

Eroded Coffee Traceability and Its Impact on Export Coffee Prices for Ethiopia¹

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Abstract

In December 2008, the Ethiopian Commodity Exchange (ECX) opened a new coffee platform that has transformed Ethiopia's coffee trade. The way ECX handles coffee in a commodity fashion has eroded traceability, a characteristic sought after by overseas coffee buyers. This paper traces the forces that give rise to the commoditization of coffee. An empirical analysis using a dataset on export coffee transactions supports the view that eroded traceability suppresses the export price of non-traceable, ECX-sourced coffee, relative to fully traceable coffee. The cumulative monetary is estimated to be 280 million USD, equivalent to 26% of farmer's farmgate income from coffee.

Keywords: Ethiopian Commodity Exchange, Ethiopian coffee, coffee traceability, commoditization

JFL Classification: C12, D80, Q17, Q28

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1. Introduction

Coffee is the single most important foreign exchange earner for Ethiopia. It accounted for 32 per cent (823 million USD) of the total value of exports in 2011 and constitutes a significant income source for 15 million people in the workforce (Ministry of Trade 2012). Historically, coffee was marketed through an auction system that was fraught with problems. In late 2008, the Ethiopian Commodity Exchange (ECX) replaced the old auction regime as the principal coffee trading platform. Critics argued that the way ECX handles its coffee trade operations would lead to commoditization, whereby coffees with considerable differentiability in cup taste, and spatial or grower origin would become homogenized. This would erode coffee traceability and conceal from overseas coffee importers credible information regarding the coffee's origin. The potential monetary loss can be substantial, as Ethiopia has more recognized coffee varieties than anywhere in the world, and many varieties enjoy high international repute. Regression analysis using the Ethiopian Ministry of Trade's dataset on export coffee transactions indicates that eroded traceability reduces coffee export prices by about 12 per cent.

The Ethiopian government and international development agencies have invested substantial resources in promoting the coffee sector. Past interventions included sponsoring agricultural research and marketing development. Several studies have been conducted on the coffee sector that can inform interventions design. For example, Gebreselassie and Ludi (2008) explain why some households decide not to participate (i.e., selling outputs) in the coffee market. Boansi and Crentsil (2013) investigate what drives coffee output and producer prices, while Worako et al. (2008) focus on how price fluctuations abroad are transmitted to various levels of the domestic coffee supply chain. The research that is most relevant to the present study is by Arslan and Reicher (2010), which finds that the trademarking of three Ethiopian coffee varieties in 2004 increased their export prices by 10 per cent. The absolute value of their estimate is strikingly similar to this paper's findings, although the signs of the estimates are different, since eroded traceability has the opposite effect of trademarking on export prices, by diminishing coffee differentiability from the perspective of overseas coffee buyers.

2. Institutional background

2.1 A brief history of the Ethiopian Commodity Exchange

ECX was officially launched in April 2008 as a trading platform for cereals. It was envisioned as a revolutionizing institution providing many of the services that are ordinarily performed by the private sector in mature cereals supply chains. Its operations include an auction floor in Addis Ababa to facilitate cereal trade; a clearing system to settle sales contracts; regional assaying centres to determine the quality of cereals; regional warehouses to preserve cereal quality; and free, real-time, multimedia dissemination of price information to local markets. The integrated operations are meant to assure buyers of the quality of their purchase, protect cereal sellers against late payments and defaults, and empower farmers by enhancing price transparency. ECX

was designed to improve cereals market efficiency by reducing transaction costs for all participants (Gabre-Madhin and Goggin 2005).

Policy makers planned to incorporate coffee into ECX since its inception, although preparation was expected to take time. The founding of ECX coincided with the 2007–2008 world food-price crisis, when grain prices spiked. In anticipation of price rises, cereals sellers ceased bringing shipments to ECX, greatly reducing its throughput and revenues, and undermining its financial independence. In December 2008, the ECX authority swiftly introduced coffee (Gabre-Madhin 2012) in order to ensure ECX's financial survival.

Whereas trading of cereals through ECX was voluntary, the trading of coffee through ECX was compulsory under a government proclamation (Proclamation No. 602/2008). In addition to creating a thicker coffee market, the proclamation in effect guarantees a constant income stream for ECX, allowing it to capture a share of the value produced by the coffee sector. The mandatory incorporation of coffee to ECX brought the demise of Ethiopia's old coffee trade regime, which had operated for three decades.

2.2 The old coffee trade regime

The old regime was installed by the communist *Derg* in 1977 to tighten control over the coffee sector. When the current government came to power in 1991, it initiated limited liberalization that permitted greater private participation in the coffee sector, although the reform was partial, for fear that unrestrained liberalization would breed vertical integration.² The coffee supply chain remained heavily regulated and compartmentalized, both geographically and functionally.³ In particular, coffee growers were required to sell all outputs in auction houses; it was not until 2001 that they could engage in direct export if they could find international buyers, bypassing the auction system.⁴ However, direct export has historically accounted for no more than 15% of annual exports. For local traders who purchase coffee from farmers, the auction system remains the only legitimate marketing channel.

