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THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
POLICY STUDIES INSTITUTE

STRATEGY SUPPORT PROGRAM | WORKING PAPER 136

SEPTEMBER 2019

Trade, value chains, and rent distribution with foreign exchange controls

Coffee exports in Ethiopia

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ABSTRACT

Exchange rate policies can have important implications on incentives for export agriculture. However, their effects are often not well understood. We study the issue of foreign exchange controls and pricing in the value chain for Ethiopia's coffee – its most important export crop. Relying on unique pricing and cost data, we find that coffee exporters are willing to incur losses during exporting by offering high prices for coffee locally in order to access scarce foreign exchange. The losses in export markets are then more than recovered in importing, indicating rents – import parity prices are significantly lower than the prices charged for imported goods, so that profits on imports are much higher than the losses incurred in exporting. We further show that the high coffee wholesale prices are transmitted to farmers, so that they benefit from the rents downstream. These results suggest that a better exchange rate alignment to reduce the overvaluation of the local currency in this case would have a lower impact on export crop producer prices than typically is anticipated.

1. INTRODUCTION

“[The Ministry of Trade and Industry (MoTI)] claimed that exporters are affecting the country's hard currency earning by buying products for a high price at ECX and exporting them at a significantly lower rate, which affects the country foreign currency revenue: ‘Under-invoicing is affecting the country. You are only considering your personal benefit at the cost of the country.’”

Capital Newspaper, April 8th, 2019 ¹

“The MoTI warns 20 high level exporters including prominent actors saying that they will take legal action unless they cease their illegal export behavior immediately.”

Capital Newspaper, June 17th, 2019 ²

Exchange rate policies are important for the economic performance of countries. It has been found that successful exporting countries have usually avoided overvaluation of their currencies as more competitive exchange rates lead to improved external balances. For example, a multi-country review by Rodrik (2008) shows that competitive and undervalued exchange rates, rather than overvalued exchange rates, are more likely to promote growth and export diversification. These findings are important as it is part of the larger literature on the positive relationship between export growth and economic development (Helpman and Krugman 1985; Greenaway and Sapsford 1994; Melitz 2003). A frequent issue in developing countries, and for the agricultural sector in particular, is a misalignment of exchange rates, leading to distortions to agricultural incentives, often at the expense of export agriculture (Krueger et al. 1988; Anderson 2009). Farmers – especially those engaged in export agriculture – have therefore been shown to often receive less benefits than in a case where exchange rates better reflect market conditions.³

We contribute to this literature through a study of coffee pricing in Ethiopia. The country over the last decades has had a regime of mostly overvalued exchange rates and a rationing of foreign

¹ Yewondwosen, M. 2019. “Selfish illegal crop trade continues”. Capital Newspaper, April 8th, 2019, Accessed September 2nd 2019 from <https://www.capitalethiopia.com/featured/selfish-illegal-crop-trade-continues/>

² Yewondwosen, M. 2019. “Twenty exporters face severe consequences.” Capital Newspaper, June 17th, 2019, Accessed September 2nd, 2019 from: <https://www.capitalethiopia.com/featured/twenty-exporters-face-severe-consequences/>

³ Exchange rate alignment was also one of the important issues in the structural adjustment debate. On the other hand, undervaluation can lead to big successes. The most well-known example is China that had under-valued exchange rates which promoted its success in export markets.

exchange (Dorosh and Ahmed 2009; Ferrand 2018).⁴ We assess how this affects the pricing of coffee – Ethiopia’s most important export crop – in the value chain and consequently the welfare of farmers. We do so by comparing export parity prices with actual export and wholesale prices; by assessing margins, profits, and rents; and by evaluating the linkages between coffee exporters and coffee producers. We also perform a similar exercise on the import side for a number of standardized commodities. Finally, we model and simulate the expected impacts of the foreign exchange control regime on prices, trade, and welfare.

Our contribution to the literature is three-fold. First, we use a number of unique datasets at wholesale, producer, and export/import level that allow us, in a system of foreign exchange control, to compare mark-ups at different levels of the value chain. Second, we combine these data with insights from interviews with exporters and importers in order to understand the functioning of their businesses, allowing corroboration of quantitative evaluations with qualitative assessments. Third, we develop a theoretical model that explains the observed empirical regularities. This model then is used to simulate the welfare effects of the observed rent on the coffee economy.

We find international prices of coffee to be significantly lower than export parity prices, leading to losses for coffee exporters from Ethiopia. The losses are incurred so that exporters can access scarce foreign exchange. Those losses in coffee exporting are then more than recovered by profits in importing. Import parity prices are shown to be significantly lower than local retail prices for imported goods, and estimated profits on imports are much higher than the losses incurred in exporting.⁵ While overvalued exchange rates typically tax exporters at the expense of consumption – and lead to lower export prices but also lower import prices – we find that this distortion is (partly) overcome in the case of Ethiopia by adjustments through the profit margins realized by importers and exporters. We further find that the consequent high wholesale prices for coffee are transmitted to producers, so that coffee farmers are unintended beneficiaries of this rent. Under reasonable elasticity and transmission assumptions, we estimate the increase of producer surplus at 166 million USD or 31 USD per coffee farmer,⁶ significantly higher than other interventions in the value chain (Minten et al. 2018). We also show that without foreign exchange controls and this rent, coffee prices and, consequently, coffee exports would drop significantly.

Our research suggests that a better exchange rate alignment through, for example, currency devaluations – the standard prescription to improve external balances and incentivize export agriculture (World Bank 2016, 2019) – will in this case have a lower impact than typically is anticipated on producer prices for export crops and on export supply response, given the role of prices in this response.⁷ The research also suggests that the exchange rate regime followed in Ethiopia leads to rents (shown by larger margins in importing than the extra costs incurred in exporting) for those able to access foreign exchange. These rents reduce the efficiency of the economy, as it is unlikely that the most efficient firms obtain the limited foreign exchange and are able to import the inputs they require for production or consumption. Finally, in contrast to the statements quoted at the beginning of this paper, it does not seem that under-invoicing at export is an issue. Policy makers should pursue other interventions to improve trade.

⁴ This has contributed to taxations of exports, e.g., Mulu and Alekaw (2017).

⁵ These findings are in line with cocoa in Nigeria after exchange rate liberalization in the 1990s (Gilbert 2009).

⁶ The Central Statistical Agency (CSA) estimates that there were 5.3 million coffee farmers in Ethiopia in 2017.

⁷ For coffee in Ethiopia, see Dercon and Lulseged (1994).

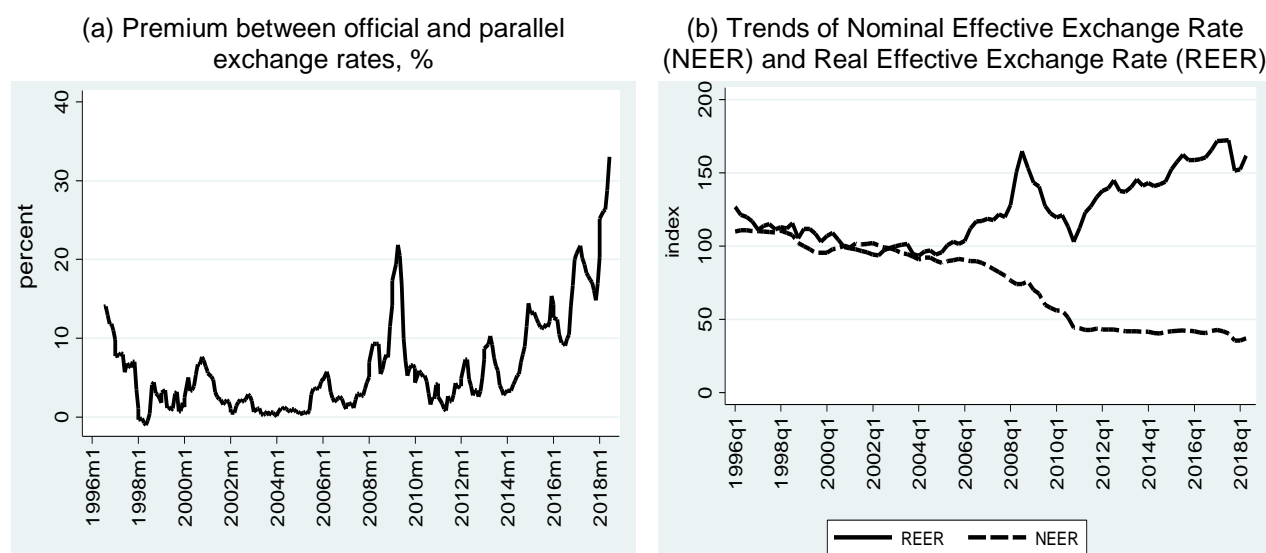
2. EXCHANGE RATES POLICIES IN ETHIOPIA

2.1. Overview

The government of Ethiopia has adopted different foreign exchange regimes over the last decades. During both the imperial (1930-1974) and the Derg (1974-1991) eras, the country followed a managed exchange regime (NBE 2018). Over the Derg period, the Birr (Ethiopia's currency) was pegged to the USD with a fixed exchange rate. The current government, when it came to power in 1991, opted for a slightly more liberalized exchange regime. However, strong controls on exchange rates and access to foreign currency have remained. Despite the gradual depreciation of the Birr vis-à-vis other currencies and several devaluations over the last three decades, with the most recent being a 15 percent devaluation in October 2017, the Birr has mostly remained overvalued (World Bank 2016).

To show the extent of overvaluation of the Birr, we present two commonly used measures. The first looks at the percentage difference between the official exchange rate and the parallel ('black market') exchange rate. The percentage difference between the two rates (the exchange rate premium) captures the extent of overvaluation, i.e., the larger the exchange rate premium, the bigger the overvaluation. Figure 2.1(a) plots the change in this exchange rate premium since 1996. The overvaluation of the Birr was kept relatively small until 2009. We then see a sudden surge in the gap between the parallel and official exchange rate with the premium reaching 21 percent in the second quarter of 2009. The 2009/10 devaluation of 17 percent substantially lowered the overvaluation, but only momentarily, as the overvaluation of the Birr continued to increase (NBE 2017c). The exchange rate premium reached an all-time high of 33 percent in June 2018, the end of the period under study.

