and as such, Africa could increase its export earnings by increasing export volume.

Similarly, although many traditional markets are growing only modestly, with consumption ap-pearing to have reached saturation point in many countries, there still exist several dynamic niche opportunities for producers to benefit from, such as specialty and certified coffees (Ibid). In Eu-rope and the United States, consumers are increasingly attentive to quality and origin, and show a growing interest in the economic,

social and environmental aspects of coffee production. Africa has a great potential to produce coffee for niche markets such as specialty and certified coffee markets that attract high premiums.

Increasing the share of certified coffee is also the other economic potential that the African coffee sector is yet to exploit. Although a substantial proportion of coffee exported from Africa is organ-ic, currently only 3 percent of its coffee export is certified as organic coffee (der Put and Stewart, 2014). This means that Africa could step up its effort to sell a story and get a price premium for its existing export. For instance, 95 percent of the coffee produced in Ethiopia is organic. How-ever, only 2 percent of the coffee export from Ethiopia is certified under the Fair-Trade scheme, suggesting that the potential gain from increasing certified coffee is huge (Minten et al. 2014).

In addition, there is a strong business case in Africa to increase the share of washed coffee export (You and Bolwig, 2003). The additional premium for washed coffee is usually as high as $1.40 per kg. Currently, there is a global excess demand for washed coffee, and the demand is expected to increase by 7.5 percent per annum. Since fully washed coffee is a labour-intensive activity, as the well-known Heckscher-Ohlin theorem predicts, low labour costs in Africa means, that Africa has a clear comparative advantage in fully washed coffee (der Put and Stewart, 2014).

Since quality is directly proportional to the labour time spent on cleaning and processing the cof-fee, due to increasing labour cost in Latin America, fully washed coffee from the region is losing its competitiveness (Easterly and Reshef, 2010). Africa could therefore increase its market share by improving quality at a lower cost (Ibid). The investment cost of increasing the share of washed coffee is also very low. The initial investment in a coffee washing station is estimated to be the US $ 15,000 to wash 40 tons of green coffee output. To fully wash 50 percent of Africa's Arabica production (225,000 tons of Arabica), the investment requirement is estimated to be US $ 93 million (Ibid).

Africa also has the potential to expand production of roasted coffee. Anecdotal evidence suggests that exporting roasted coffee generates a tenfold increase in income than exporting raw coffee beans. Currently, Africa's share of roasted coffee production is very low, at about 8 percent (ACET, undated). However, as roasted coffee typically involves the blending of 10 to 15 varieties of coffees to create the desired flavour, it requires the large-scale purchase of different varieties of coffee, a high level of capital investment, and expenditure on logistics and infrastructure. Alt-hough the required varieties are available in Africa, such undertaking requires coordination among coffee producing countries (Ibid). At present, the market mechanism cannot bring the nec-essary coordination, and there is a need for government intervention to foster cooperation, pro-vide technical assistance, as well as financial services for capital expenditure including public infrastructure.

Finally, there are opportunities to expand the production of fully and semi-processed coffee. At present, most African exporters export raw green coffee beans. Low degree of domestic value addition in coffee value chains is resulting in significant loss in job creation and poverty reduc-tion. Therefore, the potential of capturing additional value addition by developing the capacity to produce and export instant coffee is huge. At present, Africa's share of global production of in-stant coffee is barely 2 percent. In addition to capital and skill intensiveness of production, it re-quires a substantial level of investment in marketing and transportation, mainly because a signifi-cant share of the consumer market is in Europe and North America (ACET, undated). Conse-quently, although exporting fully processed coffee must be pursued as a long-term objective, in the medium term, African countries could start production to cater for regional and domestic markets. As experience elsewhere showed (Brazil), until producers become globally competitive, processing coffee in powder form to cater for the domestic market may be the viable medium-term option.

VIII. The Role of the African Development Bank In Developing The Coffee Industry in Africa

Although the coffee sector has a significant impact on growth and poverty reduction in Africa, the volume of resources allocated by the African Development Bank to the coffee sector has been relatively low. Most of its support to the coffee sector was in the 1980s. In addition, the bulk of its financing was to parastatals, and there were no AfDB interventions to support the private sec-tor.

