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Assessing the economic sustainability of coffee growing

Background

In accordance with Article 34 of the International Coffee Agreement 2007, the International Coffee Organization is required to provide Members with studies and reports on relevant aspects of the coffee sector. This document contains a study on Assessing the economic sustainability of coffee growing.

Action

The Council is requested to take note of this document.

Assessing the economic sustainability of coffee growing

Introduction

Since March 2015 the ICO composite price has been consistently below the 10-year average of 137.24 US cents/lb, raising concerns about the economic viability of coffee production and putting the livelihoods of coffee producers at risk in many countries.

Prolonged periods of low prices strain liquidity at the farm level, resulting in less than optimal input use during the following production cycle, negatively affecting yields and quality. The expectation of future coffee prices too low to cover full costs of production can hamper important investments in renovation of coffee plantations. Replanting is particularly important as part of the mitigation of the impact of climate change and to respond to increased pest and disease pressure. Finally, low or negative profitability may lead to the abandonment of coffee production as farmers may switch to other more profitable agricultural crops.

As a result, there is a widespread concern in the coffee sector that a prolonged phase of low coffee prices could negatively affect the supply of high quality coffee beans and could have adverse effects on household incomes in coffee growing communities. Hence, specific policies need to be formed to address the issue of economic sustainability of coffee production, stabilising supply in the future and enabling farmers to be fairly remunerated.

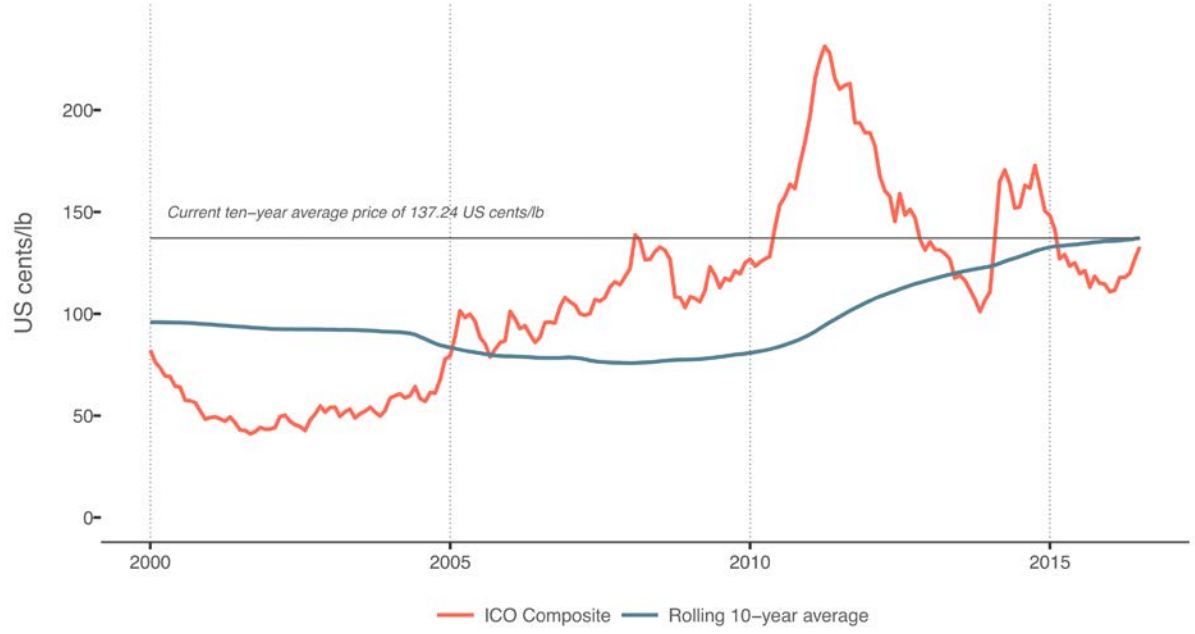
This study will (1) assess the cost structure of coffee production in selected countries, and (2) derive recommendations on how to improve the economic viability of coffee production.

The study will be based on an analysis of the coffee price levels using ICO market data, and an assessment of production based on cost data provided by Members.

Assessment of coffee prices

Coffee prices are notoriously volatile. Periods of spiking producer prices are followed by relatively low prices. While consumers benefit from low coffee prices, producers may face challenges with regard to the economic viability of production. Currently, we are in a phase of low, albeit rising, coffee prices. In July 2016, the monthly average of the ICO composite indicator price was 132.98 US cents/lb, which was the highest level in the last 17 months. However, this was still below the ten-year average price of 137.27 cents (Graph 1).

Graph 1: ICO composite indicator price since 2000



Since 2000, the ICO composite price has fluctuated between a low of 41.17 US cents/lb in September 2001 and a high of 231.24 in April 2011. For the first five years of this time period, coffee prices were persistently low, with the ICO composite below 100 US cents/lb. This was known as the 'coffee crisis', with many farmers abandoning their crops or switching to other commodities. Between 2005 and 2010, prices steadily increased from an annual average of 89.36 cents to 147.24 cents. Since 2010, the market has experienced two significant spikes; the first in 2011 when reduced output from Colombia caused a supply squeeze in the market, and the second in early 2014 due to a drought in Brazil. In between these two peaks, however, the market has generally been subjected to downward corrections.

So far we looked at nominal prices and found current prices to be close to the historical average. However, as 137 US cents today is not equivalent to 137 US cents ten years ago, it is useful to compare the development of coffee prices in both real and nominal terms. We use the UN index of manufactured goods exports by developed economies in order to deflate coffee prices and show developments in both real and nominal terms.

As can be seen in Graph 2, when a deflator is applied to the ICO composite indicator price, the increase in prices is much less steep than previously observed. In real terms, the ICO composite indicator price for January 2016 is 82.75 cents, little changed from its January 2000 level of 80.53 cents. We can also see that despite the steady upwards trend in prices since 2000 (in both real and nominal terms), there is significant variation around that trend. Between April 2011 and November 2013, for example, nominal prices more than halved. This causes significant uncertainty in the market; upward spikes are normally precipitated by adverse weather events, which are by nature hard to predict.

Graph 2: ICO prices in real and nominal terms (base = 2000)

Profitability of coffee farming

Methodological considerations

In this section, we assess the economic viability of coffee production, i.e. whether coffee farming can support itself financially over time in various countries. Specifically, we analyse farmers' ability to sustain their coffee growing operation on the basis of current and projected revenues equal to or in excess of current and planned expenditures, i.e. costs.

Revenues

Coffee is a cash crop and producers grow and sell their produce in order to generate revenues. The revenue per hectare is a function of yield levels and the market price obtained per unit of output. Accordingly, revenues differ at the same yield level if the coffee price changes and vice versa.

The level of output realised by farmers depends on input choices and a stochastic component, e.g. climatic conditions as well as pests and diseases which can lead to yield variations. Through the use of inputs such as fertiliser, pesticides and the implementation of specific agronomic techniques farmers can mitigate the impact of these factors to some degree.

Coffee producers are price takers. This does not only apply to smallholders which make up 70 per cent of the producers but also to large-scale estates. Hence, we treat price movements which directly affect the growers' revenues as exogenous. Coffee farmers often have only limited access to instruments mitigating price risk.

Costs

Coffee growers incur costs when producing coffee. Some of the costs are incurred in the course of a cropping season and depend on the (expected) yield levels. These variable costs comprise remuneration for farm workers and costs of inputs such as fertilisers, pesticides or fuel to operate machinery. Fixed costs in contrast comprise expenditures which are independent of the yield level or are incurred upfront and are independent of whether coffee production takes place or not (e.g. insurance and other overhead costs). This cost component also includes depreciation of the coffee plantation. The establishment of the coffee plantation, e.g. the preparation of soil, costs of seedlings and the planting, is a considerable cost which is usually spread evenly over the lifetime of the coffee plantation. Depending on the country the lifespan can vary between 8 and 20 or more years. However, the replacement time (i.e. replanting time) can be significantly shorter depending on the yield profile of the coffee plants. When maturing the yield of coffee plants initially increases until reaching a plateau and then gradually decreases. Extended use of coffee plantations also affects the ability of a producer to benefit from productivity increases resulting from new varieties which are often higher yielding and more resistant against pest and diseases.