Figure 2.1: Ethiopian Birr, official and parallel exchange rate changes, 1996 to 2018



Source: Authors' computation based on data from NBE (1995-2018)

The second measurement of the overvaluation of the Birr compares the gap between the Nominal Effective Exchange Rate (NEER) and the Real Effective Exchange Rate (REER). While the former is a trade-weighted nominal exchange rate, the latter incorporates relative prices of Ethiopia's domestic economy and that of its corresponding trade partners. This means that the REER captures the actual valuation of the currency and can therefore be used as a yardstick to assess the extent of overvaluation of the NEER for the Birr. Figure 2.1(b) displays the trends of NEER and REER over the last two decades. The plot shows a widening gap between the REER

and NEER over the last decade. While indices for both exchange rates were at similar levels until 2005, the index for the REER reached a level of 130 at the end of 2017, while that of the NEER declined to 40.⁸ Both these graphs illustrate a pattern of increasing overvaluation as shown by the gap between the official exchange rate and other market-based rates.

2.2. The retention policy

One policy crucial to the foreign exchange control policy regime in Ethiopia is the ‘retention policy’ which permits exporters (and also other regular recipients of foreign exchange from abroad) to have a ‘retention account’.⁹ Under this policy, exporters can open two retention accounts in the commercial banks where they do their business: a ‘forex exchange retention A’ (henceforth, retention A) account and a ‘forex exchange retention B’ (henceforth, retention B) account. Exporters are allowed to put a share of their foreign exchange currency in retention A and another share in retention B. The exporting firm can use the hard-currency in retention A for any purpose it desires, including for imports, and can keep it there for an indefinite time-period.¹⁰ On the other hand, the hard currency in retention B can be used only for imports related to the export business and only for a certain period.¹¹ After the permitted period, the hard currency in retention B has to be exchanged for local currency at the prevailing official exchange rate.

Table 2.1: Ethiopia’s foreign exchange retention policy over time, 1996 to 2017

Time	Hard currency (from export)			Time limit for Retention B, days
	Retention A, %	Retention B, %	To National Bank of Ethiopia, %	
February 1996	10	20	70	21
April 1996	10	40	50	21
October 1998	10	90	0	28
October 2017	30	70	0	28

Source: Authors’ compilation based on NBE (1996a-2018)

Modalities of this retention policy have changed over time (Table 2.1). At the beginning of the policy in February 1996, 10 percent of the foreign currency could be put in the retention A account and 20 percent in retention B, from where exporters could access it for 21 days. The remaining 70 percent had to be converted immediately into Birr at the prevailing exchange rate (NBE 1996a). In April 1996, an amendment allowed exporters to use up to 50 percent of their forex earnings (10 percent in retention A and 40 percent in retention B). In 1998, exporters were allowed to use 100 percent of their forex earnings, being permitted to place 10 percent of those earnings in retention A and the balance of 90 percent in retention B with a 28 days limit for use of the funds in retention B. The latest directive in 2017 increased the share that goes into retention A to 30 percent while the balance of 70 percent could be placed in retention B with a 28 days limit for use in obtaining imports related to the export business only.

As we will show, this policy not only affects export firms, but also import businesses, and it has an indirect effect on export markets overall. The key reasons are that foreign currency is in short supply and that the government has engaged in quantity rationing instead of using a price

⁸ A number of studies indicate that overvaluation of a currency, by creating disincentive towards exports, would intensify the current account deficit and overall economic growth, e.g., World Bank 2016; Mulu and Ashagrie 2017.

⁹ The foreign exchange recipients include resident companies, institutions, or individuals and government organizations, other than those in a diplomatic mission (NBE 2017b).

¹⁰ However, exporters engaged in service provision, such as hotels, travel agents, shipping and other carrier agents, and commission agents, among others, are required to surrender 100 percent of their forex earnings to the National Bank of Ethiopia (NBE) at the prevailing marginal exchange rate (NBE 2008).

¹¹ It is indicated in the directives that the exporter can use the foreign exchange for ‘export related business’ (such as imports of goods, except vehicles, in relation to the business, payments for promotional activities, etc.) where the definition of ‘export related business’ and ‘imports of goods’ are not necessarily clarified.

mechanism to clear the foreign currency market (Dorosh and Ahmed 2009; World Bank 2016). This foreign exchange control regime implies that importing firms often have to wait for months to obtain foreign currency through the official currency rationing scheme, providing an incentive for firms, as well as individuals, to revert to other means (informal or illegal) of accessing foreign currency, including bribing bank officials and using a black (parallel) forex market.

Another effect of the forex shortage is that it creates an incentive for an alternative use of the money held in retention accounts. The exporters are formally constrained to use currencies in retention accounts for specific import purposes – the items imported using hard currencies in a retention B account should in principle be related to the export business. However, this is often not the case in practice. The incentives to use exports as a means of accessing scarce foreign currency has important implications for exports, and coffee exports in particular, as well as for imports.

In the next section, we analyze the possible effects of this retention policy combined with foreign exchange controls through the development of a theoretical model.

3. CONCEPTUAL FRAMEWORK

The government intervenes in the foreign currency market in two ways: by restricting the amount of foreign currency available (R) and by restricting the share of forex that exporting companies can keep (θ). To understand how this policy combination (R, θ) affects trade, prices, and welfare, consider a small open economy with two commodities: (imported) cars and (exported) coffee.¹²

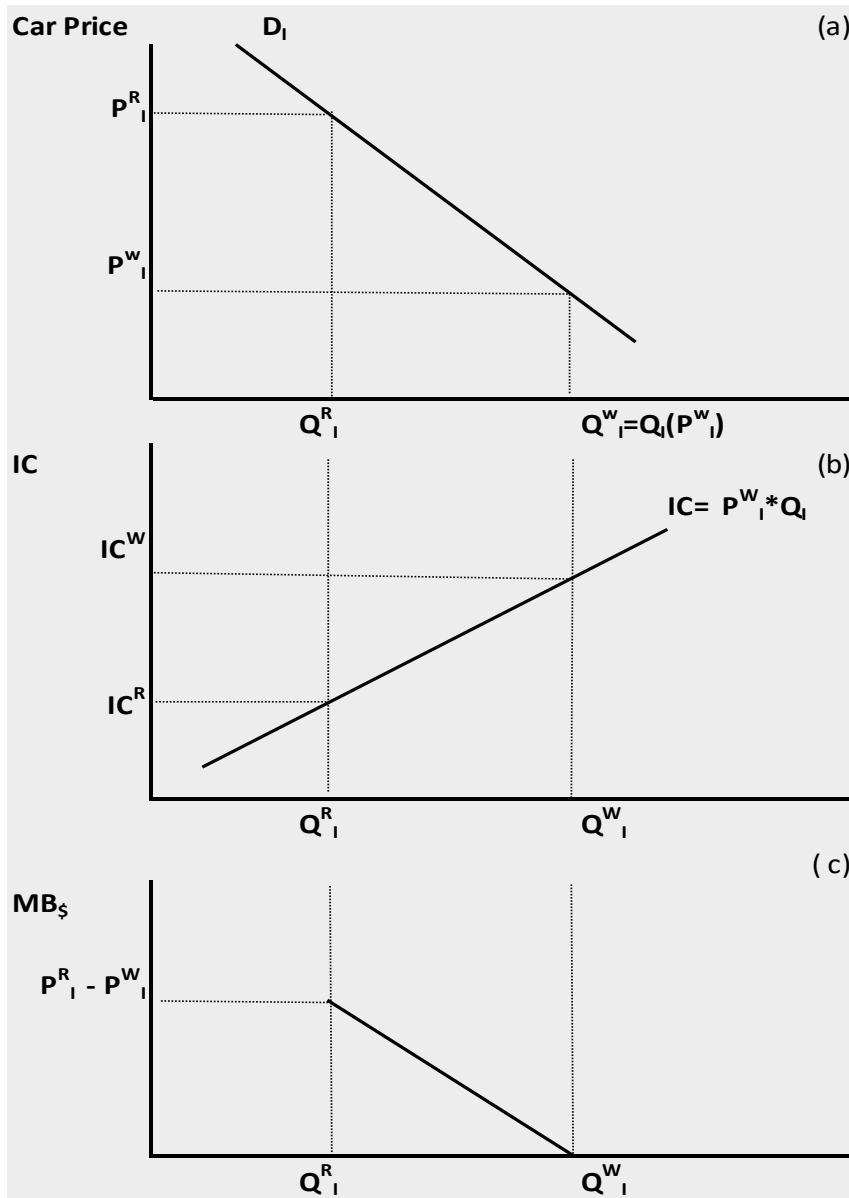
Figure 3.1 illustrates the car (import) sector. Demand for cars is represented by D_I in panel (a). If importing companies have unlimited access to foreign exchange and if there is no domestic production of cars, as is the case in Ethiopia, domestic demand equals import demand. Given the demand curve and a world market price P^W , the undistorted equilibrium import and domestic purchases of cars would be Q^{W_I} and the domestic price equals the world market price P^{W_I} . Panel (b) of Figure 3.1 illustrates the total cost of imports ($IC = P^{W_I} * Q_I$) for which foreign currency is required. In the undistorted equilibrium, the import cost is $IC^W = P^{W_I} * Q^{W_I}$.

However, this is not going to be the outcome if the government restricts access to foreign exchange. Consider a foreign currency constraint scenario where car importers are allowed only to have access to foreign currency equivalent to $IC^R < IC^W$ in panel (b). With these restrictions, importers can only import Q^{R_I} number of cars. As a result, the domestic price of cars increases to P^{R_I} in panel (a). The government restrictions cause the domestic car price (P^{R_I}) to be higher than the social optimum (P^{W_I}).