Similarly, the Bank's current intervention in the coffee sector is relatively limited. This is contrary to the experience of other regional banks, such as the Inter-American Development Bank and the Asian Development Bank, both of which are more active in supporting the coffee sector. For instance, to tackle the growing challenges of the coffee sector in Latin America, the Inter-American Development Bank has been financing many projects in the coffee sector to help re-store and enhance the competitive position and sustainability of the coffee sector. Its interventions are also helping to develop and implement a region-wide specific quality management system. Furthermore, it is providing support to access various existing market segments and niches. Its efforts are also supporting the adaptation of coffee planting to climate change, and integrating the youth into socio-economic development.

Nevertheless, in the coming years, AfDB support to the coffee sector is expected to change signif-icantly. Under its Feed Africa Strategy, which guides its intervention in the sector, the Bank plans to support the expansion of the coffee sector with the objective of positioning Africa as the top global player, and increase its export share from the 10 percent that it was in 2015 to 41 percent by 2025. The production of green coffee in Africa is expected to move from 1 million tons in 2015 to 3.2 million tons by 2025. The transformation of Africa's coffee value chain is estimated to cost USD 8-10 billion but could unlock an annual average revenue opportunity of USD 6 billion by 2025. The AfDB's objective of increasing coffee productivity and improving quality will be achieved through Feed Africa's Technology for the African Agricultural Transformation (TAAT) flagship.

As the empirical analysis sections showed, most of the constraints faced by Africa's coffee sector are related to low productivity, declining competitiveness and under-provision of critical public goods and services. The Bank's coffee sector interventions under the Feed Africa strategy will focus on addressing these constraints. Under the strategy, it aims to support: a) increasing produc-tivity; b) increasing investment in agricultural research and technology dissemination; c) address-ing financial market failures and providing access to finance for the use of improved inputs and replacing old coffee tree stock; d) increasing investment in infrastructure, especially storage facili-ties; e) financing investments that attract the youth to coffee production; f) financing initiatives to increase the share of locally processed coffee; and g) improving the quality of exported coffee beans.

Although there are many constraints that must be addressed, given resource constraints, the AfDB's support in increasing yield and coffee quality is critical areas where the Bank's interven-tion could have a substantial impact. Particularly, increasing yield will have a significant impact both on equity as well as efficiency. Although all actors in the coffee value chain benefit from the increase in yield, including governments, given that the share of farm gate prices from the export price of coffee is high, farmers are likely to benefit more. Consequently, and given the Bank's long-term strategic orientation under Feed Africa, support in the following areas could signifi-cantly improve the performance of Africa's coffee sector

8.1 Improving Productivity and Quality

Among the identified domestic factors that contributed to low yield are weak research capacity, ineffective extension services and weak research and extension linkages. Coffee tree disease is also another principal factor, but it is associated with the limited capacity of research institutions to respond in a timely manner and at the required scale to such challenges.

For undetermined reasons, private firms are unable to adequately provide research and extension services. Until the coffee sector achieves a higher level of productivity, and producers and ex-porters can jointly finance the investments in support of coffee research, public entities must pro-vide research and extension services. However, as indicated earlier, the public sector adequately doing so. This is due both to budgetary constraints, as well as lack of information on the likely gains from research and extension services.

Therefore, the AfDB's support in improving the capacity of research institutions is expected to significantly affect the performance of the coffee sector. Such interventions will facilitate tech-nical progress, generate knowledge on improved agronomic techniques and enable research insti-tutions to respond in a timely way to the diverse demands of the coffee industry. Enhancing the effectiveness of extension services and improving research and extension linkages will also be necessary for the research effort to have an impact on yield.