Figure 1 presents a schematic of the coffee supply chain. Two features of the old regime deserve attention. First, the coffee trade was centred on auction houses. Considerable efforts were invested in keeping consignments separate in storage. Prior to an auction, samples of the consignments, along with sellers' information, were put on display, and sellers were present throughout the auction process. Second, before coffee shipments could be transported abroad, exporters had to acquire clearance from the Cupping and Liquoring Unit (CLU), a government agency charged with assuring export coffee quality. CLU graded each shipment by cup tasting

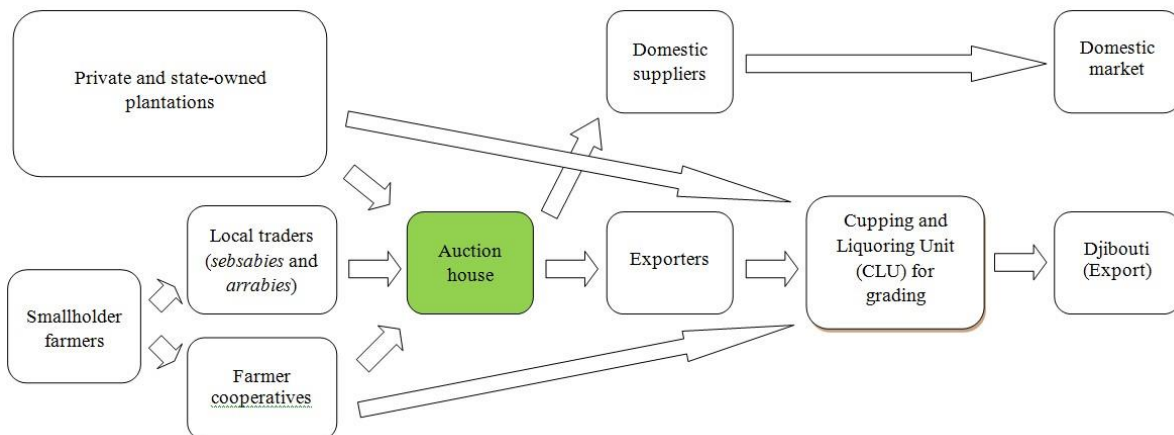
² LMC International (2000) and Petit (2007) provide detailed summaries of the reform.

³ Each agent in the supply chain fulfils a designated purpose. *Sebsabies*, or petty coffee collectors, were only licensed to buy from farmers; *arrabies*, or wholesalers, could only buy from *sebsabies* and sell coffee in auction houses; exporters and domestic suppliers in turn could only buy from auctions; domestic roasters could only buy from domestic suppliers. All licensees were restricted to stipulated geographic areas (Petit 2007). However, loopholes in the system allowed some exporters to achieve vertical integration to a degree.

⁴ Smallholder farmers account for 95 per cent of total production, the balance being from private or state-owned plantations (Chemonics International 2010, p. 3).

and physically counting the defects in a sample. Coffee of quality below a certain threshold was rejected. As will become apparent, CLU's assessment of export coffee quality is important in the empirical exercise that follows.

Figure 1: Coffee flow in Ethiopia before ECX



Note: Direct export by coffee producers (farmer cooperatives and plantations) was not permitted until 2001, and even today accounts for a minor share of total coffee exports.

Despite having operated for decades, the old coffee regime was fraught with problems. First, contract enforcement was weak. Buyers could renege on bids with impunity. When bids were honoured, payments were often delayed and occasionally defaulted. Second, the distance between auction houses and local markets, coupled with weak telecommunications infrastructure, prevented local farmers from acquiring information about coffee prices. There was anecdotal evidence that sellers and buyers colluded to suppress the price paid to local farmers and the taxes owed to the government.⁵ The regime created an environment that was unsatisfactory to producers, suppliers and the government.