Note that the gap between P^{R_I} and P^{W_I} represents the marginal benefit (MB) for car importers from accessing additional foreign currency (to import additional cars). Panel (c) illustrates this marginal benefit of access to additional foreign currency (MB_{\S}) for different levels of car imports, reflecting different levels of foreign currency restrictions. With a downward sloping demand curve, this marginal benefit increases when restrictions are stronger (and car imports lower), and vice versa. In other words, the MB_{\S} function in panel (c) represents the demand function for extra foreign currency if this could be accessed. To understand where the supply of extra foreign currency comes from, we need to analyze the coffee (export) market.

¹² Larger country case simulations yield similar results but adds to the complexity. These models can be obtained from the authors.

Figure 3.1: Conceptual framework: car import sector



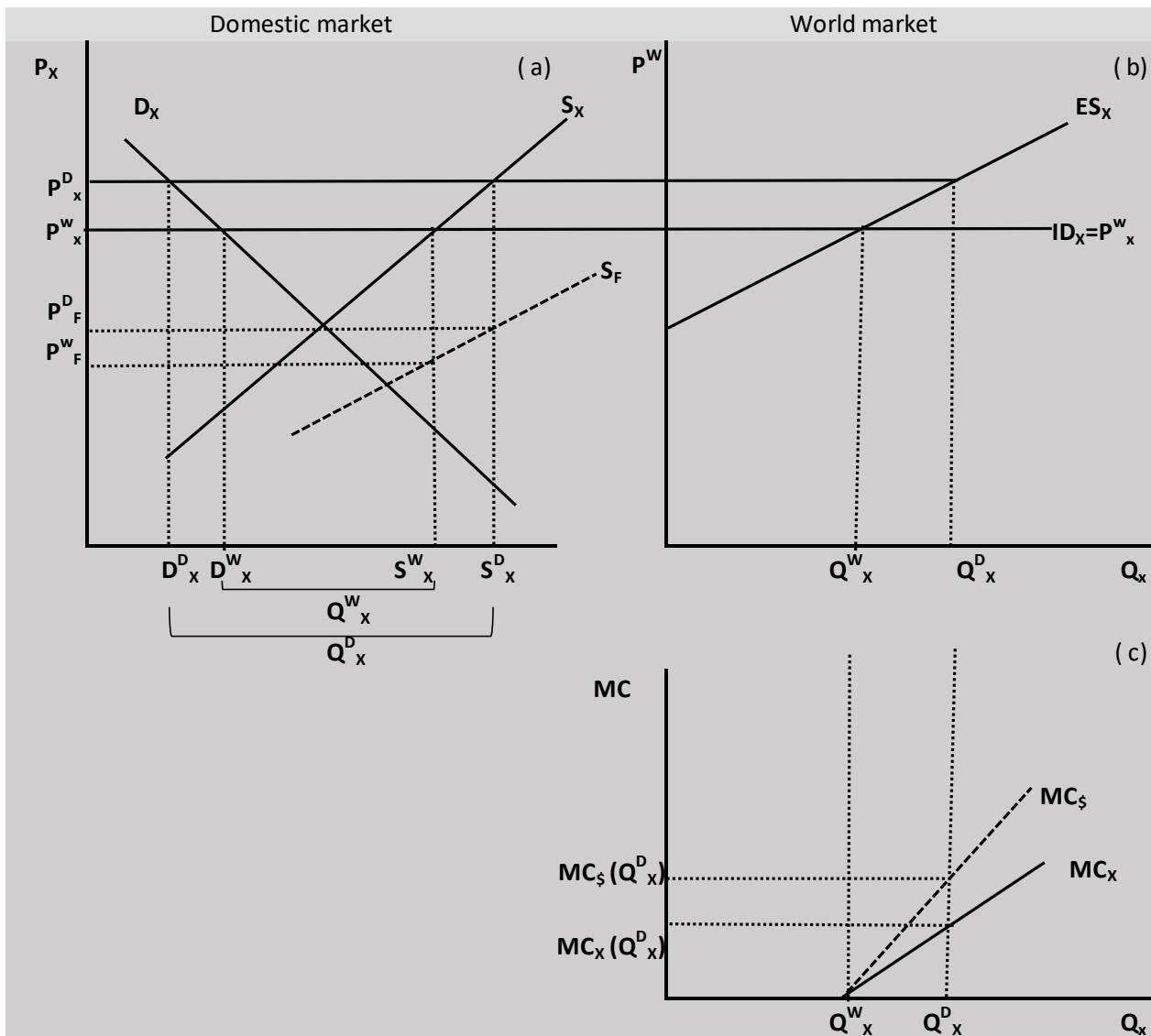
Source: Authors.

Figure 3.2 illustrates the coffee (export) market. In panel (a), farm-level production of coffee is represented by S_F and wholesale coffee supply for exports and domestic consumption is represented by S_X . The gap between both functions represents processing and trading costs.¹³

Domestic consumption is represented by demand function D_X and export supply on the world market is represented by ES_X (panel (b)). As the country is small relative to rest of the world market, world import demand (ID_X) is a horizontal function and equal to the world market price (P^W_X). Without government interventions, the world market price equals the domestic wholesale price (i.e., $P^W_X = P^D_X$, which includes transaction costs); the farm-level price is P^W_F and equilibrium levels of production, consumption, and export are S^W_X , D^W_X , and Q^W_X respectively.

¹³ A simple model that yields such functions is when farmers and (wholesale) traders maximize their respective profits. Farmers maximize profit $P_F \cdot Q_F - C(Q_F)$ where Q_F is farm production and $C(\cdot)$ production costs. The first order condition (FOC) $P_F = c_Q(Q_F)$ yields the farm supply (S_F) function. The trader maximizes $P_X \cdot Q_X - P_F \cdot Q_F - m(Q_F)$ where the first term is trader sales and $m(\cdot)$ is the trader's cost function. Assuming for simplicity that $Q = Q_X = Q_F$ (i.e., quantities do not change in the process) the trader's FOC is: $P_X = P_F + m_Q(Q)$. Combining the FOCs yields: $P_X = c_Q(Q) + m_Q(Q)$. The first right hand side term represents marginal production costs and the second term represents the marginal trader costs. The upward sloping S_F and S_X and the increasing gap between them in Figure 3.2 reflect increasing marginal production costs and increasing marginal trade costs. If marginal trade costs are constant with Q , the two functions will be parallel (see also Figure 3.4 on this).

Figure 3.2: Conceptual framework: coffee export sector



Source: Authors.

Let us now consider what would happen if the traders who export coffee can also import cars. As explained, imports of cars are constrained by government-controlled access to foreign exchange. Yet, traders can use the exchange rate retention policy to access foreign exchange by exporting coffee. This gives them the opportunity to engage in the profitable import sector. Without foreign exchange controls, coffee exporters would export Q_x^w units of coffee. With foreign exchange controls, exporters try to export more coffee even beyond the seemingly optimum point. By exporting more, they incur a loss. However, with foreign exchange restrictions they can make extra profit by importing cars. So, they will compare the losses from higher exports to the gains from more imports.

To increase exports, exporters have to pay increasingly higher prices on the domestic markets for coffee which they can only sell at the world market price P_x^w . Consider the case that they would export $Q_x^D > Q_x^w$ units of coffee. This would increase domestic coffee prices to $P_x^D > P_x^w$ and cause a per unit export loss of $P_x^w - P_x^D$. Exporting more than Q_x^D would further increase domestic prices and per unit export losses. The marginal costs of exporting more than Q_x^w are thus increasing and are represented by function MC_x in panel (c) of Figure 3.2 with $MC_x = P_x^w - P_x^D$.

However, by incurring such costs of exporting beyond Q_x^w , coffee exporters get access to extra foreign exchange. Government regulations specify that they can keep a share of this, which we

define as θ with $0 \leq \theta \leq 1$, and $\theta = 1$ if exporters can keep all of the foreign exchange. This means that the closer θ is to 0, the larger the costs of accessing foreign exchange than the losses incurred by exporting beyond Q^W_X . More specifically, the marginal costs of obtaining foreign currency $MC_\$ = MC_X/\theta$. Panel (c) of Figure 3.2 illustrates exporters' marginal export losses, MC_X , and the marginal costs of obtaining foreign currency, $MC_\$$, when exporters are allowed to keep only a portion of the foreign exchange they earned (i.e., $\theta < 1$). It is easy to show that with stricter regulations (i.e., θ being smaller) the costs of accessing foreign exchange are larger, ceteris paribus, which would be reflected in a steeper $MC_\$$ function.

Consider again the case that exporters would export $Q^D_X > Q^W_X$ units of coffee. In this case, the price that they have to pay to local wholesale coffee traders is P^D_X , their marginal losses from exporting are $P^D_X - P^W_X = MC_X(Q^D_X)$, and the marginal costs of accessing foreign exchange are $MC_\$(Q^D_X) = (P^D_X - P^W_X)/\theta$. Figure 3.2 also illustrates that domestic consumers lose with higher prices and larger sales, while local (wholesale) coffee traders and producers gain (Figures 3.3 and 3.4 present the distributions of gains and losses in more detail).

By linking the coffee and car markets, we can analyze how these two markets interact with government intervention in the forex market. Panels (a) and (b) in Figure 3.3 represent the coffee export market, while panels (d) and (e) represent the car import market. Panel (c) illustrates the "additional foreign exchange market". $MC_\$$ represents the marginal costs for coffee exporters to access foreign exchange and $MB_\$$ the marginal benefit for car importers to access forex. The equilibrium is where marginal benefits and marginal costs are equal. This equilibrium identifies the optimal level of coffee exports and car imports given a specific level of government regulations (R, θ) of foreign exchange. With R and θ in place, car imports will be at Q^*_I and coffee exports at Q^*_X .