Profits and economic viability

Profit is the differential between revenues from selling coffee beans and the cost of production. In the short term coffee production is profitable if variable costs of production are covered. Long-term profitability is achieved only if full costs of production (variable costs and fixed costs including depreciation) are covered.

In this study we define a production system which is profitable in the long-term as economically viable. If the full costs of production are not covered, depreciated assets cannot be replaced, e.g. ageing trees cannot be replanted or outdated machinery substituted. As a result, productivity may decrease and there is a risk that coffee plantations could be neglected or abandoned.

Data and analytical approach

The ICO has obtained from its Members data on production costs and farm gate prices from important producing regions. The data set covers the coffee years 2006/07 to 2015/16 and four countries: Brazil, Colombia, Costa Rica, and El Salvador.[1]

The data allows for a disaggregation of production costs into variable and fixed costs for some of the countries (Colombia, Brazil) while it remains patchy for the remaining countries. Within the category of variable costs, we can distinguish between labour and non-labour costs. The data provided has been collected by the individual countries using their specific methodology. While cost comparisons across time within a country are possible, the potentially differing methodologies applied in each of the countries make the results of across-country comparisons less robust. Hence, we have opted for an approach in which we treat each country separately as a case study. First, we take a detailed look at how the profitability of coffee farming has developed in each country. In a second step we discuss the trends across countries.

It should be noted that the data for all countries except Brazil was provided based on national averages. The cost and revenues reported in a given year represent those of average farms. This limits the extent to which a detailed analysis of spatial heterogeneity between production regions within a country is possible. Variation within the population of coffee farmers with respect to cost-effectiveness can also not be explored using the data available. Hence, it should be noted that conclusions drawn from the analysis are regarding the profitability of average coffee farmers in a given country. Those farmers with a more favourable cost structure are better off economically, and vice versa.

[1] *Data was also provided by Cameroon, the Democratic Republic of the Congo, and Honduras which requires some additional information in order to be included in this analysis.*

In this study we assess profits on a per-hectare basis. Compared to per-unit profits this has the advantage that this variable controls for varying yield levels and provides a proxy for farmers' income and household welfare.

The results of the profitability analysis are presented in local currency. This allows to reflect changes in the exchange rate, which can be an important factor determining the profitability of coffee farming in a given year, affecting the household income and thus welfare of coffee farmers. Weakening local currencies increase farm-gate prices and thus are beneficial to producers exporting their coffee. However, the costs for imported inputs also increase but this depends on the share of imported goods in the overall input mix. The single most important input in coffee production, labour, is local. Hence, it is less affected by a depreciation or appreciation of the local currency (unless the currency depreciation leads to significant inflation which would also affect labour costs).

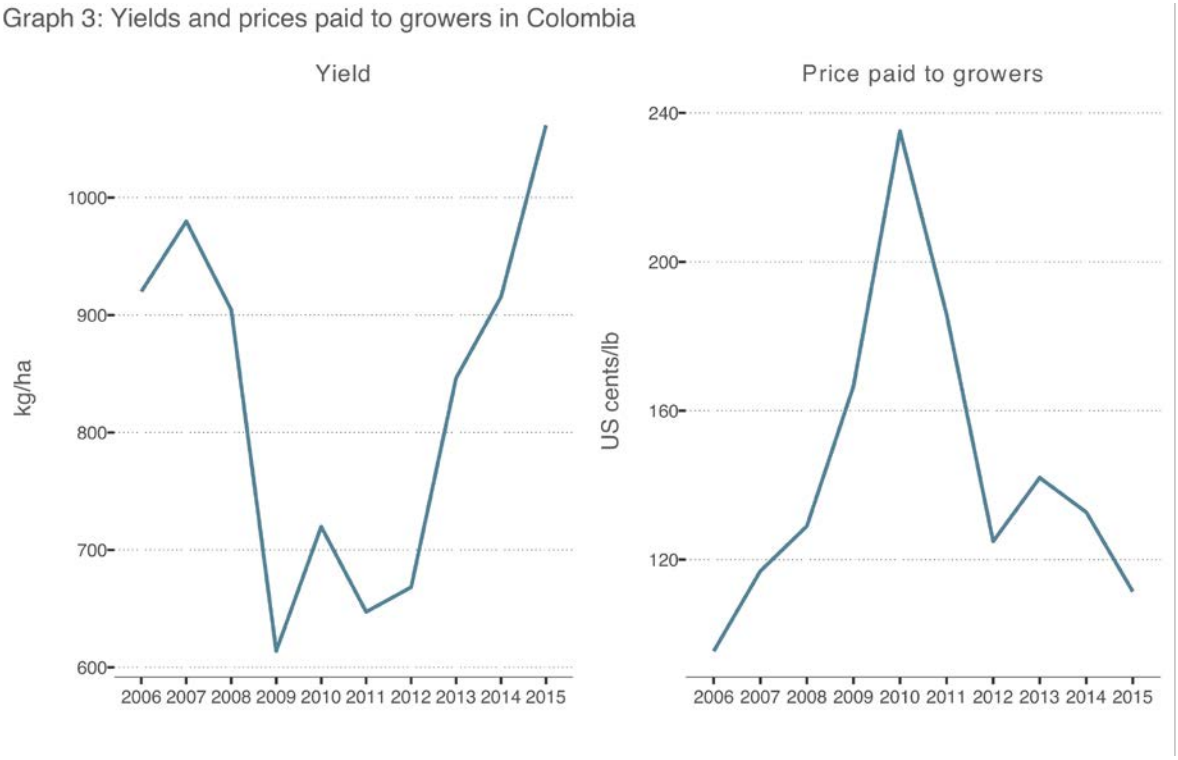
Economic viability of coffee farming – country case studies

Colombia

Colombia is the third-largest producer of coffee in the world. Between 2006/07 and 2015/16 the annual production was on average 10.6 million bags. In the year 2015/16 production of Arabica coffee was estimated at 13.5 million bags which is a strong rebound from the low point of 7.6 million bags during the coffee leaf rust crisis in 2011/12.