The AfDB can intervene and fill the gaps on its own, as well as act as a catalyst to promote pub-lic-private partnerships. Since coffee roasters and processors have been supporting the coffee sector in the other regions, the AfDB can establish partnerships with these entities to finance re-search and extension services. The Bank can also draw from the experience of other development banks and provide similar support in Africa. For instance, the Inter-American Development Bank launched its pilot Coffee Renovation Project in June 2015. Its objective was to provide affordable long-term loans and related technical assistance to small- and medium-sized coffee growers in Central America. The project aims to reverse the declining trend of productivity caused by the coffee rust disease and partly by poor farm management practices in Nicaragua, Honduras, Costa Rica, Peru and Mexico. The project will also provide these countries with new fungus resistant coffee varieties and technical support to improve their agricultural practices. The AfDB could initiate similar interventions from its resources, or through a partnership with other stakeholders. For example, it could assist coffee farmers to replace ageing trees, and those that are affected by Coffee Wilt Disease.

The AfDB could also provide support in improving coffee quality. As the global coffee market is progressively becomes more competitive, coffee quality becomes one determinant of competitive advantage. The quality requirement is also becoming a mandatory requirement, as in under the World Trade Organization's Sanitary and Phytosanitary agreement.

Therefore, for Africa's coffee producing countries to maintain competitiveness, capture addition-al premium and meet the growing requirements for high standards, it is imperative that they re-ceive support. The AfDB could help its regional member countries put in place a marketing sys-tem that rewards quality. This would have a significant impact on the performance of the coffee sector. In the existing marketing system, there is a weak link between price and quality. Since farmers do not see such a link, they have little or no incentive to improve quality. If this anomaly is not addressed, Africa, in the long-term, could lose its reputation as a quality coffee supplier. In this regard, the Bank could consider commissioning a study to develop a marketing system that ensures traceability and reward quality.

Although there are opportunities to capture additional premiums by supplying coffee to specialty markets, Africa has not yet exploited such opportunities. Commissioning a study to identify the constraints and technical assistance needs of AfDB regional member countries and how they might be able to exploit such opportunities could be another area that the Bank could support.

Increasing the share of washed coffee exported is yet another area where AfDB interventions could have a significant impact on the quality of coffee exported from Africa. To this end, providing short-term and medium-term loans to establish small-scale coffee washing stations will enable the Bank's regional member countries to capture additional value-added and maximise their earnings from the coffee sector. The Bank can also support the private sector to undertake domestic roasting and production of fully processed coffee.

8.2 Finance and Inputs

As the analysis in the previous section shows, securing finance to purchase fertiliser, for working capital and purchase of agricultural and agro-industrial equipment is a challenge to smallholder coffee producers. Similarly, input suppliers and coffee traders lack access to concessional finance. The collateral requirement, which is sometimes twice the loan amount, and high-interest rate for credit for fertiliser import reduces supply. Furthermore, it prevents traders from realising econo-mies of scale, which ultimately contributes to inflating the farm gate prices of fertiliser, and limits its application.

Coffee exporting firms, particularly those that are owned by locals, have also been unable to get concessionary finance in contrast to their competitors' foreign-owned firms in Africa. This has been severely undermining the competitiveness of local firms, and unless they are offered with equally concessionary finance, in the long-term, they will exit the market. Similarly, although a small number of African roasters and soluble coffee producers are trying to break into the inter-national market, they are unable to do so due to lack of concessionary finance.

Commercial banks in Africa are usually reluctant to provide credit due to risk consideration or in terms that make such investment worthwhile. Although lending for farming and export activities is risky, it is usually exaggerated, and it is based on the incorrect and excessive perception of risk. As experiences elsewhere have shown, although there are innovative ways to reach farmers and exporters, most banks show little effort to be innovative and to reach this potential group of commercial customers. To address market imperfection and improve the competitiveness of local exporters, the AfDB could play some roles. By designing tailor-made interventions, the Bank could facilitate financial access for local coffee firms to enhance their competitive position. Again, the Bank can draw experiences from other development banks. For instance, like the In-ter-American Development Bank, it could establish a regional coffee financing fund in partner-ship with large-scale coffee processors and other development partners in Africa.

Alternatively, the AfDB could support the coffee sector by helping to strengthen other develop-ment banks in Africa, especially those specifically serving the agriculture sector. Its support could take the form of providing technical assistance and seed money, as well as sharing risks. In this regard, it could emulate the successful experience of the Vietnamese Bank of Agriculture and Rural Development. This bank played a major and exemplary role in the success of Vietnam's coffee sector. Through its 1,600 branches in rural areas, this Vietnamese bank meets the financial needs of coffee producers, with over 75 percent of its credit going to coffee growers.