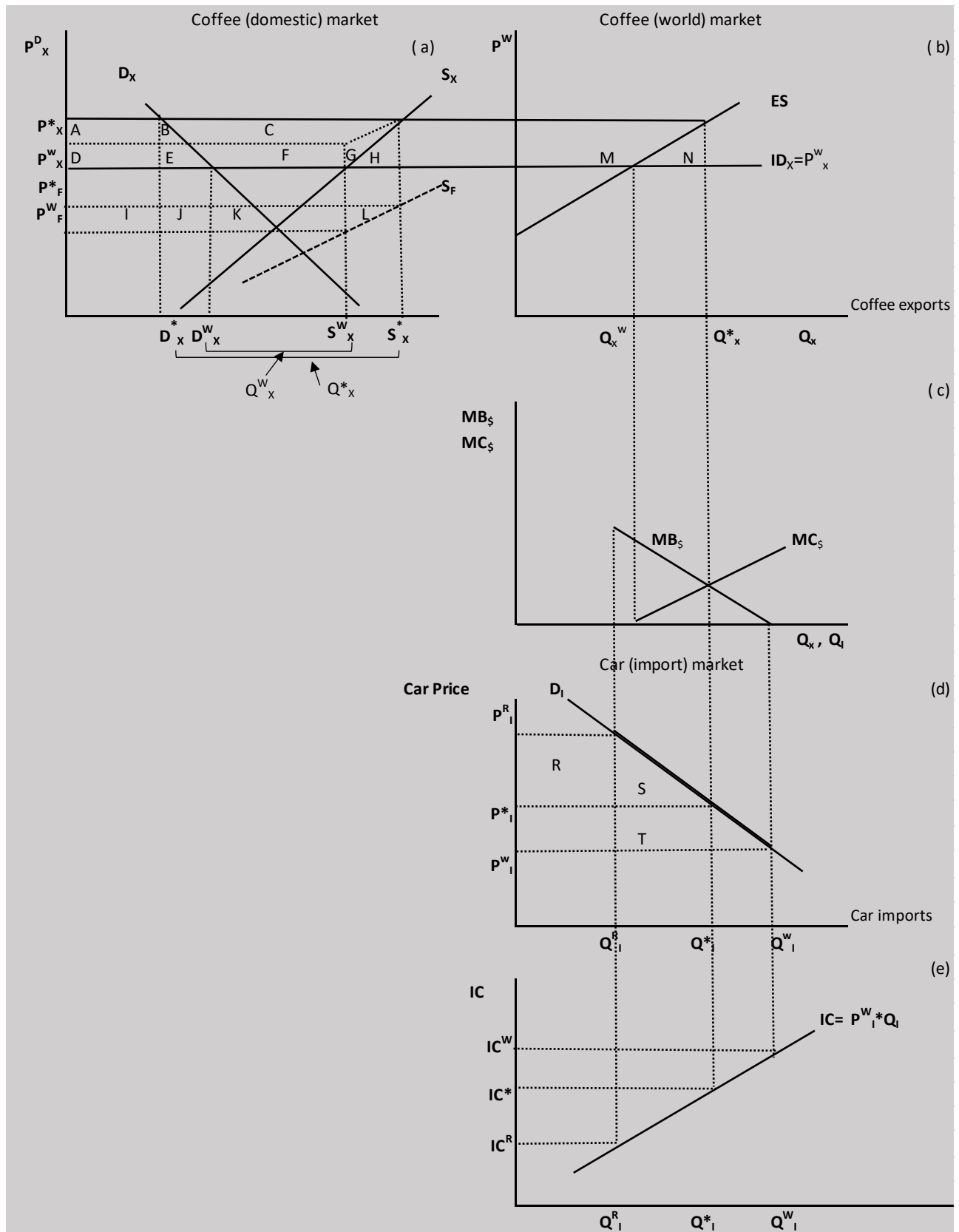
As the retention policy θ enables exporters to trade foreign exchange with importers, this allows more car imports into the country which pushes down the domestic price of cars from P^R_I to P^*_I (Figure 3.3 panel (d)). The coffee export level where marginal costs equal marginal benefits is at $Q^*_X > Q^W_X$. Hence, with foreign exchange restrictions, coffee exports are higher than without. In addition, exporters buy from the domestic market at a higher price. The result is that the domestic price of coffee (P^*_X) is now higher than the world market price of coffee (P^W_X). Exporters incur losses in their export business – as indicated by the upward sloping marginal cost curve beyond the equilibrium point – to access the foreign exchange which they can use to import more profitable import commodities.

How do these changes affect welfare? We first analyze welfare changes in the coffee export sector. The higher local price of coffee means that local consumers lose (in the form of losses on consumers' surplus) the sum of areas A, B, D and E in Figure 3.3.

On the supply side, the coffee value chain has three segments in Ethiopia: the exporters, the local traders, and the coffee farmers. As already explained, exporters lose from exporting coffee beyond the optimum. The loss for exporters is $Q^*_X \cdot (P^*_X - P^W_X)$. This is represented in Figure 3.3 by areas M+N in panel (b) and by areas B+C+E+F+G+H in panel (a).

Higher domestic coffee prices mean gains for the rest of the coffee value chain, i.e., the combination of local coffee traders and coffee farmers. The total gains are areas A+B+C+I+J+K+L in Figure 3.3. The distribution of these benefits between both groups will depend on the marginal trade (and processing) costs. Figures 3.2 and 3.3 illustrate the case of increasing marginal trade costs. In this case, both groups benefit. In Figure 3.3, farmer gains are represented by the areas I+J+K+L, which equals area A+B+C. Traders gain area D+E+F+G.

Figure 3.3: Conceptual framework: coffee exports and car imports with foreign exchange restrictions

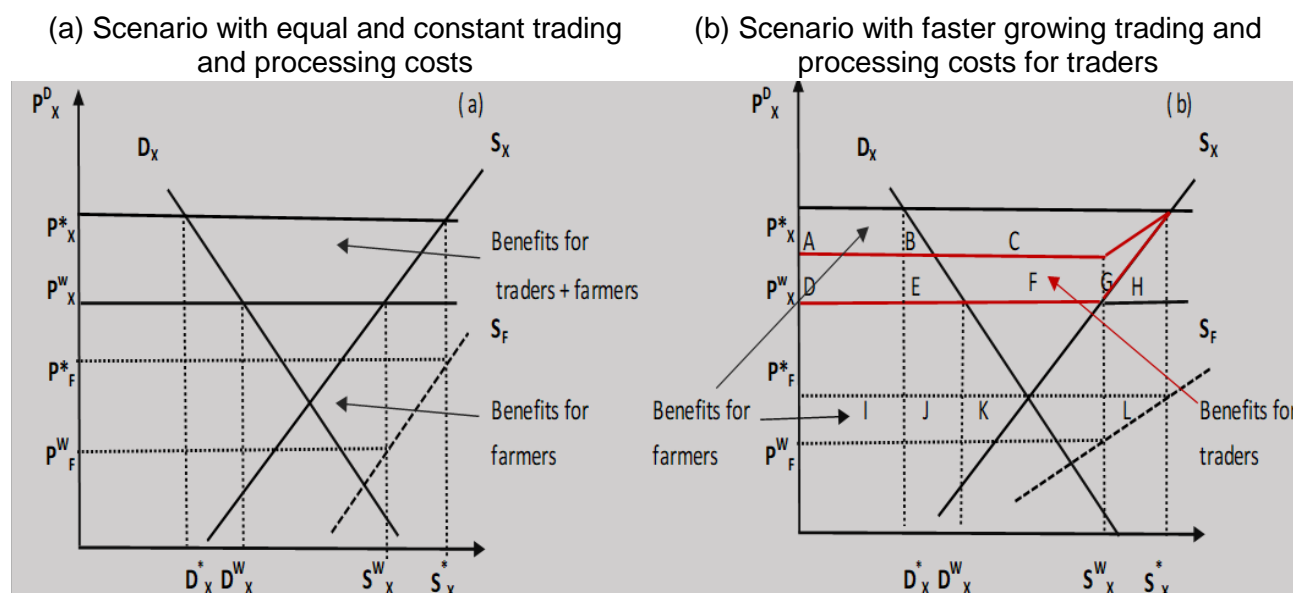


Source: Authors.

If marginal trade costs are constant, all benefits go to the farms. This is illustrated in Figure 3.4. The right panel of Figure 3.4 represents the increasing trade costs case – as in Figures 3.2 and 3.3. The left panel of Figure 3.4, the case of constant trade costs, is reflected by parallel supply

functions (S_x and S_F). In the “parallel” case of the left-hand panel, all the benefits (equivalent to areas A+B+C+I+J+K+L in the right-hand panel in Figure 3.4) go to the coffee farmers.

Figure 3.4: Benefit distribution between local coffee wholesale traders and coffee farmers (disregarding local coffee consumers)



Source: Authors.

Finally, there are also deadweight losses in the coffee market as a consequence of the government intervention. This loss is represented by areas B, E, and H in Figures 3.3 and 3.4.

On the import side, the increasing supply of car imports leads to a decline of domestic selling prices of cars. Local consumers of cars benefit in the form of higher consumer surplus amounting to the sum of areas R and S in Figure 3.3. Car importers lose area R, but gain area T. The net effect is a gain equal to areas S and T. The overall net effect, then, depends on the magnitude of the deadweight loss in the coffee export market, i.e., areas B, E, and H in Figure 3.3, and the net gain in car import business, i.e., areas S and T.

4. DATA

We use a number of unique datasets to empirically analyze the effective situation in Ethiopia. For exports, we obtained datasets at different levels of the coffee value chain: downstream, midstream, and upstream. Downstream, we use data from the International Coffee Organization’s (ICO) affiliated department under the Ethiopian Coffee and Tea Authority (ECTA). The ICO dataset is exclusively focused on coffee exports, containing information for the period between July 2006 and December 2017. The ICO dataset has detailed transaction level information on price, quantity, coffee type, certification of Voluntary Sustainability Standards, processing (washed or natural), exporter type, buyer type, and destination country. Midstream, we rely on a dataset obtained from the Ethiopian Commodity Exchange (ECX). These data contain information on price, quantity, production, source of origin, and trade margins for seven items traded on the ECX trading floor, i.e., coffee, sesame, haricot bean, maize, wheat, green mung bean, and pea bean. The data cover the period between December 2008 and March 2018. Upstream, we use the Ethiopian Central Statistical Agency (CSA)’s producer price data. The data are collected at the district (*woreda*) level for each agricultural item produced and sold in the country, including major export crops such as coffee. The data cover the period from July 2001 to December 2017.