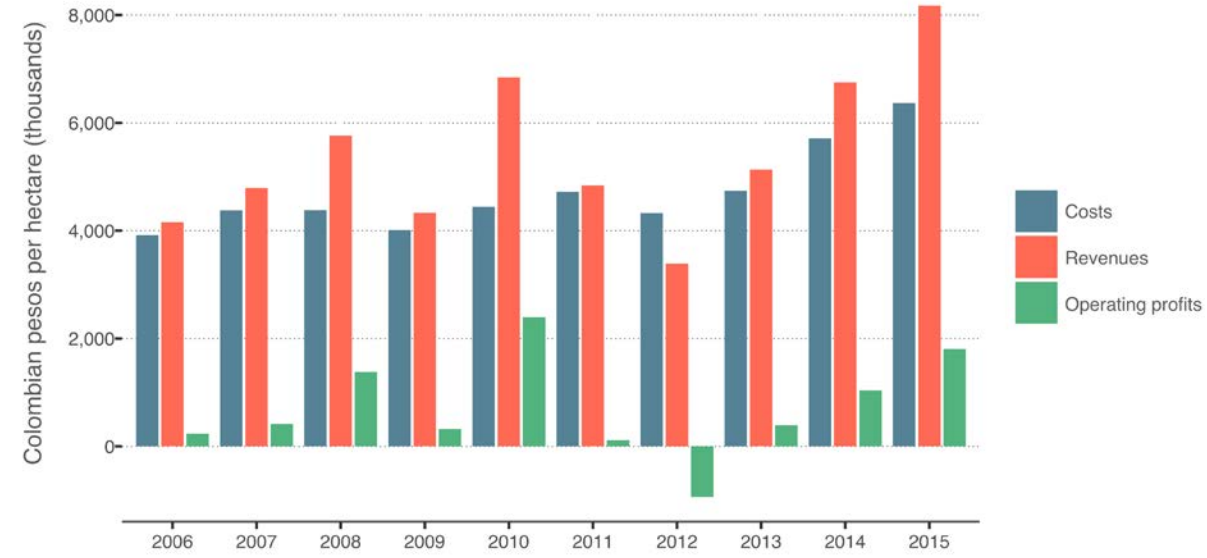
Production costs varied in a band of roughly 3.4 million COP/ha to 6.3 million COP/ha but overall followed an upward trend (Graph 4). After increasing for three years consecutively, the growth in production costs came to a halt when Colombia was first severely affected by coffee leaf rust in 2008/09. The plant disease caused significant crop damage and yields dropped by one third to 614 kg/ha compared to the three-year average of 934 kg/ha. The drop in yields went along with lower labour requirements for picking cherries.

Graph 3: Yields and prices paid to growers in Colombia



Indeed, the data reveals that the driver behind the decrease in total production costs is lower labour costs which in the Colombian context make up 71 % of total costs on average. In the years after the first severe incident of coffee leaf rust, productions costs grow at a lower rate as yields slowly recover. From crop year 2013/14 onwards, as yields caught up and eventually exceeded pre-crisis levels, production costs increased steeply as a result of increased harvest and post-harvest labour requirements.

Graph 4: Costs, Revenues & Operating profits for Colombia



In most seasons, farmers realised positive, albeit low operating profits. On average profits in 2006/07 to 2015/16 were 0.7 million COP/ha and there is only one crop year (2012/13) during which farmers accrued an operating loss of 0.9 thousand COP/ha.

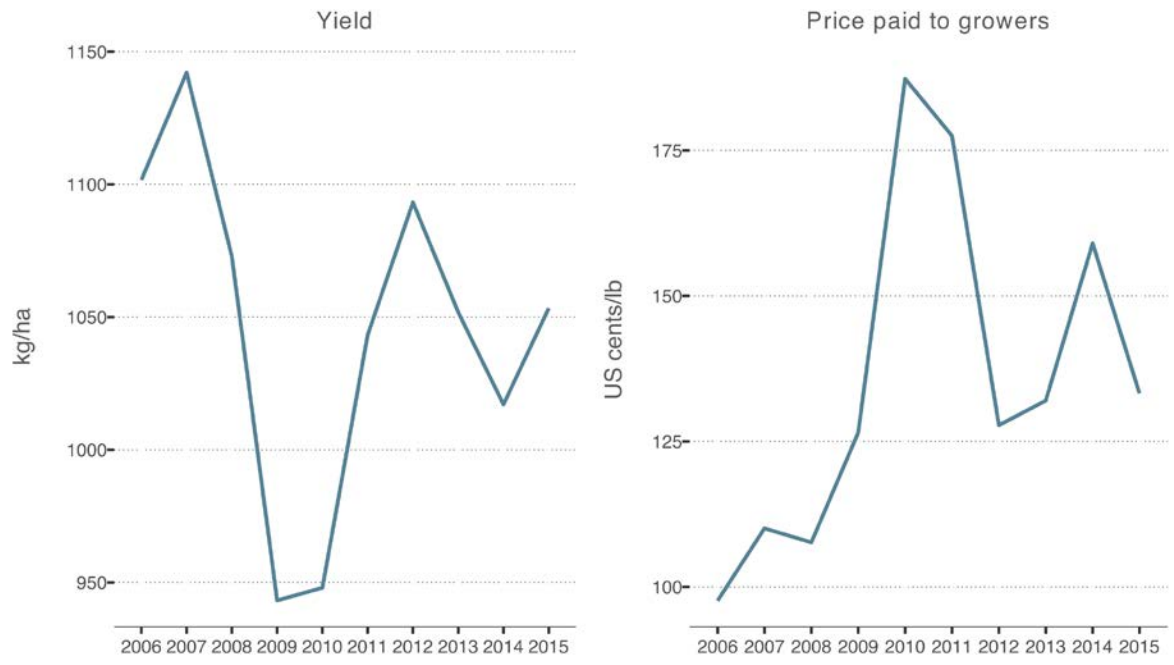
While operating profits were mostly positive, long term economic viability of coffee farming can only be attained if full costs of production, i.e. variable and fixed costs, are covered. Indeed, the picture changes if establishment costs of around 10 million COP/ha are taken into account. Evenly spread across the lifetime of the asset (8 years) this translates into annual depreciation of 1.25 million COP/ha. If these costs are taken into account, the economic viability of coffee production in Colombia becomes more uncertain. There were only four crop years in the ten-year period in which total profits greater than or equal to zero.

Costa Rica

Over the period under consideration output has fluctuated but overall followed a negative trend. Coffee production decreased by 13% from 1.71 million bags in 2006/07 to 1.49 million bags in 2015/16. Today, Costa Rica is the 14th largest producer of coffee in the world.

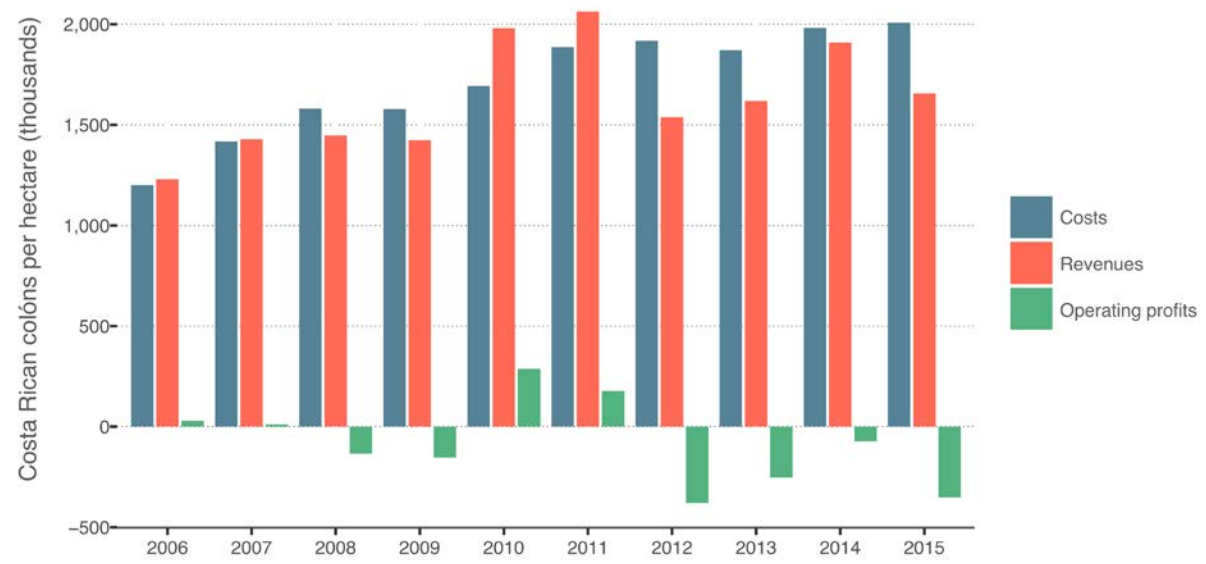
The cost structure of producers in Costa Rica is on average not dissimilar from their Colombian peers. In crop year 2006/07 the cost of production was 1.2 million CRC/ha – which is approximately the level observed in Colombia (when converted into US dollars). However, the cost of production has followed a clearer upward trend. Between 2006/07 and 2011/12 production cost has significantly increased 58% to more than 1.9 million CRC/ha. This trend has slowed down due to the outbreak of coffee leaf rust. Similar to Colombia, yields were negatively affected by coffee leaf rust, reducing the demand for labour. Indeed, the data confirms that the decrease in total costs is driven by lower labour costs related to the harvest of coffee. Since 2012/13 production costs have returned on a growth path, increasing from 1.9 million to more than 2.0 million CRC/ha.