Finally, as noted above, it appears that banks in Africa hold an extremely high-risk perception towards agriculture, which may not always be defensible. The AfDB could commission a study to determine whether the risk perceptions of banks in Africa on lending to the agricultural sector in general and to cooperatives is reasonable.

Based on the findings, capacity building interventions are needed to equip banks with the skills to better manage associated risks and engage in agricultural lending. This way, once the Coffee Fund phases out, commercial and development banks will be able to play a greater role in providing the longer-term finance required by farmers and other coffee value chain players.

8.3 Market Development

Imperfect competition in the domestic coffee markets may undermine the capacity of coffee farmers to benefit from any interventions that improve yield and quality. While coffee production is characterised by constant returns to scale, trading and transporting activities are characterised by economies of scale. As a result, there are many producers, but a few buyers and this weakens the bargaining power of farmers. To address differences in bargaining power, the AfDB can support the formation of new producers' cooperatives or help consolidate existing producers' coopera-tives. Such interventions would not only enhance farmers' bargaining power, but also allow them to realise economies of scale, both in output and input markets (Valentinov 2007).

Supporting the development of value chain infrastructure is also another area that could improve the performance of the coffee sector. In most of the leading African coffee producing countries, such infrastructure, namely warehousing, packaging, transport, energy, and telecommunications infrastructure, are inadequate and this has an impact on the efficiency of marketing and allied activities, with possible adverse impact on the prices coffee farmers get for their coffee.

8.4 Climate Change

Climate change is increasingly becoming a challenge for coffee production. Rainfall has become increasingly erratic, with both greater unpredictability of occurrence and shorter periods of rain. As coffee production depends on the amount and specific distribution pattern of the rainfall, such changes adversely affect yields, coffee quality, as well as increase production costs (Nsibirwa, undated). Climate change has also created favourable conditions for pests and the development of disease. The Bank's support for irrigation development could help address the challenge of cli-mate change, and particularly, the effect of rainfall variability on coffee yield. Providing technical assistance to enhance the capacity of meteorological services to provide accurate and timely in-formation could also be another area of support. When the study team visited Uganda for data collection in May 2015, during one of its meetings with Uganda's coffee development authorities in Kampala, it was informed that both areas of interventions were priority areas of the govern-ment, and for which it was seeking the Bank's support.

8.5 Gender Equity

Women play a major role in coffee production. Women provide labour for more than 70 percent of the farm maintenance and harvesting activities. Nevertheless, they usually have little control over the harvest proceeds. Gender-based inequity in terms of access to production resources and cultural practices, among others, are the key reasons for this. To partially ameliorate such gender-based unequal distribution of benefits, the AfDB could help female coffee farmers improve their asset base. The Bank could provide support by organising the women into cooperatives and providing the necessary finance for them to own and run wet-milling coffee processing plants.

8.6 Promoting Youth Participation in Coffee Production

The share of youth in coffee production is dwindling. In most recent years, the average age of coffee farmers in Africa has been over 60, despite the fact that 60 percent of Africa's population is at the average age of under 35 (ICO, 2015; ADR, 2015). The young people of Africa could be mobilised into becoming a very useful resource in the development of the coffee sector. Since productivity is inversely related to age above a certain threshold, it is also imperative that pro-grammes be developed to attract young people to coffee production. This will not only create employment opportunities for young people but will also increase productivity.

Shrinking average land size, low yield, and declining coffee price are some of the main disincen-tives to youth participation in coffee production. To reverse the trend and attract the youth to the industry, improving coffee yield could be one if not the only sustainable solution. Ensuring ade-quate access to land by the youth will also help a lot. Other helpful initiatives could include the introduction of land reform programmes, and market-based mechanisms to encourage land trans-fer from less efficient to more efficient coffee producers. It might also be useful to promote cof-fee production in climate conducive locations where there is spare land. The AfDB could launch studies to explore the feasibility of such options.