On the import side, we obtained two major datasets. First, import level data for the period January 2010 to December 2017 was obtained from the Ethiopian Revenue and Customs Agency (ERCA). ERCA's import data contain detailed transaction level information on all imports into the country. For each imported item, the data include price, quantity, country of origin, and different import tariffs and duties. Second, we obtained CSA's retail price data. These data contain prices for a number of items sold in a large number of markets in Ethiopia, including imported commodities. We only use data for Addis Ababa, the largest retail market in the country. These data cover the period July 2005 to December 2017.

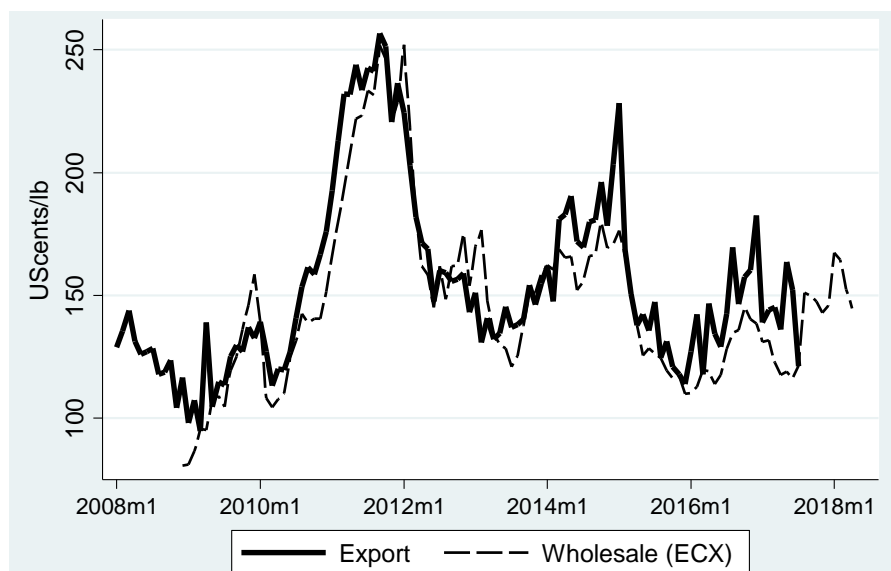
Finally, we conducted key stakeholder interviews with individuals involved in import and export businesses in Ethiopia. We interviewed 20 owners and managers of firms actively engaged in export and import businesses. We focused on those businessmen that had been in the business for some time, i.e. at least 5 to 10 years, so as to better understand changes in the sector. During these interviews, we also aimed at obtaining data on transaction costs in importing and exporting. We triangulated these data with those reported by Agrer (2014). In our calculations and simulations, we use the most conservative cost estimates coming out of these interviews.

5. EXPORT AND IMPORT PREMIUMS

5.1. Export parity versus export prices

Figure 5.1 shows the trend of the premium between export (f.o.b.) and wholesale (ECX) coffee prices between 2009 and 2017. The difference was on average 9 percent, a relatively small margin.

Figure 5.1: Coffee price premiums, difference between export and wholesale, 2009 to 2017



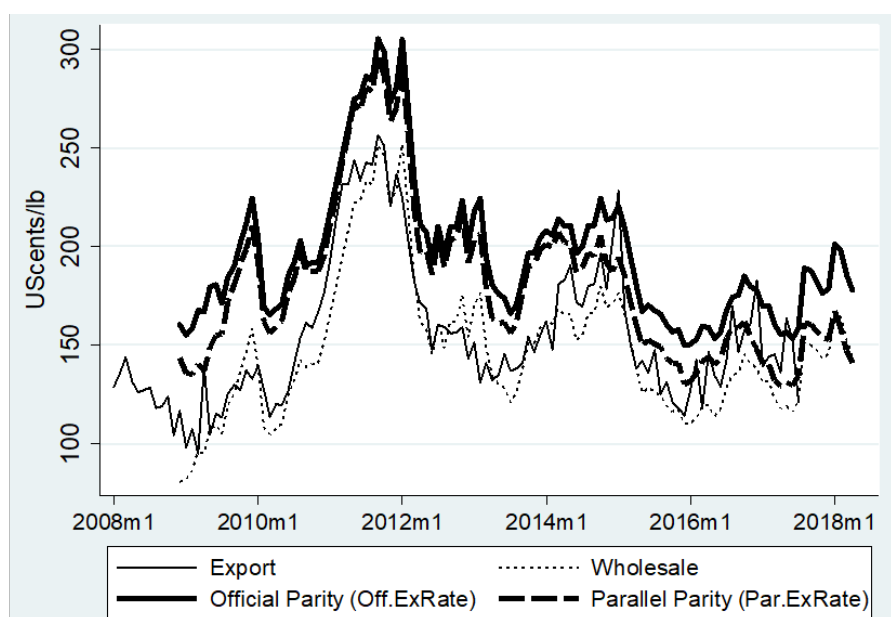
Source: Authors' calculation based on MoTI (ICO) and ECX data (2008-2017)
Wholesale prices are those of the Ethiopian Commodity Exchange, while export prices are free-on-board (f.o.b.) prices.

To get at export parity prices, we obtained the transaction costs between the purchase at ECX and export (f.o.b.). Annex 1 provides the breakdown of the major costs. They include costs for regional taxes, transport from warehouse to Addis Ababa, transport from Addis Ababa to Djibouti, interest payments to the private banks that exporters use to trade with ECX, cleaning and weighing services, transit process and port handling costs, and insurance. These and other relevant costs amounted to Birr 16.2 per kg (about USD 0.6 per pound) at the time of the study. We further assess the costs of rejects and add these to the estimates. It is important to note that we are only

considering the most common and most regular cost types. The estimations should therefore be considered a lower bound.

Taking into account the costs documented in Annex 1, we add in Figure 5.2 export parity prices (i.e., the wholesale (ECX) price plus transaction costs) to the prices plotted in Figure 5.1. To have a proper comparison of the wholesale (ECX) prices that are reported in local currency, i.e., Birr, with export prices that are quoted in USD, we use the official exchange rate. This rate is also used for the calculation of export parity prices. We also use a parallel ('black') exchange rate. We refer to the export parity price calculated using the official exchange rate as 'official parity' and the latter export parity price as 'parallel parity'.

Figure 5.2: Trends in wholesale (ECX), export (f.o.b.), and export parity prices, 2008 to 2017



Source: Authors' calculation based on data from MoTI (ICO) and ECX (2008-2017)
 ECX = Ethiopian Commodity Exchange; f.o.b. = free-on-board price

Analysis of margins between the effective export price and the two export parity prices reveals that coffee exporters operate with substantial loss – export prices are almost always lower than export parity prices. Over the period examined, the overall margin between the export and the official export parity prices averaged 26 percent, while the margin between the export and the parallel export parity prices was about 17 percent. The two export parity prices display close movement until the end of 2013. Thereafter, the margin between them widened. While the gap between the official and the parallel parity averaged about 5 percent between 2008 and 2013, it increased to 11 percent over the period 2014 to 2018. The gap between the two prices has widened more recently with a margin of 15 percent and 20 percent in 2017 and 2018, respectively.

Next, we analyze the differences between effective export prices and export parity prices in a multi-variate regression framework that allows us to more correctly control for the quality characteristics of the coffee. To do so, we employ a hedonic pricing model (HPM) to analyze the premia between export and export parity price levels. For this exercise, we use both the official and parallel exchange rate parities. Given that the HPM¹⁴ estimates the effect of the different attributes

¹⁴ A more detailed description of the conventional HPM can be found in the seminal work of Rosen (1974). Rosen presents a theoretical framework that describes the relationship between the marginal change in value (price) of a given item and the corresponding utility benefits of marginal changes in the different components of the bundle of attributes of an item.

of an item on the (economic) value of the item, we regress coffee price against a number of coffee attributes that could affect its value. Following Bajari et al. (2012), we use the following specification:

$$LP_t = \beta_e X_t^e + \beta_k X_t^k + U_t \quad (6)$$

where LP_t is the logarithm of coffee price in US cents per pound at time t , X_t^k is a K -dimensional row vector of time-varying different attributes of coffee, β_e is our parameter of interest that shows the margin between export and each of the export parity prices, β_k is a K -dimensional column vector of parameters, while U_t is an idiosyncratic error term.

Results of four specifications of this model are presented in Table 5.2. The first two use the official parity price, i.e., based on the official exchange rate, while the latter two specifications rely on the parallel parity price. Under specification 1, we run a parsimonious regression where we regress the logarithm of prices on a dummy variable representing official (export) parity and export prices. Here, export prices are shown to be significantly lower than their parity prices (ECX + transaction costs) by 13 percent. Under specification 2, we control additionally for coffee type (as proxied by local source of origin), whether the coffee was washed, coffee grade, and year and month dummies. Estimated parameters indicate that export prices are still significantly less than the official (export) parity prices. The size of the difference, nonetheless, is substantially lower than for the first specification – export prices are now lower than export parity prices by about 7 percent.