Graph 5: Yields and prices paid to growers in Costa Rica



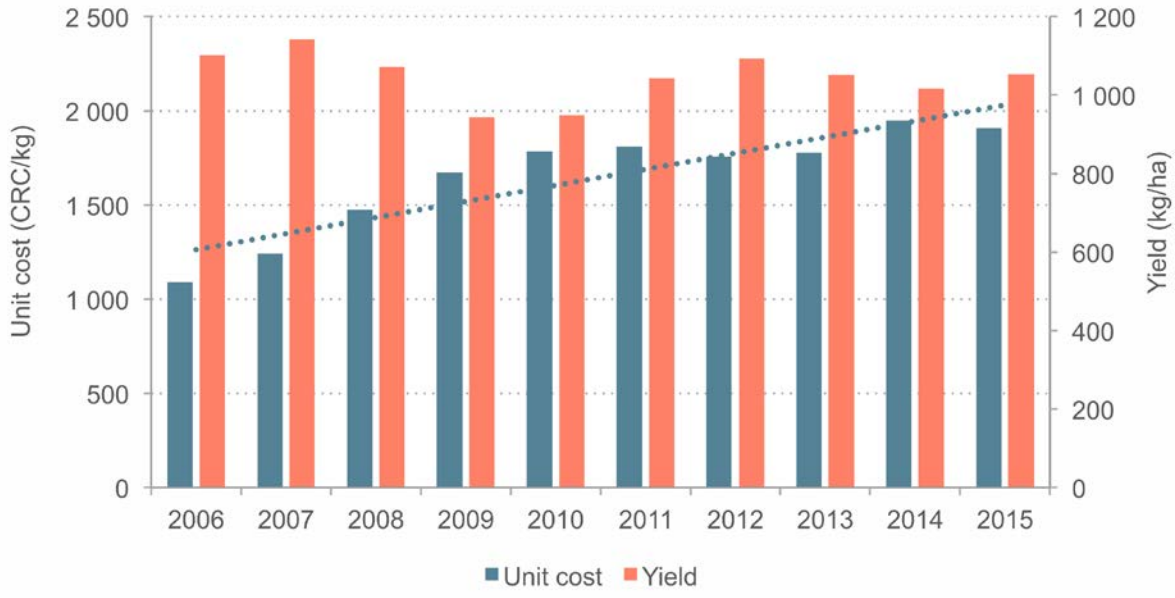
The farm gate price for coffee roughly doubled between 2006 and 2010 from 95 US cents/lb to 182 US cents/lb and then dropped slightly to 173 US cents/lb in 2011. The increasing price in combination with relatively stable yields of around 1,000 kg/ha led to revenues from coffee production high enough to cover the steeply growing cost of production in most years between 2006/07 and 2010/11. In the following crop year when the coffee price was significantly lower revenue sharply declined and did not suffice to cover the operating costs incurred by farmers. Between crop year 2012/13 and 2015/16 profitability was consistently negative.

Graph 6: Costs, Revenues & Operating profits for Costa Rica



Graph 7 depicts the development of per unit costs and coffee yields over time. While unit costs consistently increase, yields remain relatively constant. In a scenario in which coffee prices increase this is not necessarily worrying as higher costs can be offset by higher revenues. This was the case for the period 2005/06 to 2010/11 when coffee prices doubled and outpaced unit costs which grew by two-thirds. However, when the coffee price contracted significantly after 2012, revenues did not suffice to cover the higher production costs and losses were incurred by farmers.

Graph 7: Unit costs and yields in Costa Rica

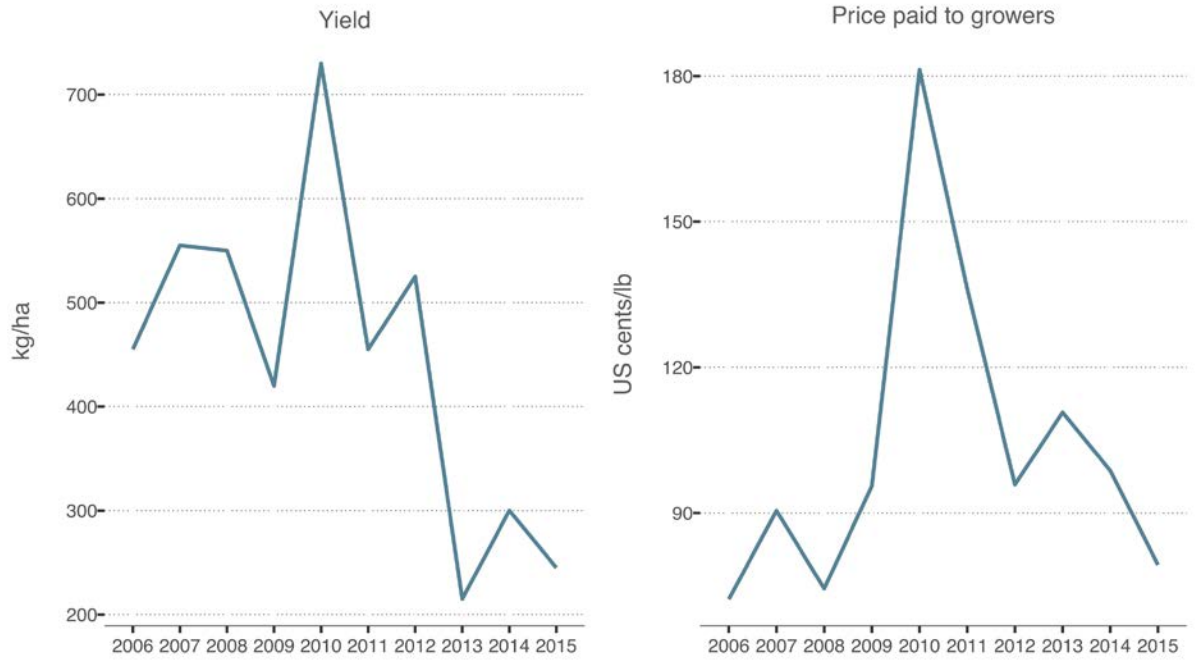


El Salvador

Over the past decade El Salvador has lost ground as a coffee producing country. In 2006/07 overall output stood at almost 1.20 million bags but production has contracted by 50% and is estimated at 0.57 million bags in 2015/16. This sharp decline comes after initial growth in output as production reached record levels of 1.87 million bags in 2010/11 before coffee leaf rust negatively affected per hectare yields.

Production costs followed an upward trend between 2005/06 and 2011/12, increasing from 1,000 USD/ha to 1,400 USD/ha (Graph 9). Following the outbreak of coffee leaf rust, production costs decreased to roughly 1,300 USD/ha which is mainly due to lower labour costs as a result of a drop in yield by ca 50% (Graph 8). At the same time the price paid to growers decreased from 181 US cents/lbs to 79 US cents/lbs between 2010/11 and 2014/15 (Graph 8). Low yields in combination with relatively low coffee prices in years 2012/13 to 2014/15 led to a drop in revenues to levels of around 50% of the ten-year average. This suggests that compared to their Colombian peers which could benefit from a large-scale replanting programme supported by the Government, the El Salvadorian coffee farmers were less able to respond effectively to the Roya crisis.