8.7 Government Support to the Coffee Industry

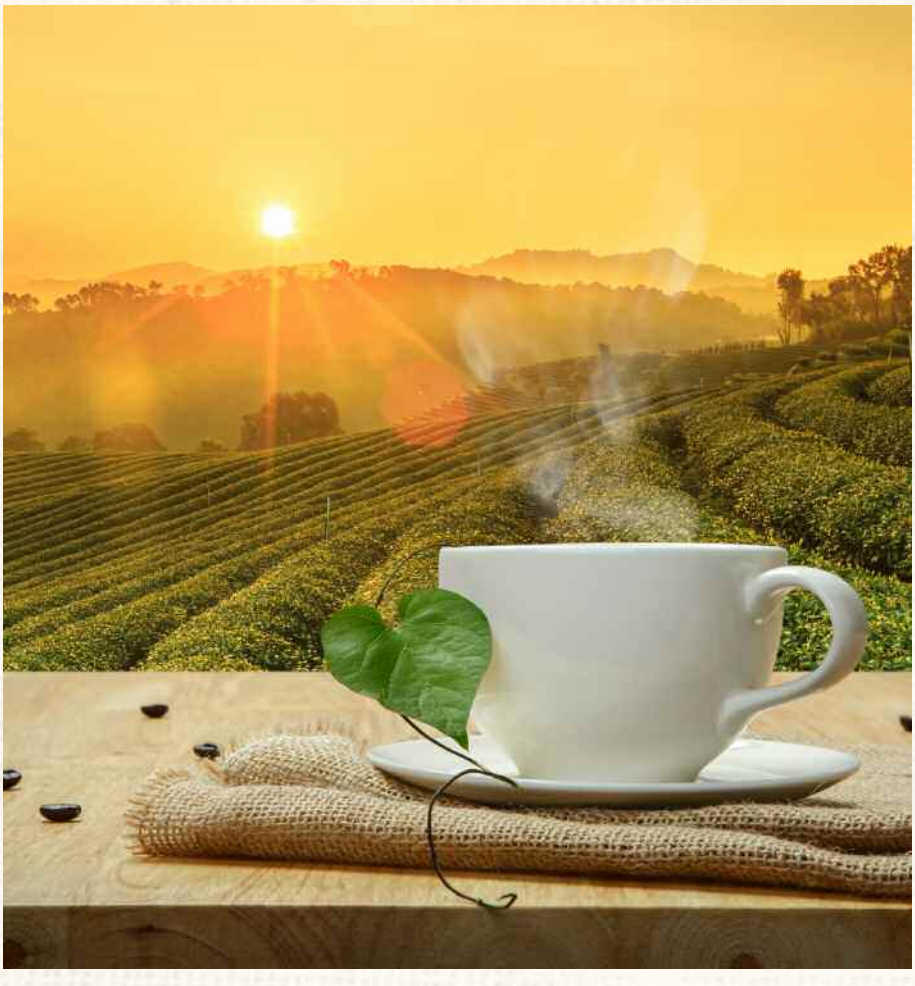
Low level of government assistance to the coffee industry is yet another key constraint in Africa. In other coffee growing regions, the government has played and continues to play a vital role in supporting the coffee industry. In India for example, by implementing innovative and effective measures, the government actively supports large- and small-scale coffee farmers and ensures the continued sustainability and profitability of the coffee sector. An active institutional organisation supports the coffee industry under the authority of the Coffee Board of India.

The sector organisation includes the agronomic research activities, which the Central Coffee Re-search Institute (CCRI) and extension services jointly conduct. CCRI research activities concen-trate mainly on developing high-yielding varieties of both Robusta and Arabica and integrated pest management. Public extension service providers promote the latest agricultural practices through a training programme, disseminating research findings to coffee growers and running demonstration centres. In addition to its research and extension roles, the Coffee Board also pro-motes the sale and consumption of coffee in India and abroad. It provides farmers with financial assistance to establish small coffee producers, as well as up-to-date global market price infor-mation.