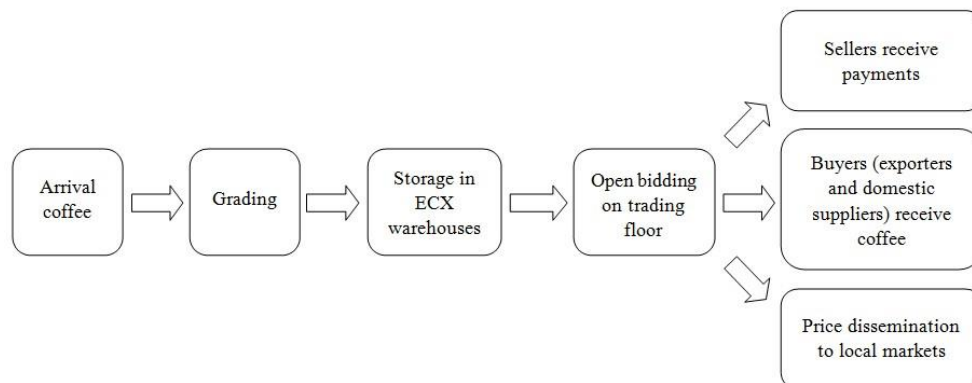
2.3 ECX's new coffee trade regime

From December 2008 ECX replaced the old auction system. Figure 1 is still an accurate depiction of the coffee flow, except that ECX replaces the auction house. Local traders bring coffee to ECX's regional offices, where ECX staff sample the coffee and assign it a geographic label and a grade. Coffee shipments are then taken to nearby ECX warehouses where coffee of the same zonal label and grade are stored in the same compartment without identity tags or other means of distinction. Sellers then sell the coffee on ECX's trading floor. Unlike the auction system, coffee samples are not put on display, nor is the identity of sellers revealed. Buyers acquire no more information than that provided in coffee contracts, namely, the coffee variety

⁵ Despite licensing regulations, some exporters were able to run coffee-collecting businesses (as *arrabies*) and held dual-seller licences by proxy. Having two licences allowed them to buy back their own coffee in auctions (LMC International 2000, p. 22; Mezlekia 2009).

(indicated by the zonal label), its grade and volume. ECX also broadcasts coffee prices in real time. Contract settlement takes place within the a few days.⁶ ECX adopts a first-in-first-out delivery system: coffee that is stored the earliest is delivered first to the next immediate buyer. In practice, buyers receive from ECX coffee of the agreed variety, grade and volume, but the shipments are almost certainly not those initially offered on the trading floor, which will be delivered to future buyers in unrelated transactions. Figure 2 presents a schematic of ECX's coffee trade operations, which closely mimic its cereals trade operations.

Figure 2: Coffee trade at ECX



ECX appears to have made a significant contribution to rectifying problems of the old coffee regime. Evidence in the literature and the media (Tadesse 2010, p. 15; Bjerga and Patton 2011a; Tefera 2012; AFP 2013), as well as findings from a 2012 field study in Jimma (personal interviews with farmers and traders in several villages close to Jimma, 1–5 June 2012), attest to ECX's contribution as a clearing house and in enhancing price transparency. The ECX system was also designed to thwart seller–buyer collusion. The concealment of seller identity during bidding is insufficient to achieve this, as colluding parties may identify each other by specific price–volume signals. Instead, first-in-first-out delivery is the centrepiece. As buyers no longer receive the specific lots that the counterparty put on sale, the former's incentive to collude all but vanishes. Given first-in-first-out delivery, it is immaterial which lots the buyers receive, so long as the contract specifications (variety, grade, and volume) match. It is likely that storage without identification has been adopted from the cereals trade operations to reduce operating costs.

2.4 Commoditization of Ethiopian coffee

The ECX coffee regime is marked by a trend towards commoditization, as is evident in the way coffees are stored and delivered. To store similar coffee in the same compartment without distinction is to disregard the subtle differences in cup taste within a grade category, and specific spatial and grower origin under the same areal label. First-in-first-out delivery has a similar effect of homogenizing the coffee, as buyers will receive a coffee blend from multiple, anonymized

⁶ ECX members maintain both pay-in and pay-out accounts in designated banks. ECX transfers deposits between accounts to clear transactions; it boasts a settlement period of one day after transaction (T+1).

sources. ECX's plan for storing coffee in silos is also suggestive of this trend (personal interview with two senior ECX officials, 8 June 2012). Interestingly, the Ethiopian government also endorses commoditization, as indicated in a 2011 directive that all export coffee be shipped in bulk containers. Previously, the industry practice was to keep coffee in 60 kg jute bags, which had the advantage that different coffee lots could be transported in a single container while maintaining lot separation. Shipment in bulk containers would require large overseas wholesalers to repackage coffee beans, and force out of the market many medium-sized distributors and specialty coffee roasters who bought small volumes. Faced with strong resistance, the government revoked the directive within a month (Mezlekia 2011).

Coffee that passes through ECX thus becomes less distinct in cup taste and is non-traceable in spatial or grower origin. Compared to coffee that is directly exported by producers, ECX-sourced coffee is a less differentiated product, although it may be of the same quality at the farm level.

While commoditization is the direct consequence of measures taken to thwart collusion, it can be understood in a broader historical context. Commoditization and the subsequent weakening of linkages between coffee merchants actually eased the government's apprehension about the predominance of private interests in the coffee sector – historically the most important in the Ethiopian economy. In addition, because there was little preparation time in introducing coffee to ECX, the coffee regime was modelled on ECX's cereals trade operations.