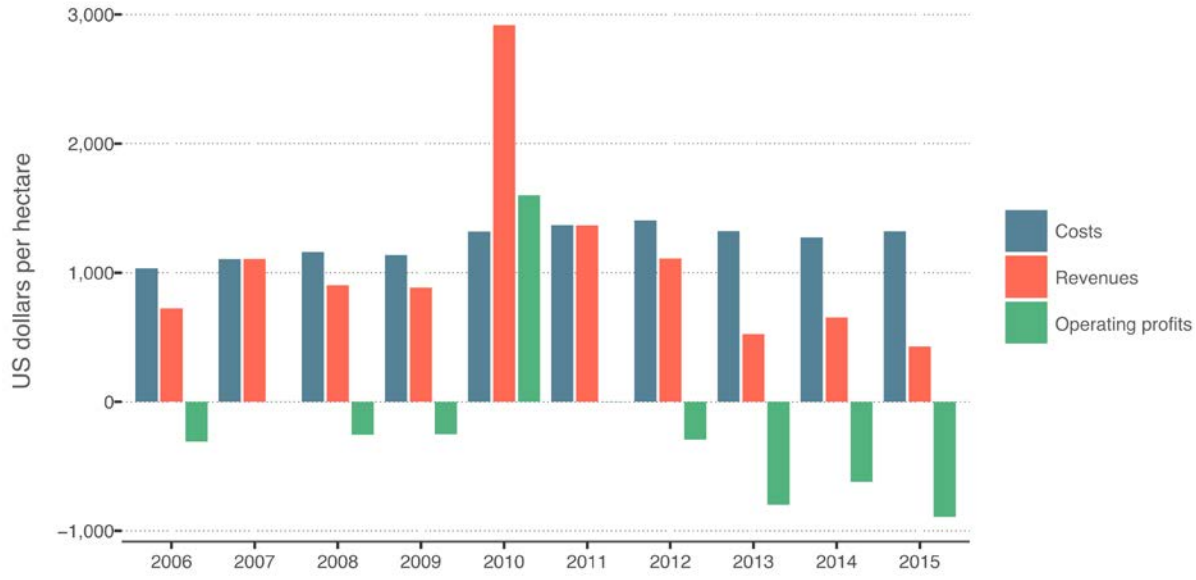
Graph 8: Yields and prices paid to growers in El Salvador



Operating profits were negative in most years over the past decade, including the last four consecutive crop years when production has been severely affected by coffee leaf rust. On average farmers incurred operating losses of 181 USD/ha. The economic performance would have been significantly worse without the record year 2010/11 when profits were extraordinarily high (1,599 USD/ha) as result of high coffee yields (greater 700 kg/ha) and a high farm gate price (180 US cents/lb).

In view of negative operating profitability, the long-term viability of coffee production is not given in El Salvador. Even in the absence of reliable data on establishment costs and the average lifespan of coffee plantations, it is evident that farmers who incur operating losses are not able to undertake necessary investments to replant and modernise existing plantations. Hence, it is not surprising that there is anecdotal evidence of farmers switching from coffee to cocoa, a currently more economically attractive alternative.

Graph 9: Costs, Revenues & Operating profits for El Salvador



Brazil

Brazil is the largest producer of coffee in the world, growing both Arabica and Robusta. At 43.2 million bags in coffee year 2015/16, the estimated output will be close to the 10-year average. Compared to Central American countries production has varied less across years, not least because Brazil has been affected only very mildly by coffee leaf rust.

The data provided by the Brazilian authorities allows us to view Arabica and Robusta production systems separately. As the data was collected on the level of individual municipalities, it is possible to explore whether there are regional differences with respect to costs, revenues, and profits. For example, it can be investigated how coffee growing regions with different production systems, levels of productivity, and cost structures cope with variations in the coffee price.

Arabica

First, the development of costs in Arabica producing regions is assessed. Overall production costs follow a clear positive trend. In crop year 2006/07 total cost per ha range between 4,164 and 8,178 BRL. The highest cost can be observed in Luis Eduardo, a municipality with a high degree of mechanisation. The lowest costs in 2006/07 are incurred by coffee growers in Guaxupe, although these become the highest by 2015/16. On average since 2006/07, costs have doubled to reach 10,487 BRL/ha.

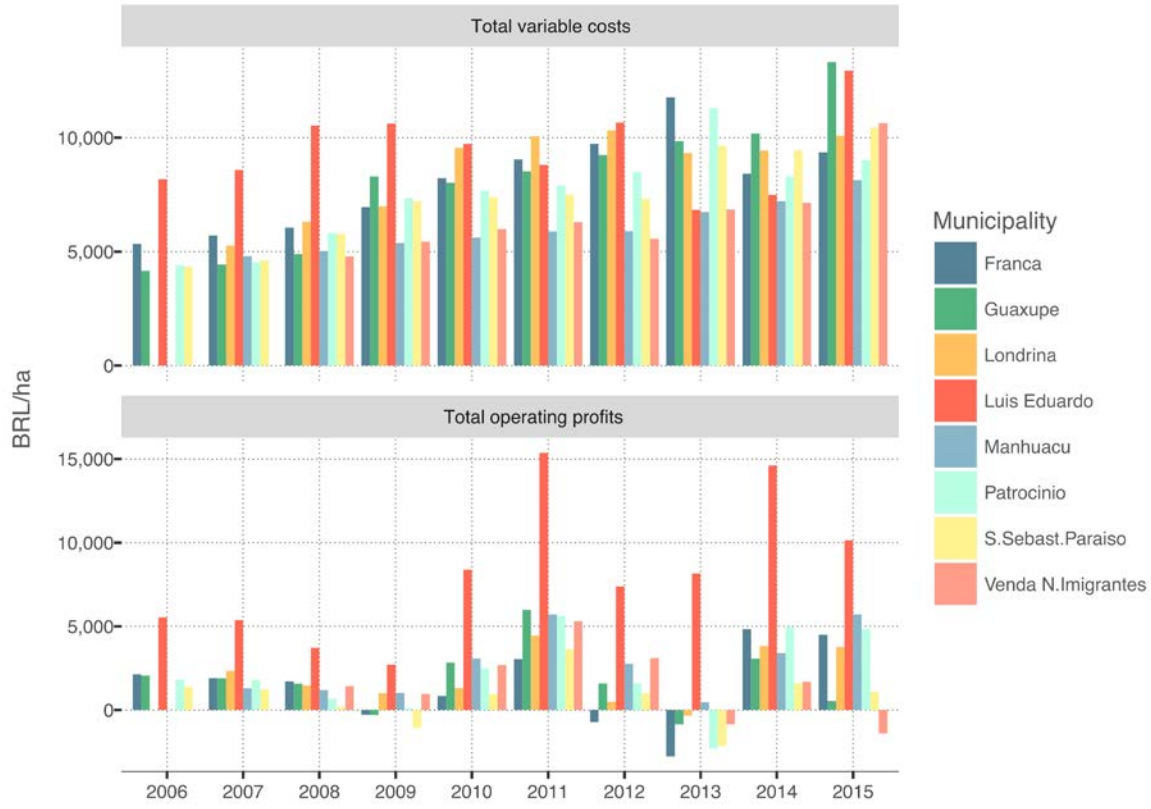
In municipalities with a high degree of mechanisation and high yield levels (notably Luis Eduardo) inputs such as fertiliser, pesticides and fuel make up an important share of total costs. In contrast, it can be observed that in municipalities where coffee cherries are still picked by hand labour costs remain a dominant element in total costs.