The role of government intervention in Vietnam's coffee success is also exemplary. The govern-ment's support to the sector has been largely credited for achievements of the coffee industry. In the 1990s, the sector registered an annual increase of 20-30 percent, and its global share jumped from 0.1 percent to 19 percent over a 30-year period. Some important policies embarked upon by the government include pursuing marketing policies that ensure coffee farmers get competitive prices for their coffee, providing them credit at concessionary rates and flexible terms, and providing subsidised inputs and extension services. The role played by the Government encour-aged foreign investors in coffee production and has been critical for the growth of the sector.

The experiences of India and Vietnam, however, are less evident in Africa. Limited government support, mainly after the sector was liberalised, has been the norm, and one of the key contrib-uting factors to the weak performance of Africa's coffee industry. Some of the growth constraints of the sector emanate from market and policy failures as well as under provision of public goods and services. Therefore, government interventions to address these constraints are necessary to restore the coffee sector as well as to enhance the effectiveness of the AfDB's assistance to the sector. To that effect, providing need-based technical assistance to the public sector might also be necessary.

IX. Conclusion



The conclusion that stems from our review of the coffee industry is that coffee production in Africa is devoid of significant technical progress, and shows significant yield gap. This means that not only is coffee production in Africa taking place well below suboptimal level, but also that the yield gap is widening over time. As a result, although theoretically, Africa possesses a compara-tive advantage in coffee production, it is losing its global competitiveness. Even though labour costs in Africa are still relatively low by world standards, low level and widening yield gap, and supply chain inefficiency are undermining its competitiveness.

Low yield has locked the African coffee sector in a vicious cycle. That cycle is one where low yield has led to low-income and low-income has led to low level of liquidity. Hence there is lim-ited ability to finance investment and apply improved technologies. The resultant effect is low yield, and the vicious cycle continues.

It is necessary to address the contributing factors to low coffee yield, and thus put the coffee sec-tor on a higher growth trajectory. The equity impact of increasing yield will be significant. Alt-hough all actors in the coffee value chain benefit from an increase in yield, including the gov-ernment, given that the share of farm gate prices from the export price of coffee is high, farmers are likely to derive greater benefit.

In addition, to yield, the potential to increase quality and hence earning from coffee is also huge. The market for differentiated coffee is growing, such as sustainable, gourmet and specialty cof-fees. Each specialty coffee commands a significant price premium. There is also excess demand for such types of coffee, which means the price premium is unlikely to disappear soon.

Although the agro-ecological diversity of Africa provides immense opportunities to produce these specialty coffees, no significant efforts have been made towards that direction. Therefore, by identifying

and implementing the required policy and institutional changes, through certification to one or more of the standards, Africa could maximise its earnings from the coffee sector. Alt-hough there is excess global demand for washed coffee, Africa's share is still relatively low, and increasing the share of washed coffee could enable the region to earn an additional premium of up to 40 percent.

Most of the causes that contributed to low yield and the share of washed and specialty coffee ex-port are associated with missing and imperfectly competitive market conditions, as well as under provision of public goods and services. Therefore, addressing the causes cannot be left to the market mechanism. There must be government interventions, both to supply the necessary public goods and services, as well as to play a gap-filling role, i.e., to play a coordination role, which the market mechanism failed to do. In addition to promoting efficiency, government interventions are also necessary to ensure that the benefits that come from increased productivity and quality improvements are equitably shared among actors that are engaged in the coffee value chain.

As the empirical result suggests, although domestic factors mainly contribute to the malfunction-ing of the African coffee sector, external adverse conditions are also significant contributors, both directly and indirectly by undermining the effectiveness of domestic policy measures aimed at improving the performance of the coffee sector. Therefore, African countries also need to make a concerted effort with other coffee exporting countries to demand a fairer condition in the distri-bution of the value added generated in the global coffee value chains. In addition to regulating supply through concerted efforts, Africa should promote domestic consumption of coffee. While this makes domestic demand for coffee more elastic, and protects the incomes of farmers when the world market price declines, it will also encourage domestic roasting and production of fully processed coffee.

The AfDB has important roles to play towards revitalising the African coffee sector. The Bank's support in the areas of knowledge generation and dissemination, as a public good, is vital, both in supporting the sector to operate optimally, as well as helping it keep pace with the technical change being experienced by other regions.