Ever since details of the ECX regime were announced in 2008, industry practitioners and observers at home and abroad have continually voiced concerns that commoditization eliminates traceability.⁷ The general opinion is that the mixing of coffee beans is equivalent to the blending of French wines in a “big, nasty *cuvée*” (quoted in Bjerga and Patton (2011a)). The Specialty Coffee Association of America (SCAA) was particularly concerned that ECX ruled out the purchasing of coffee from a single source. To accommodate overseas specialty coffee buyers, ECX established a second platform, direct specialty trade (DST), that traded fully traceable coffee. Prior to a monthly DST auction, ECX posted information on individual lots on its website, including the grower, geographic origin and cup profile. Coffee samples were also sent to registered potential bidders upon request. DST was initiated in February 2010 but was quickly discontinued after two trading sessions, owing to the small number of transactions.⁸ Since then ECX has made no further attempt to trade traceable coffee.

2.5 The consequence of commoditization

⁷ There has been no lack of media coverage. See Allison (2009), Frenette (2010), and Bjerga and Patton (2011b) for examples.

⁸ It is unclear why DST failed to generate as much interest as had been anticipated. One plausible reason may be DST's rather exclusive nature. On the supply side, only specialty-grade coffee could be traded through DST; on the demand side, only 30 buyers, all overseas, were registered (ECX 2010a). Sellers at ECX had to demonstrate that coffee farmers would receive at least 85 per cent of the free on board (FOB) price (ECX 2010b, p. 20). This left only 15 per cent of the proceeds to be divided among other participants in the supply chain, greatly diminishing the attractiveness of DST as a marketing channel.

Cereals are bulk commodities, and commoditization is suitable as it takes advantage of any economies of scale in their marketing. However, commoditization is inappropriate for coffee because of its great product differentiability. Whereas cereals have only a few key quality indicators, connoisseurs have developed a rich lexicon comparable to that used for wine to describe coffee’s complex cup taste. Storing homogenous cereals in bulk does not significantly alter the quality, but storing coffee in bulk would smooth out the distinct characteristics of individual lots. Furthermore, cereals and coffee have different consumer groups. Cereals are mostly consumed by locals for subsistence, with little attention paid to their origin. In contrast, coffee drinkers increasingly care about coffee traceability, which is a prerequisite for coffee certification and a desirable characteristic of gourmet coffee.⁹ This information is lost through commoditization, and the mandatory trading of coffee through ECX forces much of the export coffee to undergo this anonymizing process. Its imperfections notwithstanding, the old coffee regime preserved coffee traceability – the ability to guarantee the origin of coffee – more effectively than does the current regime. ECX has artificially created information asymmetry. In economics, the transition from the auction system to ECX represents a transition from a game of complete information to one of incomplete information from the perspective of the overseas buyers. Game theory predicts that non-traceability will suppress the price of non-traceable coffee.

3. Empirical Evidence

Recall that there are two legal channels for coffee export. Exporters that do not grow coffee must buy from ECX, while coffee producers may export coffee directly. As overseas buyers can establish direct contact with producers, direct export coffee (hereafter producer coffee) is perfectly traceable. In contrast, coffees that are purchased from ECX (hereafter trader coffee) are non-traceable by design. Whereas traceability adds value by enhancing product differentiation, commoditization diminishes it. It is hypothesized that, holding everything but the source of coffee constant, overseas buyers will pay less for trader coffee in response to commoditization.

3.1 Data source

During a field study, a dataset on export coffee transactions was acquired from the Ministry of Trade (MOT) of Ethiopia which contains enough information to test the hypothesis. Table 1 shows five random entries from this dataset.

Table 1: Random entries in the MOT dataset

Year	Month	Exporter	Coffee	Grade	Destination	Weight (MT)	FOB value (000s USD)
2008	Apr	Exporter 1	Jimma	4	South Africa		320.1
2009	Dec	Exporter 2	Teppi	2	Belgium	72	210.7
2010	Sept	Exporter 3	Limmu	5	France	36	91.3
2011	June	Exporter 4	Yirgacheffe	3	United States	125	915.4

⁹ The most common certifications include shade-grown, organic and Fairtrade certifications.

2012	Aug	Exporter 5	<u>Harar</u>	<u>4</u>	<u>Japan</u>	<u>16</u>	<u>89.6</u>
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Note: Exporters are anonymized in this table; grade is assigned by CLU.
Source: Ministry of Trade (MOT), Ethiopia.

In total there were around 13 000 transaction entries from 2007 to 2012. The dataset contains information on the value, volume and destination country of green (unroasted) coffee exported by individual exporters on a monthly basis. As explained, export regulations oblige coffee exporters to acquire clearance from CLU (see Figure 1). The MOT dataset contains information about the variety and grade of shipments, as assigned by CLU. Since grading occurs before the actual shipment but after the negotiation of coffee contracts, it does not affect the negotiation outcome. If two coffee shipments register the same variety-grade label, they are deemed by CLU to share a similar cup quality.