Table 5.2: Estimates from a hedonic price model to examine differences between effective export prices and export parity prices for Ethiopian coffee

Dependent variable: unit price (log)	Unit	Based on official exchanges rates				Based on parallel exchange rates			
		Specification 1		Specification 2		Specification 3		Specification 4	
		Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Export price (reported by MoTI (ICO) (Export parity, i.e., ECX + cost=default)	yes=1	-0.128***	-54.05	-0.072***	-35.96	-0.023***	-9.48	0.019***	9.34
Washed coffee (natural=default)	yes=1			0.093***	39.60			0.096***	39.65
Grade (grade 1=default)									
Grade 2	yes=1			-0.237***	-56.38			-0.245***	-54.44
Grade 3	yes=1			-0.304***	-64.98			-0.309***	-62.91
Grade 4	yes=1			-0.414***	-90.69			-0.417***	-86.66
Grade 5	yes=1			-0.459***	-95.76			-0.459***	-91.41
Coffee type (Sidama=default)									
Yirgachefe	yes=1			0.097***	46.94			0.098***	45.26
Jima	yes=1			-0.090***	-45.57			-0.094***	-46.44
Nekemte	yes=1			-0.113***	-36.65			-0.118***	-38.64
Harar	yes=1			0.321***	123.84			0.322***	122.06
Year dummy		No		Yes		No		Yes	
Month dummy		No		Yes		No		Yes	
Intercept		0.668***	629.82	0.458***	70.37	0.563***	482.90	0.367***	54.04
Observations		74,021		63,348		74,048		63,373	
F(,)		2921		6449		89		6108	
R-squared		0.05		0.71		0.001		0.70	
MSE		0.29		0.17		0.30		0.17	

Source: Authors calculation based on ECX and MoTI data (2008-2017)

**, **, * significant at 1%, 5%, and 10% significant levels respectively; robust standard errors

While most coffee is exported in formal markets using official exchange rates, it is also interesting to test to what extent the export prices reflect parallel exchange market prices. Under

specification 3, we therefore replicate specification 1, but this time with parallel parity prices instead of the official parity. Estimates from this parsimonious regression show that export prices are still lower than the parallel (export) parity prices, but only by about 2 percent. The last specification replicates specification 2, but it compares export price with the parallel exchange rate parity price instead of the official exchange rate one. Under this specification, export prices are slightly higher than the parallel exchange rate parity price by about 2 percent, indicating that these losses disappear if a parallel market exchange rate would be used.

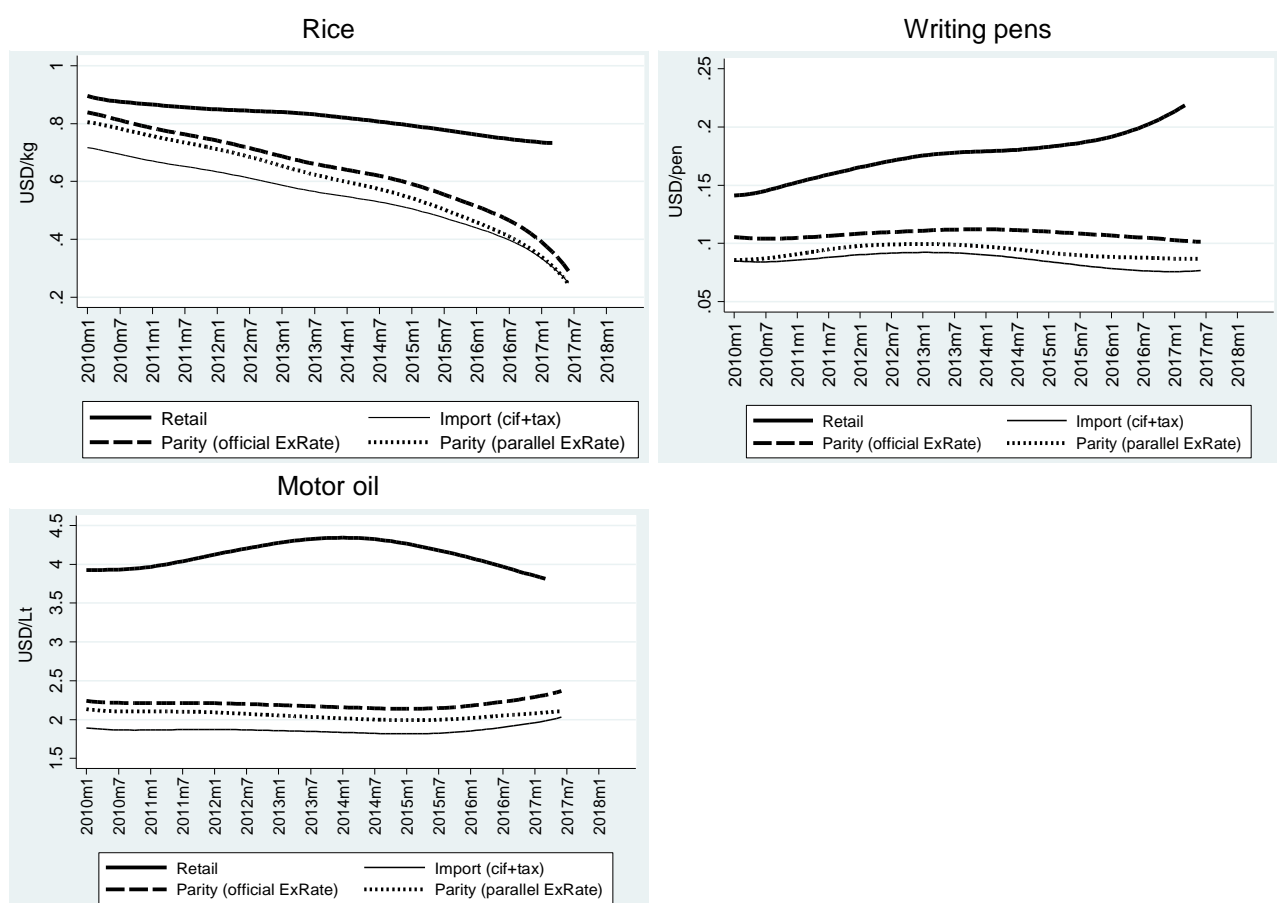
The general finding from this graphical and econometric analysis is that coffee exporters engage in exports with significant losses when they use the official exchange rate, as they are required to do.¹⁵ In the next section, we examine the premium from the import side.

5.2. Import parity versus domestic retail prices for imported goods

Relying on key informant interviews, we identified items that are commonly imported by most exporters that use forex from retention B. Using ERCA's import data, we identified and calculated prices (c.i.f. (cost, insurance, and freight) price + tax) of these imported goods. As we have access to the domestic price of the imported commodities and associated transaction costs, we can calculate premiums between the domestic and the import parity prices. For the local price, we use CSA's retail price from Addis Ababa. To get insights on associated transaction costs, we relied on interviews of key informants involved in the import business. We use the costs listed under Annex 2 to calculate import parity prices. We then compare import prices (c.i.f. price + tax), import parity prices (c.i.f. price + tax + transaction costs) calculated based on official and parallel exchange rates, and domestic prices as proxied by CSA's retail prices in Addis Ababa. Figure 5.3 presents these comparisons for three selected and relatively homogeneous items, i.e. rice, ballpoint writing pens, and car motor oil.

¹⁵ This result confirms results found in other settings (e.g. Cashin et al. 2003; Gilbert 2009; Bodart et al. 2015; Kohlscheen et al. 2016; Hatzenbuehler et al. 2016). In these studies, real commodity prices co-move with real exchange rates, with the real exchange rate often adjusting towards a long run equilibrium with real prices (Cashin et al. 2003; Kohlscheen et al. 2016).

Figure 5.3: Margins between domestic retail and import parity prices for rice, pens, and motor oil



Source: Authors' computation based on data from ERCA, and CSA (2009-2017)

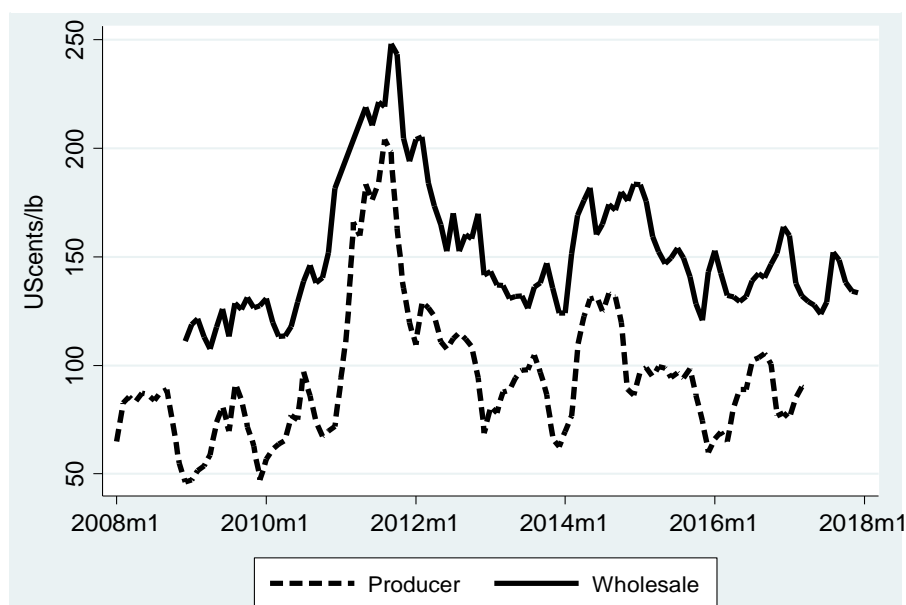
On average, over the 2010 to 2017 period, the differences between retail and the parallel import parity prices for rice, pens, and motor oil were 34 percent, 87 percent, and 103 percent, respectively. The margins between the retail prices and import parity have become even bigger recently, except for motor oil. Over these years, the average margin for rice, pens, and motor oil were 64 percent, 117 percent, and 100 percent, respectively, indicating higher differences than the losses at the export level and an indication of rents in trade. It is to be noted that exchange rate rents are included in the calculation of parallel import parity prices, i.e., we use the parallel exchange rate. If an exporter can import these goods himself, he can internalize these rents in his business so as to pay for the losses realized in exporting.