Revenues are calculated based on per-hectare yields for each of the municipalities over the ten year time period. However, due to lack of more granular price data, a uniform farm gate price is applied across municipalities. Hence, the revenues may be slightly over- or understated as the farm gate price realised in specific municipalities deviates from the national average. The outcome of this intermediate step is used to estimate the profitability for each of the municipalities.

The results suggest that in contrast to the other countries included in this study operating profits in the major Brazilian coffee producing regions are consistently positive. However, there is a considerable differential in profitability between municipalities. While for crop years 2006/07 to 2015/16 profits for Luis Eduardo are between 2,500 BRL/ha and almost 15,000 BRL/ha, only in recent years could losses be observed. Profitability is lowest in Franca, where in most years the average producer breaks even or makes a small profit while there are also two crop years in which a loss was incurred.

Furthermore, If establishment costs are taken into account, profits in most producing regions remain positive. For example, annual depreciation costs range from around 400 to 500 BRL per ha for some of the lower yield farms to nearly 2,000 BRL for highly mechanised municipalities such as Luis Eduardo.

Graph 10: Total variable costs and operating profits in Arabica producing municipalities



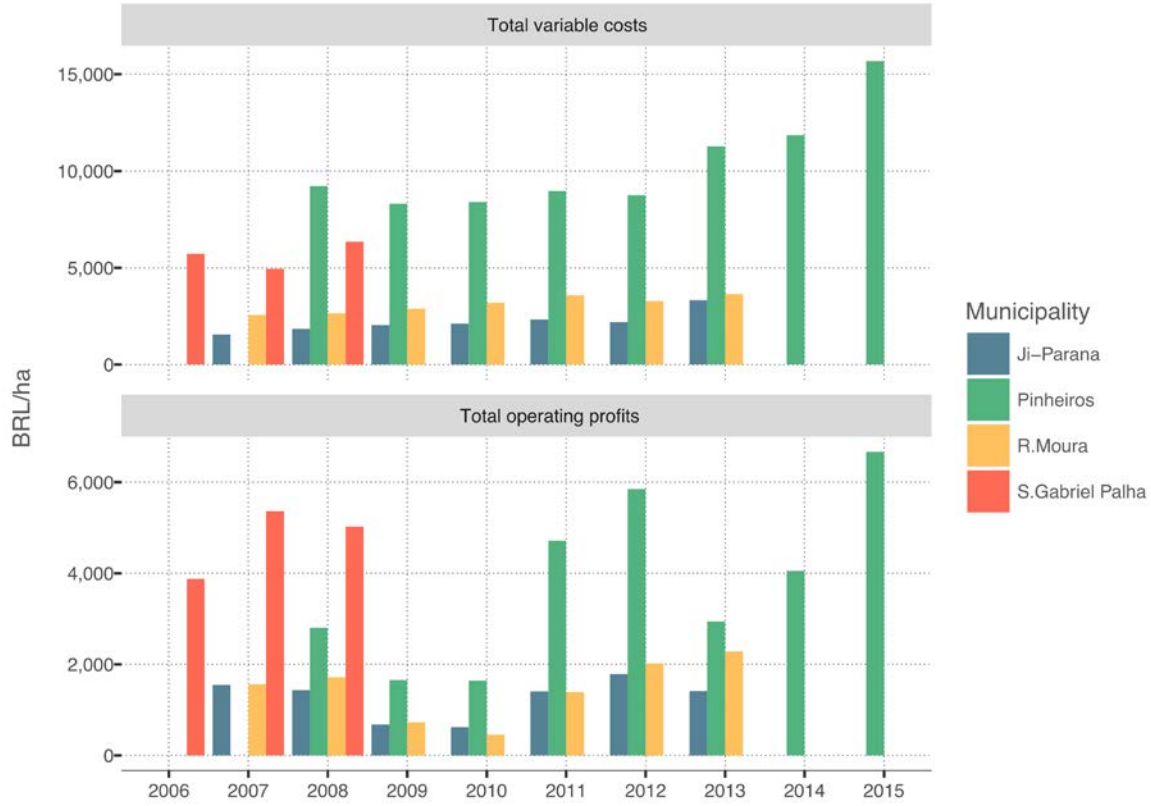
Robusta

For Robusta, we find similar results. There are significant differences between municipalities in the cost structure.

The variable costs of production and some of the fixed costs (excluding establishment costs) could be covered in all municipalities, albeit profits were low in the years 2008/09 and 2010/11. Profits were particularly high in S. Gabriel Palha and Pinheiros, but data is not available consistently for all years in period 2006/07 until 2015/16.

However, the results should be interpreted with a degree of caution. Overall, the data available for Robusta producing municipalities is patchier than for Arabica growing areas as not all crop years are covered. In the absence of price data disaggregated by municipality we apply a universal price paid to growers (similar to the approach taken for the analysis of Arabica production). Hence, profitability levels might be slightly over- or underestimated.

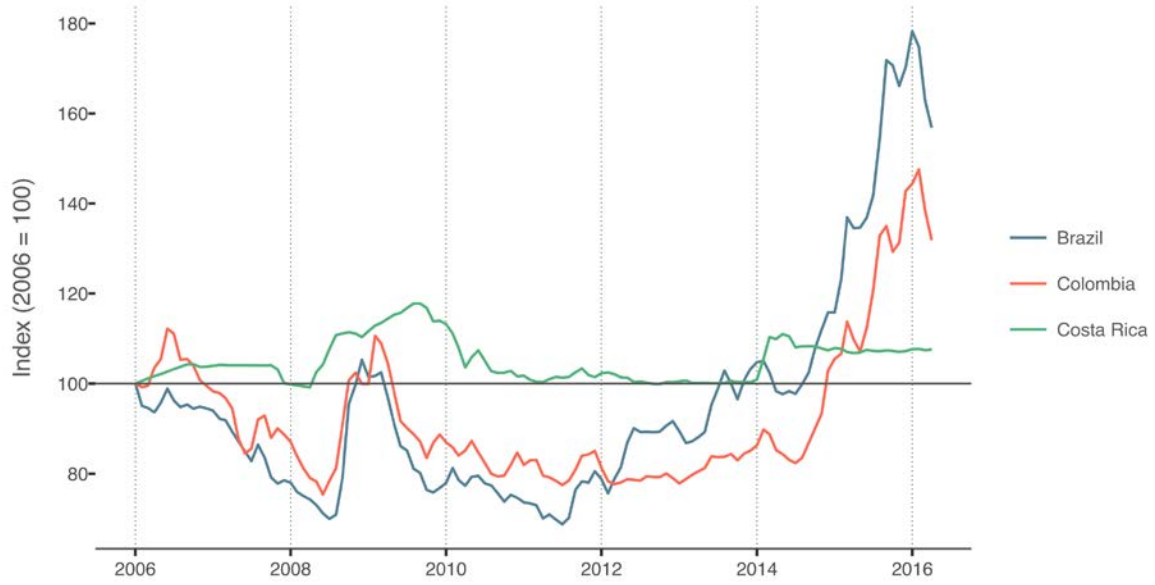
Graph 11: Total variable costs and operating profits in Robusta producing municipalities



The main factors which drive the profitability of coffee production in Brazil (both Arabica and Robusta) are linked to modern and cost-effective production systems with a high degree of mechanisation, as is the case in municipalities such Luis Eduardo. At the same time, the competitiveness of Brazilian coffee on the world market has benefitted from the devaluation of the Real.

Graph 12 depicts the movement of the Real, Colombian Peso and Costa Rican Colon against the US Dollar. While the Colon remained relatively stable against the US Dollar, both the Real and the Colombian Peso depreciated significantly, especially since 2012. Brazilian producers benefitted more than their Colombian peers.