Slightly fewer than 270 entities exported coffee between 2007 and 2012. Extensive efforts were made to identify whether the exporters grew coffee, in which case their shipments would be classified as producer coffee, and otherwise as trader coffee sourced from ECX. Several methods were used conjointly to arrive at a decision.¹⁰ After classification, observations were grouped together by the exporter type (producer or trader), coffee variety and grade, export destination and export date. For each group of observations, the total export value (USD) and volume (kg) were calculated. Dividing the former by the latter yielded the simple monthly average export prices for producer coffee and trader coffee of particular varieties and grades that were shipped to particular countries at a particular time. The prices of producer and trader coffee were in turn matched to compute the dependent variable used in the regression.

3.2 Regression model and results

Of the 13 000 raw entries in the MOT dataset, about 30 per cent (4100 entries) could be matched with the four categories (export date, coffee variety, grade, and destination country). The matched entries produced 699 observations, constituting the full sample for the regressions.¹¹

¹⁰ The most direct method is to check company websites. Companies that own processing plants and warehouses, but not coffee farms, must be traders. Occasionally, websites indicated whether coffee is purchased from ECX. However, this method has limited application as not all Ethiopian companies maintain websites. Second, company names that contain such key words as “trading” or “general import–export” indicate that these are trading companies, while some private coffee plantations are named “agro-business”. The state-owned plantation enterprises and farmer cooperative unions are easily identifiable by their names. A third method is to search for companies in the membership lists of various organizations, including ECX, the Ethiopia Coffee Exporters Association, and the Ethiopia Coffee Growers and Exporters Association (ECX 2013; ECEA 2013; Boot 2011, p. 39). Traders are likely to be members of the first two, whereas membership of the last is restricted to producers. Lastly, the volume, frequency and variety of export shipments provide supporting evidence, as producers are unlikely to produce huge volumes and export different coffee varieties regularly throughout the year. Of the 13 000 raw entries, around 500 (involving 24 exporters) remained unidentified. These shipments are assumed to be trader coffee, on account of the historically high share of trader coffee (no less than 85 per cent of total exports).

¹¹ Regressions were run using samples that cover 70% of raw entries, which produce quantitatively similar results; see Tables 3 and 4.

The following regression model is designed to test the hypothesis:

$$y \equiv \frac{P^P}{P^T} - \frac{P^T}{P^T} = \beta_0 + \beta_1 P_{NY} + \beta_2 \text{Coffee} + \beta_3 \text{Grade} + \beta_4 \text{ECX} + \varepsilon$$

The average export price of producer coffee is denoted as P_P and that of trader coffee P_T , both expressed in USD per kilogram and computed as described in the previous paragraph. The dependent variable is the percentage difference (%) in export price between producer coffee and trader coffee of a particular variety and grade that is exported to a particular country in the same month of a given year. The way the dependent variable is defined controls for the macro environment (export date and destination) and the bean's inherent characteristics (variety and grade) to the extent possible. The percentage difference, if it exists, is due entirely to the sourcing of coffee, and not to difference in export time, destination or the coffee's inherent characteristics.¹²

The first regressor (P_{NY}) is the monthly average coffee price at the New York Mercantile Exchange, published by the International Coffee Organization (ICO 2013). A limitation of the MOT dataset is that not all entries contain information on whether the export coffee is Fairtrade or organic certified. This prevents the use of certification as a control variable in the regression model, even though certification is a potential driver of the price spread. It is plausible that any observable change in the percentage difference is due to certification which is unobservable in this dataset – recall that producer coffee is traceable and certifiable, whereas the ECX-sourced trade coffee is not.¹³

P_{NY} is inserted as a proxy for certification, since certification either acts as a price floor (in the case of Fairtrade) or adds a premium (in the case of organic or shade-grown) above the prevailing market price (FLO 2013). As the world price drops, so too will the general export price of Ethiopian coffee. However, the percentage difference should *increase* because the producer coffee price would proportionally fall by less than that of trader coffee, as some portion of producer coffee is certified.¹⁴ Expressed in dollars per kilogram, P_{NY} is in principle in an

¹² Controlling for coffee characteristics is important in view of the possibility of self-selection: coffee producers may choose to export high-quality coffee at a higher price and sell the remainder through ECX at a lower price. Lowquality, ECX-sourced coffee will be branded as trader coffee and exported for a lesser value simply because of its low quality, regardless of commoditization. Controlling for coffee characteristics ensures that the two coffees that are being compared are similar in quality.

¹³ Organic coffee consistently accounts for around 5 per cent of Ethiopia's total annual exports, and this trend persists in the coffee trade at ECX (self-derivation based on ICO data). In other words, the growing gap, if it exists, cannot be explained by a larger volume of producer coffee receiving certification. The only way that certification may influence the price gap is through fluctuations of the general coffee price at the global level, which is captured by the variable P_{NY} .