6. QUANTIFYING THE WELFARE EFFECTS OF THE RENT ON THE COFFEE ECONOMY

Figure 6.1 presents prices at the wholesale (ECX) and producer level, converted to US cents per lb. of green coffee bean. To construct the producer prices, we first consolidated prices of 22 major coffee producing zones in the country, i.e. covering almost all coffee producing zones. Then, following CLU's coffee categorization, we mapped the 22 zones into the five major coffee types, i.e., Sidama, Yirgachefe, Harar, Jimma, and Nekemte. Finally, to obtain a representative price, we took volume weighted averages over the five coffee types. Figure 6.1. shows that over the period considered, producers obtained about 62 percent of the wholesale price. Most importantly, the two lines show the strong linkages between wholesale and producer level prices. Absolute margins appear rather stable and peaks and throughs are similar in both graphs, broadly indicating

transmission of prices from wholesale traders to producers. See Annex 3 for a detailed analysis of the extent and speed of price transmission for coffee between wholesale traders and farmers using a Threshold Autoregressive (TAR) Model.

Figure 6.1: Wholesale (ECX) and producer prices, 2008-2018



Source: Own computation based on CSA (2008-2018) and ECX (2008-2018)
ECX = Ethiopian Commodity Exchange.

Next, we quantify the welfare impacts of these higher prices because of the foreign exchange controls on the coffee economy in Ethiopia. The parameters used for the simulation are the following:

- We focus on the most recent year when data are available. For the year 2017/18, the average producer price was 1.71 USD per kg of green coffee in Ethiopia.
- Export and production data for the period were obtained from the International Coffee Organization. These data show exports at 238,573 and production at 450,000 metric tons. Consumption is calculated as a residual.
- The difference between export parity and wholesale prices in 2018 was 385 USD per mt.
- We run simulations assuming different ranges for price elasticities for demand ϵ_d (0.8 and 1.0) and supply ϵ_s (0.1 and 0.3) for coffee, in line with existing empirical estimates for Ethiopia (Dercon and Ayalew 1995; Tafere et al. 2010).
- We run further simulations under a transmission efficiency of prices between wholesale and producer levels of 100 percent (full), 75 percent, and 50 percent of ECX prices to coffee producers.

Table 6.1 shows the results of these simulations under these different assumptions. No observed gap between export parity and wholesale prices and full transmission would imply for 2017/18 a reduction in producer prices of approximately 385 USD per mt. We focus the interpretation on price elasticity of supply and demand of respectively 0.3 and 1.0. Following the model presented in Section 3, because of higher export prices under the foreign exchange control scenario, producers increase coffee production by 39,059 metric tons compared to a no-control scenario. The producer surplus increases because of this higher price by 166 million USD. On the other hand, as consumers face a higher price and they consume less coffee, consumer welfare is reduced by 99 million USD. The deadweight losses are estimated at 20 million USD. Total exports are increased by 104,156 mt or an increase by 77 percent of the quantity of coffee exported. Under different assumptions of lower elasticities or lower transmission efficiencies, these differences are

much smaller, but still substantial. For example, we note an increase in exported quantities of 37 percent if $\epsilon_d=0.8$ and $\epsilon_s=0.1$ and complete (absolute) price transmission.

Table 6.1: Welfare impacts on the coffee sector of the elimination of the gap between export parity and wholesale prices

	Unit	Elasticity scenarios						
		ϵ_s	0.10	0.10	0.30	0.30	0.30	0.30
		ϵ_d	0.80	1.00	0.80	1.00	1.00	1.00
		Transmission efficiency*	1.00	1.00	1.00	1.00	0.75	0.50
		Observed in 2018						
								Impacts
Producer price	USD/mt	1,716	1,331	1,331	1,331	1,331	1,427	1,523
Exported quantity	mt	238,573	-65,098	-78,117	-91,137	-104,156	-92,416	-82,159
Production	mt	450,000	-13,020	-13,020	-39,059	-39,059	-27,318	-17,061
Consumption	mt	225,000	-52,078	-65,098	-52,078	-65,098	-65,098	-65,098
Change consumer surplus (CS)	million USD		96.66	99.17	96.66	99.17	74.38	49.59
Change producer surplus (PS)	million USD		-170.77	-170.77	-165.76	-165.76	-126.01	-85.00
Dead-weight loss	million USD		-12.53	-15.04	-17.55	-20.05	-20.05	-20.05

Source: Own computations

* 1.00, 0.75, and 0.50 respectively assume 100%, 75%, and 50% transmission efficiency, defined as the share of the higher wholesale price going to coffee farmers.

7. CONCLUSION

One of the stylized facts of the agricultural sector is that farmers are taxed in the poorest agricultural economies, while they are subsidized in the most advanced ones. A number of political reasons have been advanced to explain this intriguing phenomenon (Anderson et al. 2013; Swinnen and de Gorter 1993; Swinnen 1994). A frequent issue for farmers in developing countries, and part of that taxation, is a misalignment of exchange rates, leading to distortions to agricultural incentives often at the expense of export agriculture (Krueger et al. 1988; Anderson 2009). Farmers, especially those engaged in export agriculture, therefore have been shown to often receive less benefits than in a case where exchange rates better reflect market conditions.¹⁶

While exchange rate policies can have important impacts on the agricultural sector and rural areas more broadly, it has also been shown that changes in exchange rates to local prices are incomplete, especially so in developing countries (Campa and Goldberg 2005; Borensztein and Queijo Von Heideken 2016; Bekkers et al. 2017). The reasons for this limited pass-through are often not well understood. We study this issue in the case of coffee in Ethiopia – its most important export crop – and assess how the exchange rate control regime there affects pricing of coffee in the value chain as well as the welfare of coffee producers, using modeling as well as empirical estimates.

Relying on unique price data at the export, wholesale, farm, and retail level, on cost data for trading, and on a variety of methodologies, we find that in a situation of rationed foreign exchange coffee exporters over the last decade were willing to incur large losses during exporting in order to access foreign exchange. This is illustrated by the export prices for coffee being significantly lower than export parity prices. These losses in export markets are then recovered by relatively high profits in importing commodities, as import parity prices are found to be significantly lower than domestic retail prices for those imported commodities. We further show that coffee producers are the unintended beneficiaries of these distortions in foreign exchange markets as the higher

¹⁶ Exchange rate alignment was also one of the important issues in structural adjustment debates in the 1980s and 1990s. On the other hand, undervaluation can lead to big successes. The most well-known example is China that had under-valued exchange rates and therefore succeeded in penetrating export markets.

wholesale coffee prices that result are transmitted to them. We show a producer surplus 166 million USD higher that would be the case without foreign exchange controls because of the gap between export parity and export prices. The findings on the coffee value chain in Ethiopia show similarities to observed situations in other countries.¹⁷

The findings of this research have a number of implications. First, a better exchange rate alignment, to better reflect market conditions and rectifying this system, would in this case have less impacts on improved external balances, and on export agriculture supply response, than typically anticipated. This is important as a commonly seen policy prescription to get agricultural export agriculture going in these types of economies is better exchange rate alignments that would typically lead to relatively higher producer prices for export crops and therefore increased export supply (World Bank 2016, 2019). Second, the exchange rate policies being pursued in Ethiopia seemingly lead to undesirable inefficiencies and rents that should be addressed. The lack of exchange rates reflecting market conditions leads to non-transparent allocations of foreign exchange for importers and exporters and to delays and increased transaction costs in order for an exporter to be successful in trade. It is therefore unlikely that it is the most efficient firms that get access to the foreign exchange and imported inputs needed for production or consumption. Finally, as shown in the quotes at the beginning of this paper, it does not seem that under-invoicing of coffee transactions at export is an issue, but other mechanisms are at play. Policy makers should therefore pursue other interventions as well in order to improve Ethiopia's international trade and export performance.

¹⁷ For example, Gilbert (2009) showed that Nigerian cocoa producer prices at official exchange rates averaged 140 percent of world prices over 1990-95 and 220 percent over 1996-2000.

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ANNEXES

Annex 1: Transaction costs for coffee exports from Ethiopia

Panel (a) of Table A.1 provides a breakdown of the major costs associated with exporting coffee from Ethiopia. They include costs for regional taxes, transport from warehouse to Addis Ababa, transport from Addis Ababa to Djibouti, interest payments to the private banks that exporters use to trade with ECX, cleaning and weighing services, transit process and port handling costs, and insurance. These and other relevant costs amounted to Birr 16.2 per kg (about USD 0.6 per pound) at the time of the study.

Panel (b) of Table A.1 further shows the costs incurred because of rejected coffee beans during the cleaning and quality inspection process between purchase at ECX and export. All exportable coffee undergoes two stages of quality inspection: the first at ECX laboratories, and the second at the Ethiopian Coffee Liquoring Unit (CLU). After coffee passes through the ECX laboratories, it is traded on the ECX trading floor. Some of the coffee considered fit for export by ECX may, however, fall short of the standards of the CLU and may be deemed unfit for export. For this reason, after the ECX testing, exporters have their coffee cleaned at cleaning warehouses in Addis Ababa before they take it to CLU for a second round and arguably the most important quality inspection. After the cleaning process at the warehouses and at the CLU laboratories, some of the coffee is judged as unfit for export ('reject').

According to our key informants' estimates, of all the coffee that is considered fit for export at the first stage of testing at the ECX laboratories, on average only 86 percent actually qualifies as exportable according to CLU testing. The remaining 14 percent is identified as reject and unfit for export. Key informants estimated that about 93 percent of the reject, i.e., 13 percent of coffee bought at ECX, can be resold on the ECX floor to be released into the local market, while 7 percent, i.e., 1 percent of coffee bought at ECX, is estimated to be completely discarded. The majority of the reject that is re-sold at the ECX floor obtains a price that is on average 20 percent lower than that at which it was originally purchased. This implies that exporters lose about 20 percent on the 14 percent "reject" coffee, i.e., an additional cost to exporters estimated to be about 3.5 percent of the value. In Panel (c) of Table A.1, we add this estimated cost to the transaction costs reported in panel (a).¹⁸

¹⁸ According to our key informants there are other variables that might further increase the cost estimation.