Graph 12: Movements in exchange rates



Trends in production costs

In this section we examine the trends in production costs and coffee prices and establish whether the cost of production factors (e.g. labour) have increased over time.

Between 2006/07 and 2015/16, the average annual growth of per-hectare costs in the countries included in the study varied between 2.76% in El Salvador where production intensity was scaled back as a result of Roya impact and 8.49% in Brazil where production cost doubled (Table 1). Over the same time period, the ICO composite indicator price increased at a much lower rate of 1.45%. Generally, the differential between the growth rate of costs and prices suggest that coffee farmers had to increase yields significantly in order to be able to buffer the negative impact on their margins. However, it should be noted that growth rates of both per-hectare costs and the coffee price are sensitive to how the time period is defined. During the first five years of the period covered of this study, the growth in coffee prices (+18.50%) by far outpaced the average annual growth in costs (between 3.18% in Colombia and 11.60% in Brazil). In the second half of the time period under consideration, the coffee price significantly decreased (-8.58%) while costs increased in all countries (except in El Salvador) albeit at a lower rate.

Table 1: Average annual growth rates (coffee years)

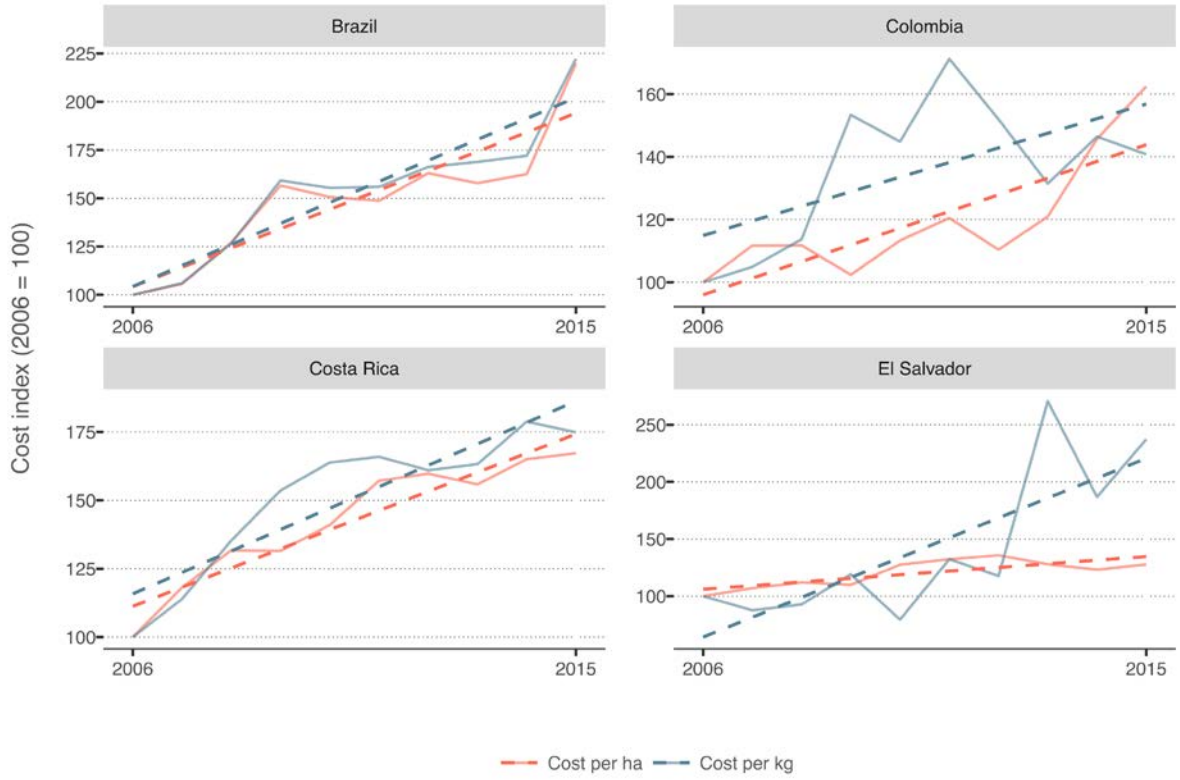
	2006 – 2010	2011 – 2015	2006 – 2015
Brazil	11.60%	7.14%	8.49%
Colombia	3.18%	7.76%	5.54%
Costa Rica	8.96%	1.56%	5.88%
El Salvador	6.27%	-0.87%	2.76%
ICO composite indicator price	**18.5%**	**-8.58%**	**1.45%**

So far we have established that per-hectare production costs have significantly increased in the past decade. However, per-hectare costs are highly dependent on yield levels. There is a positive correlation between yield levels and input use, especially labour during the harvest period. In this section we conduct a robustness check to establish whether production costs have increased while controlling for yield levels. Within our sample of countries, Costa Rica showed the most stable yields, i.e. very low variation between years (see Graph 5). Hence, it provides a good starting point for the robustness test. If we can observe increasing costs over time (while yields remain constant), this increase can be attributed to growing factor costs,

e.g. labour or other inputs. We would expect trend lines for both per-unit and per-hectare costs to have the same slope, i.e. develop parallel to each other.

Graph 13 also depicts the development of costs in Costa Rica between crop years 2006/07 and 2015/16. The solid lines represents the actual costs, the dashed lines the (linear) trends. The actual per-unit costs (blue) and per-hectare costs (red) follow the trend line very closely, i.e. there is only minor deviation from the trend in each year. Furthermore, the two trend lines are almost parallel. This is in line with our expectation and we can indeed conclude that costs have increased over time in Costa Rica as results of higher factor costs.

Graph 13: Costs per hectare and kilogram by country



Carrying out a similar robustness check for Colombia we also find upward sloping trend lines (dashed). However, there is much higher variation of per-hectare and per-unit costs in a given year. This can be explained by a highly variable yield in Colombia. At the beginning of the time period under consideration coffee yields are relatively stable but contract significantly as a result of the outbreak of coffee leaf rust in the year 2008/09 and remained depressed. Only after crop year 2012/13 did yields return to pre-crisis levels. A negative correlation between per-hectare and per-unit costs is apparent. In years of high yields when the per-hectare costs are high (due to labour demand for picking the cherries), per-unit labour costs are low and vice-versa. This explains the divergent development of per-hectare costs and per-unit costs in Colombia. It should be noted however, that the time period under consideration covers a full cycle of increasing, decreasing, and again increasing yields.

This is not the case for El Salvador where yields increase over the first years but then contract as a result of coffee leaf rust yield losses. A recovery from yield losses similar to that observed in Colombia was not realised. Hence, the trend lines for per-hectare costs and per-unit costs are not parallel. As a result, it cannot be established with certainty whether costs of production inputs have increased in El Salvador but it seems likely.

We have established that production costs followed an upward trend in the countries under consideration. Next, we will discuss the main drivers of per-hectare production costs. Cost have increased largely due to:

- Increased labour costs as result of economic development and rural-urban migration
- Rising prices for agro-chemical inputs such as fertiliser and pesticides the growth of which has slowed down/reversed in recent years as a result of low oil prices
- Increased intensity in the use of capital goods and related expenditures resulting from higher yield levels in some countries. Where the impact of pests and disease and resulting lower yield levels, lower per-hectare costs could be observed in recent years.
- The impact of exchange rate fluctuations on costs is ambiguous. If the local currency depreciates significantly against the US Dollar (as is the case for Brazil and to some extent Colombia), the cost of imported goods increases. Depending on the share of imported inputs (e.g. fertiliser and pesticides) in the overall mix, costs can increase significantly.