¹⁴ Fairtrade-certified producer coffee always stays above a minimum price threshold, whereas trader coffee may drop below it. When the drop in global coffee price is significant, the percentage difference will increase. In the case of organic or shade-grown certification, the inverse relationship between percentage difference and global market price can be demonstrated by a simple mathematical manipulation. As before, let P_P and P_T denote the export price

inverse relationship with the dependent variable; the first coefficient estimate, β_1 , is expected to be negative.¹⁵

The second and third sets of regressors (Coffee and Grade) are dummy variables for coffee type and grade. Since traceability is more important for high-end products, the impact of its erosion should be more salient for the famous coffee varieties, namely Yirgacheffe, Sidamo and Harar. Similarly, holding everything else equal, higher grades should be more affected by eroded traceability.

The final regressor, ECX, indicates whether the export date was before or after the coffee trade platform transited to ECX in December 2008. The commoditization of trader coffee is expected to widen the price spread. The high level of publicity drawn by industry practitioners meant that the impact of commoditization on export price was immediate, with no time-lag effect. If eroded traceability indeed suppresses the export price of trader coffee, the price spread will grow,

θ

α , and the new percentage difference becomes

$\alpha > 0$.

θ
 α)

holding everything equal. The purpose of the regression analysis is to test whether this coefficient estimate, $\widehat{\beta}_4$, is positive and statistically significant. Other than those mentioned, there do not seem to be independent variables that can systematically explain the price differential.

of producer coffee and trader coffee, and let denote the certification premium. The original percentage differential is $y_1 = \frac{(P^p + P_T) - P_T}{P_T}$. When the global coffee market faces a downturn, the coffee export price reduces by a general

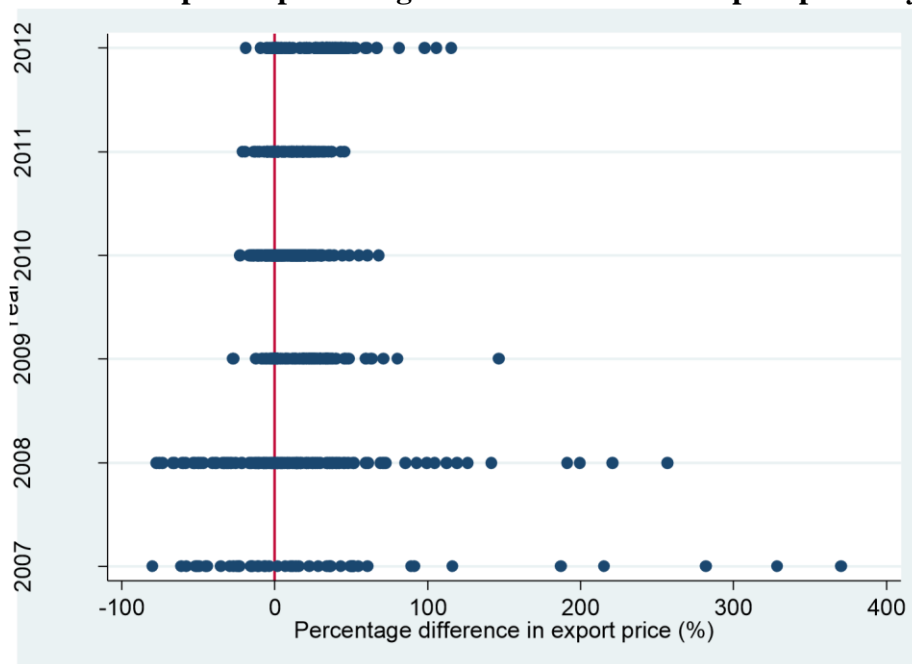
factor of $y_2 = \frac{((1-\alpha)P^p + (1-\alpha)P_T) - P_T}{P_T}$. It is obvious that $y_1 < y_2$, for any

¹⁵ Caution must be taken against a literal interpretation of the coefficient estimate. It cannot be assumed that certification would increase the spread by a percentage equivalent to the coefficient estimate (θ), which is affected by 1) certification itself; and 2) the unknown portion of producer coffee in each observation that are certified. For all intents and purposes, the regressor is added to net out the otherwise unobservable impact of certification in creating the price wedge.

3.3 Regression results

Aside from the transition to the ECX system, a thorough search identified no policy change in the coffee sector that would have had an uneven impact on the two types of exporters. Figure 3, created to understand the distribution of the percentage difference by year, shows revealing trends.

Figure 3: Scatterplot of percentage difference in coffee export prices by year



Each of the 699 observations is represented by a dot in Figure 3. As a reminder, each observation represents the percentage difference of export coffee ($\frac{P_P}{P_T} - 1$), of a particular variety and grade, to a particular country at a particular time. If there is no great difference in coffee export price, the dots would cluster around the red vertical line marking zero per cent. The chart shows that in 2007 and 2008 the means of the percentage differences in coffee export price are approximately zero. This contrasts with the later years when the distribution of dots has abruptly shifted to the right, beginning in 2009.