1. Losses incurred during transportation from regional ECX warehouses to the cleaning space in Addis Ababa. The major reason for this particular type of loss is the so called 'kisheba', i.e. cheating by some of the transporters. These transporters might steal a small amount from each bag (a precautionary tactic not to draw special attention to a particular bag) for a cumulative of up to 3 quintals from a shipment of about 40 mt, or about 0.75 percent of the total shipment.
2. At the cleaning warehouse in Addis Ababa, coffee could stay between 1 and 6 months due to either a) waiting in queue for cleaning, which could take between 1 and 2 months or b) using the cleaning house as a relatively cheap warehouse to store coffee bought earlier until all purchase orders are met. In both cases, additional storage, unloading, loading, and other related costs could be incurred.
3. In the process of waiting at the cleaning warehouse (either for cleaning or until all purchase orders are met), coffee could lose weight due to moisture loss. This loss is estimated to be as much as 2.5 percent.
4. After the coffee is inspected and gets clearance by government officials at customs for export, during the long-distance travel (especially to destinations in North America and Europe), coffee might lose even more weight. According to our key informants, the weight loss during such shipments could be about 0.5 percent where in such instances, coffee exporters in Ethiopia are required to settle the difference (the loss) in foreign currency.

These and other relevant variables that might affect per unit cost calculations are deliberately left out of our analysis as they are irregular, i.e., incurred either only by some types of exporters or only at certain condition or time period.

Table A.1: Transaction costs for coffee between wholesale (ECX) and export level

Cost Items	Cost breakdown	Cost in ETB		
		100 kg	1 kg	1 lb
Panel (a) - Transaction costs				
Cost at point of purchase (considering 10-day delivery time)	ECX fee	2.6	0.0	0.0
	Regional tax	850.0	8.5	3.9
	Local transport	91.7	0.9	0.4
	Unloading charges	1.8	0.0	0.0
	Interest payment to the banks	205.5	2.1	0.9
	Coffee commission	2.7	0.0	0.0
Variable costs during processing, cleaning	Cleaning costs	60.4	0.6	0.3
	All handling costs	28.2	0.3	0.1
Export costs	CLU cupping	1.0	0.0	0.0
	CLU labor service	3.8	0.0	0.0
	Bags marking	0.4	0.0	0.0
	Port handling charges	50.0	0.5	0.2
	Weighing service	60.0	0.6	0.3
	Fumigation service	35.0	0.4	0.2
Documentation / inspection	Quality inspection service	1.0	0.0	0.0
	Maritime service`	30.7	0.3	0.1
	Insurance	18.0	0.2	0.1
	Transit Djibouti	58.0	0.6	0.3
	Truck transport	80.0	0.8	0.4
	Bags	40.0	0.4	0.2
Total costs in ETB		1620.9	16.2	7.3
Total costs in USD		136.7	1.4	0.6
Panel (b) - Other relevant costs				
Of all coffee originally bought for export at ECX, 14% would be rejected: [A]	What happens to rejected coffee	Premium loss (%) [B]	Per unit cost (%) [A*B]	
13% resold at ECX	Resold at ECX, to be injected into local market	19.0	2.5	
1% lost during cleaning	Loss	1.0	1.0	
Panel (c) - Total proportional loss (%)				3.5
Total (direct and indirect) costs, per kg	Total of panels (a) and (b):	3.5% of price +1.4 USD		

Source: AGRER (2014), ECX, and key informant interviews
 ECX = Ethiopian Commodity Exchange.

Annex 2: Transaction costs for imports into Ethiopia

Table A.2 presents estimates of the most common transaction costs associated with importing goods into Ethiopia. According to key informants, these costs include:

- Premiums paid to get access to foreign currency in the parallel market. This is the biggest cost with the premium averaging around 9.5 percent for the period 2010 to 2018. The premium has increased substantially over this period, reaching about 27 percent in October 2018 (the last column of the table) in line with the patterns of currency overvaluation over time reported in Section 2.
- Bank related charges, including charges related to the Letter of Credit (LC). These could be as high as 4.5 percent.
- Local freight cost from the port of Djibouti to the dry port in Mojo and then to Addis Ababa. This cost is around 4.2 percent of import value.
- Storage costs at the ports for the imported items. Even though the items could stay for more than 90 days (and therefore increase costs), we take the estimated storage costs for up to 90 days, which amount to around 6.3 percent of import value.
- Other miscellaneous costs, such as loading at dry port, transit processing cost, and insurance fees. These altogether amount to about 2 percent.

In total, between the sea port at Djibouti and Addis Ababa, it is estimated that importers incur transaction costs of around 26 percent of the import value (c.i.f. price + tax).

Table A.2: Domestic transaction costs related to imports between seaport and retail markets in Addis Ababa

Local transaction costs related to imports	Per unit cost, % of import value	
	2010-2018	Oct. 2018
Buying USD (illegally) from parallel market	9.52	26.61
Bank charges, including Letter of Credit charge	4.50	4.50
Transport from seaport (Djibouti) to dry port (Mojo) to Addis Ababa, 20-foot container with capacity of 16 mt	4.21	4.21
Storage cost at dry port (Mojo), for average 90 days	6.32	6.32
Loading at dry port, if forklift: ETB 6000 per 16 mt; if laborers: ETB 2 per kg	0.63	0.63
Transit process fee	0.24	0.24
Insurance	0.86	0.86
Total local cost	26.28	43.37

Source: Authors' compilation based on key informants (importers) estimates

Annex 3: Coffee price transmission between wholesalers and producers and integration tests

To quantify the speed of transmission from wholesale to producer, we use the Threshold Autoregressive (TAR) Model (van Campenhout 2007):

$$\Delta d_t = \begin{cases} \rho^{out} d_{t-1} + \rho^{out}_t d_{t-1} + \varepsilon_t & : d_{t-1} > \theta_t \\ \varepsilon_t & : -\theta_t \leq d_{t-1} \leq \theta_t \\ \rho^{out} d_{t-1} + \rho^{out}_t d_{t-1} + \varepsilon_t & : d_{t-1} < -\theta_t \end{cases}$$

where d_t , in our case, is the difference between the wholesale and producer price levels for coffee, i.e., $d_t = E_t - P_t$, where E_t is the price at the ECX (wholesale) level and P_t is the price at the farmer (producer) level at time t . $\Delta d_t = d_t - d_{t-1}$ denotes the time trend, and θ is an approximation for transaction costs.¹⁹ ρ^{out} is the adjustment factor²⁰ for prices outside the transaction cost band (that is $-\theta$ to θ), whereas ε_t is the estimated residual. We do the test for the period December 2008 to December 2017, a period for which we have comparable data at each level.

Table A.3: Transmission between Ethiopian Commodity Exchange prices and producer prices for coffee, 2009 to 2017

Coffee type	Average speed of adjustment #	Trend of average speed of adjustment	Average half-life, months	Estimated transaction cost, % of average price	
				2009	2017
Overall	-0.132**	-0.001	4.9	50.4	49.4
Washed	0.530**	-0.008***	-1.6	69.2	51.0
Unwashed	-0.456***	0.003***	1.1	65.8	29.7

Source: Authors calculation based on CSA, ERCA, ECX (2009-2017).

***, **, * significant at 1%, 5%, and 10% significant levels, respectively

If average speed of adjustment = -1, it means perfect speed of adjustment; if the adjustment = 0, it indicates no adjustment; if -1 < average speed of adjustment < 0, it indicates certain degree of adjustment with faster adjustment the closer the speed of adjustment to -1. A positive speed of adjustment indicates that price levels are drifting apart and not integrated in the short-run.

We present estimates from this analysis of vertical integration between wholesale (ECX) and producer prices for washed, unwashed, and overall coffee types, respectively (Table A.3). The price transmission estimates show mixed results for the different coffee types. While transmission between wholesale and producer prices for washed coffee is non-existent, with the two price levels drifting apart, a good level of price transmission is seen for unwashed coffee. The overall coffee type, mostly composed of unwashed coffee, also shows price transmission between the wholesale and producer levels. The half-life estimates indicate that it takes just over a month for a given price shock to be transmitted between wholesale (ECX) and producer price levels for unwashed coffee bean, while it takes about 5 months for overall coffee. Focusing on unwashed coffee, while the strong price transmission (-0.456) between wholesale and producer price levels suggests that producers benefit from price changes at the wholesale level, the positive trend in the speed of adjustment (0.003) implies that the speed of price transmission is slowing slightly over time.

Estimates of transaction cost levels over time show that these diminished between 2009 and 2017 for unwashed and for overall coffee, although the decline is smaller for the latter. Lower average prices in later years of the period partly account for this – coffee prices peaked in 2011.

¹⁹ Following Van Campenhout (2007) and also using a grid search method (Chan, 1993), the threshold can be modeled as a simple linear function of time: $\theta_t = \theta_0 + \frac{(\theta_T - \theta_0)}{T} \cdot t$, where t is the time running from 0 to T .

²⁰ We also present 'half-life' estimates. A 'half-life' is defined as the time it takes for a given deviation from a long-run equilibrium to return to half of its initial value. Half-life can be calculated as the solution for T in $f(t+T) = f(t)/2$, which is just $T = \ln(1/2)/\ln(b)$, where, in our case, $b = 1 + \rho^{out}$ (Van Campenhout (2007)). If, for example, ρ^{out} is -0.5, then T is one, which means that it takes one month to correct half the shock. In the limit, when ρ^{out} approaches -1, any shock in $t-1$ is fully corrected in t .

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The Ethiopia Strategy Support Program (ESSP) is managed by the International Food Policy Research Institute (IFPRI); is jointly implemented with the Policy Studies Institute (PSI); and is financially supported by the United States Agency for International Development (USAID), the Department for International Development (DFID) of the government of the United Kingdom, and the European Union (EU). The research presented here was conducted as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by IFPRI. This publication has been prepared as an output of ESSP and has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and are not necessarily representative of or endorsed by IFPRI, PSI, USAID, DFID, EU, PIM, or CGIAR.

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