The Bank's support in tackling the under-provision of public goods and to enhancing the capacity of governments to regulate the coffee sector will also be crucial. Providing support to coffee pro-ducing countries to improve coffee quality, increase their global share in the specialty market and in putting in place a marketing system that ensures traceability and which reward quality are other areas that the Bank could support.

The AfDB can also enhance the capacity of the private sector to capture additional value added, such as by extending financial services to produce washed coffee, semi and fully processed cof-fee. As well as improving efficiency, the Bank could also support the sector in terms of enhancing the equitable distribution of the value added generated in the coffee value chain. It can do this by helping to strengthen the asset base and capacity of some stakeholders, like women and the youth, and building the bargaining capacity of farmers by supporting the formation of cooperatives.

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Annex

Table A.1 Levin-Lin-Chu Panel Unitroot Test

Variable	Adjusted t*	P-Value
Volume of Coffee Exported	-0.45	0.32
Coffee Yield	-1.57	0.06
Coffee Price	-3.07	0.00
Coffee Production	-2.64	0.00
Area Under Coffee	-0.18	0.43
Urea Price	-1.28	0.10

NB: Ho=Panel Contains Unitroot; Ha=Panel are stationary.
The nmber of lags are chosen on the basics of AIC.

Table A.2 Error-correction-based cointegration tests for panel data

Model	Z-value	P-Value
Volume of Coffee Exported	-1.39	0.08
Coffee Yield	-1.64	0.05
Coffee Production	-2.60	0.00
Coffee PArea Under Coffee	-2.50	0.92

*Westerlund error correction based cointegration tests

Table A.3 Wooldridge test for autocorrelation in panel data

Model	F-value	P-Value
Volume of Coffee Exported	10.20	0.02
Coffee Yield	222.00	0.00
Area Under Coffee	0.81	0.41

*Westerlund error correction based cointegration tests
H: no first-order autocorrelation

Table A.4 Panel data LR test for Hetroscedasticity

Model	F-value	P-Value
Volume of Coffee Exported	81.80	0.00
Coffee Yield	0.00	1.00
Area Under Coffee	69.25	0.00

*Westerlund error correction based cointegration tests
H0

Table A.5 Seemingly Unrelated Regression

Latin America

Equation	RMSE	R-sq	chi2	P
lnyield	0.20	0.14	8.39	0.00
lnarea	0.09	0.10	5.53	0.02
lnVolexp	0.18	0.09	4.92	0.03
Dependent Variable Coef.	z	P>z		
lnyield				
lnprice	0.14	2.90	0.00	
_cons	8.07	36.65	0.00	
lnarea				
lnprice	-0.05	-2.35	0.02	
_cons	15.81	154.96	0.00	
lnVolexp				
lnprice	0.10	2.22	0.03	
_cons	14.27	70.07	0.00	

Asia

Equation	RMSE	R-sq	chi2	P
lnyield	0.14	0.22	14.77	0.00
lnarea	0.56	0.19	11.69	0.00
lnVolexp	0.73	0.19	12.33	0.00
Dependent Variable Coef.	z	P>z		
lnyield				
lnprice	0.14	3.84	0.00	
_cons	8.25	52.77	0.00	
lnarea				
lnprice	0.48	3.42	0.00	
_cons	11.80	19.00	0.00	
lnVolexp				
lnprice	0.64	3.51	0.00	
_cons	10.41	13.02	0.00	

Africa

Equation	RMSE	R-sq	chi2	P
lnyield	0.11	0.00	0.02	0.88
lnarea	0.16	0.02	0.77	0.38
lnVolexp	0.19	0.00	0.00	0.99
Dependent Variable Coef.	z	P>z		
lnYield				
lnprice	0.00	-0.15	0.88	
_cons	8.34	67.72	0.00	
lnarea				
lnprice	0.03	0.88	0.38	
_cons	14.68	85.52	0.00	
lnVolexp				
lnprice	0.00	-0.01	0.99	
_cons	13.66	63.96	0.00	

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