A second observation is that the sample displays heteroskedasticity. Prior to ECX, there is a greater variance in the percentage differences. There are also outliers that showed producer coffee to be sold at a price considerably higher than trader coffee, by more than 200 per cent in several cases. These are either indications of erroneous coding in the dataset, or the results of unusual circumstances.¹⁶

¹⁶ The outliers and their disappearance may be proof of ECX's success in curbing collusion. Suspicion would arise if exporters were found to have paid little for coffee lots during auctions, but received a high export price. Therefore, coffee exporters who colluded might find it necessary to underreport the true value of the export. This can explain

Two sets of regressions are performed. The first employs robust regression, which involves an algorithm that weighs down outliers, leverage and influential points to offset their dominating influence on the regression line.¹⁷

Table 2: Regression analysis results using the first sample

	Robust regressions		OLS regressions with robust standard errors	
	(1) With Controls	(2) No Controls	(3) With Controls	(4) No Controls
ECX	12.07*** (6.51)	14.52*** (6.85) -2.18**	13.23*** (3.93)	12.43*** (3.64) -2.699***
P_{NY}	-2.32** (-3.28)	(-2.66)	-3.169*** (-5.20)	(-4.14)
Controls	Coffee, Grade	None	Coffee, Grade	None
R^2	0.228	0.064	0.166	0.031
Observations	699	699	690	690

Note: t statistics in parentheses; OLS, ordinary least square.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Column (1) in Table 2 reports results from a robust regression using the full sample (699 observations); 21 observations receive a final weight of zero and are in effect removed. As hypothesized, the coefficient estimate for P_{NY} is negative. Most importantly, the coefficient estimate for ECX validates the hypothesis that eroded traceability suppresses coffee export prices. Holding everything else constant, differences in coffee prices are estimated to have increased on average by 12.0 percentage points since ECX, with a 95 per cent confidence interval of ± 3.6 points (8.4 to 15.7). This result is consistent with the first observation made by visual inspection of Figure 3. The estimates for P_{NY} and ECX are statistically significant, although those for the control dummies are by and large insignificant. The latter is surprising given the expectation that commoditization would have a greater impact on the famous coffee varieties, or on superior quality coffee. Column (2) in Table 2 presents results from another robust regression. The two sets of dummy variables, Coffee and Grade, which are added as controls in the first regression, are removed, leaving only two regressors, ECX and P_{NY} . The coefficient estimates are statistically significant and quantitatively similar to those in Column (1).

In the second set of regressions, observations with the absolute percentage difference exceeding a certain threshold are omitted, in order to rule out outliers. That threshold is chosen to be

the vast price spread between producer coffee and trader coffee. Under the ECX system, the incentive to collude vanishes, as does the incentive to underreport the export value of coffee.

¹⁷ The regression is performed using the econometrics software Stata, with the *rreg* command.

± 150 per cent. This is equivalent to imposing the condition that no observation in the sample will register one coffee being sold at less than 40 per cent of the other's value.¹⁷ The lower limit seems reasonable considering that the two coffees were similar in inherent characteristics, and shipped to the same country in the same month of a year. Compared to the robust regression, the removing criterion drops fewer (9) observations from the full sample. Ordinary least square (OLS) regression was then run on the slightly reduced sample, using robust standard errors, since tests indicate the data are heteroskedastic. As shown in Columns (3) and (4) in Table 2, the regression results are similar to those of robust regressions.

The previous regression results are based on a 699-observation sample that matched raw entries in the MOT dataset by four categories: export date, coffee variety, grade and destination country. Its advantage is that the resulting matched entries are the most comparable. The disadvantage is that only 30 per cent of raw entries are matched. Therefore, two alternative samples are compiled using broader categories. In the second sample, continent replaces country as the destination criterion. A third set is created by removing the destination criterion entirely. The result is two samples of 653 and 452 observations covering 66 per cent (8 800) and 68 per cent (9 000) of raw entries, respectively. Note that relaxing the matching criteria reduces the sample size because more raw entries are grouped together.

Table 3: Regression analysis results using the second sample

	Robust regressions		OLS regressions with robust standard errors	
	(1) With Controls	(2) No Controls	(3) With Controls	(4) No Controls
ECX	9.019*** (4.55)	10.75*** (4.81)	10.34** (2.90)	9.578* (2.56)
		-0.577		-1.473
P _{NY}	-1.400 (-1.86)	(-0.68)	-2.028** (-2.69)	(-1.81)
Controls	Coffee, Grade	None	Coffee, Grade	None
R ²	0.235	0.038	0.193	0.017
Observations	653	653	646	646

Note: *t* statistics in parentheses; OLS, ordinary least square.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Regression analysis results using the third sample

	Robust regressions		OLS regressions with robust standard errors	
	(1) With Controls	(2) No Controls	(3) With Controls	(4) No Controls
ECX	13.91*** (5.85)	10.37*** (3.70)	15.18*** (3.95)	13.57** (3.25)
		-0.0186		-1.597

P_{NY}	-1.571 (-1.84)	(-0.02)	-2.229** (-2.66)	(-1.61)
Controls	Coffee, Grade	None	Coffee, Grade	None

$\frac{P_P - P_T}{P_T} \leq 150\% = 4$ implies $P_T \in [10, 4]$.	6	4	10
R^2	0.371	0.035	0.035
Observations	452	452	450

Note: t statistics in parentheses; OLS, ordinary least square.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Tables 3 and 4 present the results of the robust regressions and OLS regressions using robust errors for these two samples. The coefficient estimates for the ECX effect, $\widehat{\beta}_4$, are quantitatively similar to those in Table 2, although the estimates for coffee certification, β_1 , lose statistical significance. For the purpose of this study, it suffices that the sign for the ECX coefficient estimate is positive, which confirms that the general conclusion is robust and insensitive to the way the sample is compiled.