Box: Production cost data from other sources

There is considerable interest in production cost data among stakeholders in the coffee sector, both private and public. Accordingly, besides official statistics gathered by ICO Members, other actors such as consultants and firms in the coffee industry collect data at the level of individual farmers or in a more aggregate fashion. This data can close an important gap which exists particularly in countries where systematic publically funded data collection is limited for various structural reasons.

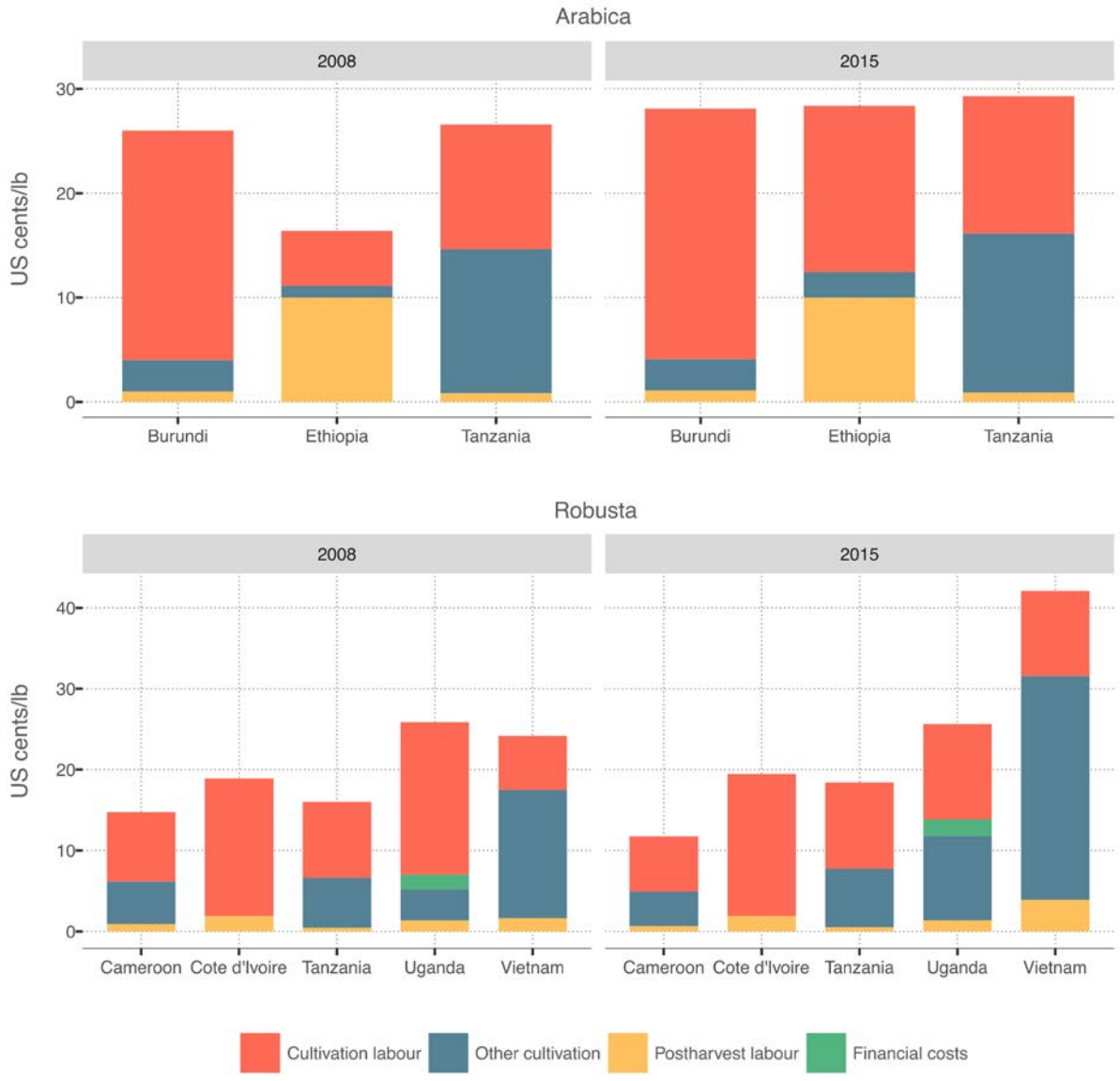
Agrilogic, a Netherlands-based consultancy, collects data on production costs from individual farmers. For this study, Agrilogic has made available aggregated data for selected African countries and Vietnam. The underlying methodology differs considerably from the way data is collected by ICO Members, making a direct comparison with the data obtained by the ICO difficult. Nevertheless, in view of the general scarcity of detailed production cost data and the difficulties in collecting the data, we complement the main findings of the study with a production cost comparison.

The data covers two crop years (2008 and 2015), four African countries (Cameroon, Cote d'Ivoire, Tanzania, and Uganda), and Vietnam.

Production costs for Arabica and Robusta coffee have increased between 2008 and 2015 but the level of the increment varies. While variable costs have increased moderately in most African countries, costs in Ethiopia (Arabica) and also Vietnam (Robusta) jumped by more than one third. In Ethiopia costs increased from 15 US cents/lbs to almost 30 US cents/lbs while in Vietnam costs went up from 25 US cents/lbs to more than 40 US cents/lbs. Labour costs are a significant cost component and make up the majority of total costs in all countries except for Vietnam. This is in line with expectations as labour costs in countries of Sub-Saharan Africa such as Burundi are particularly low and the use of inputs like fertilisers and pesticides is less pronounced.

The results of the analysis of the Agrilogic data are broadly in line with the findings in this paper. Production costs increased across production regions over the past years but the growth rate varies between countries.

Graph 14: Cost of production data from Agrilogic



Discussion of the results

Over the past ten years average short-term profitability (i.e. operating profitability) was low in most countries in the sample except for Brazil. We observe a large variation in operating profitability with years in which farmers on average could not cover the variable costs of production and other years where high profits could be realised.

The variation in profits between years can be explained mainly by changes in yields and prices paid to growers where the latter seems to be the most important determinant.

Costs of production have increased steadily over time and follow a clear upward trend. Due to methodological differences in data collection we cannot directly compare the levels of profits between countries. Hence, we conclude only cautiously that there are time trends within countries. In the limited context of the 4 countries under consideration we find producers with better economic performance throughout the ten year time period resulting from cost-effective production systems and other factors such as the exchange rate (Brazil) and those with decreasing profitability (the remainder of countries).

If coffee prices continue to remain low, this may lead to a spatial shift of production from less profitable growing regions to more profitable ones. An increased concentration of production in countries with advanced production systems and favourable cost structure could meet the growing demand for quality coffee worldwide in terms of quantity.

However, concentration also comes at a risk as extreme weather events or pests and disease have a more severe impact in the context of concentrated rather than spatially diversified global production base. As a result, volatility of coffee prices could increase.

Recommendations

- More research is needed to understand the economic viability of coffee production world-wide. Currently, research is hampered by data availability.
- Across the board productivity increases (e.g. through more efficient use of fertiliser and new varieties) as well as adoption of modern agronomic techniques with the aim of mitigating production risk can have a positive impact on the global supply of coffee and thus may also reduce price volatility.
- While increasing productivity can help farmers to become more cost-effective, they may still incur losses in years of low prices. Price volatility is part of market risk which includes also exchange rate, interest rate and counterpart default risk. The data suggests that market risk (price risk) is a particularly important variable.
- Hence, mitigation of price risk should rank high on the agenda. Farmers need to get access to risk management tools with the aim of (i) mitigating exposure to risk, and in order to (ii) strengthening resilience against inevitable shocks.

- Some countries have developed effective policy responses to factors which negatively affect the profitability of coffee farming. For example, Colombia responded successfully to the threat of coffee leaf rust, which Costa Rica has become a pioneer for measures to mitigate the impact of climate change in the coffee sector. These positive experiences should be shared between countries.