3.4 Monetary loss

Commoditization suppresses the export price of trader coffee compared with that of producer coffee, leading to a widening price spread. It is possible using the regression results to provide a measure of the monetary loss. With the ECX effect, the percentage difference is

$$y = \frac{P_P - P_T}{P_T} = \widehat{\beta}_0 + \widehat{\beta}_1 P_{NY} + \widehat{\beta}_2 \text{Coffee} + \widehat{\beta}_3 \text{Grade} + \widehat{\beta}_4 \text{ECX} + \widehat{\varepsilon}.$$

Without the ECX effect, the difference would be

$$\frac{y}{T} = \frac{P_P - P_T}{P_T} = \widehat{\beta}_0 + \widehat{\beta}_1 P_{NY} + \widehat{\beta}_2 \text{Coffee} + \widehat{\beta}_3 \text{Grade} + \widehat{\varepsilon}.$$

The counterfactual export price of trader coffee (P_T) is not observable in reality. Since changes in export price that affect the supply–demand relationship would induce a feedback effect, the true P_T is difficult to pin down. However, a first-order approximation of the counterfactual price can be determined by subtracting \mathcal{Y} from \mathcal{Y} , omitting the feedback effect. The difference, Δ , between P_T and P_T represents the loss resulting from commoditization, per kg of trader coffee exported:

$$\Delta \equiv P'_T - P_T = \frac{\widehat{\beta}_4(P_T)^2}{P_P - \widehat{\beta}_4 P_T}$$

The calculation requires P_P . This is not an issue for transactions of trader coffee in the MOT dataset that can be paired up with corresponding entries of producer coffee. For the unmatched entries, making inferences about losses is difficult owing to missing producer prices. For this exercise, the third sample was used as it covers 68% of raw entries. Using the coefficient estimate for the ECX effect ($\widehat{\beta}_4$) of 14 per cent, the per-unit loss (Δ) was computed for each of the observations in the third sample. Multiplying the per-unit loss by the corresponding volume of trader coffee and summing gives a monetary loss estimate of 191 million USD for the 68 per cent of raw entries that are covered. The figure is then adjusted upward to account for the remaining 32 per cent not covered, to arrive at a final estimate of 280 million USD. Given Ethiopian coffee farmers capture 53 per cent of the export value (Sentayhu 2011), an overall reduction of 14 per cent in export value implies that coffee farmers lose 26 percent of their income.

Exporting traceable coffee may involve extra costs, and this 280 million USD is the amount of *gross* revenues forgone. The net amount is likely to fall within a narrow range, as commoditization affects only the final exportation stage of the coffee supply chain. Exporters may incur extra costs in finding overseas buyers of traceable coffee and in adopting processing procedures that comply with their specifications. The production costs for all upstream participants should be identical. If farmers and local traders have been supplying the market at the current price level, they are willing to supply the same coffee at a higher price level. In essence, the 280 million USD is the information rent that was lost as a result of commoditization.

4. Discussion and conclusion

Although first-in-first-out delivery is necessary to break collusion, it need not be a necessary evil if the exporters who buy from ECX are allowed to acquire information about the coffee lots – including their spatial and grower origin – they receive. The information can preserve coffee traceability and help rebuild severed linkages between sellers and buyers at ECX, without enhancing the incentive to collude, since the information is revealed ex-post. To cover increased operating costs and to ensure sellers and producers upstream will receive a share of the benefits of recovered traceability, a fee can be charged to those who opt to receive the information. This is a form of price discrimination. Exporters that supply to more discerning overseas buyers will find it advantageous to acquire the information.

All this proposal requires is a scan-tag system, with such tags being attached to individual jute bags. This is well within the current technical capability of the ECX and could be implemented with little additional cost. Furthermore, since this intervention could be executed by one central agency and requires no coordination effort, it will be the single most cost-effective of all

interventions for Ethiopian's coffee sector. The economic returns are promising, as the intervention could recover 26 per cent of the coffee farmers' income.

The findings in this study by no means discredit ECX's contributions in enhancing coffee sector efficiency. Rather, it is hoped that the findings can help the ECX authority to finetune coffee trade operations. The widening price differential between producer coffee and trader coffee is predicted by standard economic theory, and finds support in empirical evidence. The story of ECX and its commoditization of coffee is a captivating example of economics at work.

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