Welfare and Poverty Impacts of Cocoa Price Policy Reform in Côte d'Ivoire

July 17, 2017

Abstract

Côte d'Ivoire is the world's leading cocoa producer, supplying nearly 40 percent of world cocoa production. Developments in the cocoa sector can have significant implications for poverty reduction and shared prosperity given that the sector is a source of livelihood for about one-fifth of the population, as well as an important source of export and government revenues. Cocoa pricing has always been a major focus of public policy in the country, and in 2011 the government initiated a new round of cocoa sector reforms seeking to stimulate cocoa production and to secure the livelihoods of cocoa farmers through guaranteed minimum farm-gate prices. Policymakers would certainly like to know the likely impacts of this price policy reform on household welfare and poverty. This paper uses a nonparametric approach to *policy incidence analysis* to estimate the first-order effects of this policy reform. To assess the pro-poorness of the reform in cocoa pricing, variations in poverty induced by the policy are compared to a benchmark case. While increasing the cocoa farm-gate price has a potential to reduce poverty among cocoa farmers, it turns out that the increase in 2015-2016 translates into a relatively small drop in overall poverty. This variation is assessed to be weakly pro-poor. It is likely that this poverty impact could be amplified by additional policy interventions designed to address the key constraints facing the rural economy such as productivity constraints stemming from factors such as lack of relevant research and development, weak extension services, poor transportation and storage infrastructure, and generally poor provision of relevant public goods. Addressing these issues require a coherent policy framework that can be effectively implemented by accountable institutions to increase the role of agriculture as an engine of inclusive growth in Côte d'Ivoire.

Poverty and Equity Global Practice
Country Department AFCF2
Africa Region

This report was prepared by a World Bank team led by Roy Katayama (Economist, GPV01) and comprised of Andrew Dabalen (Lead Economist, GPVGE), Essama Nssah (Consultant, GPV01), and Guy Morel Amouzou Agbe (Consultant, GPV01). The team benefitted from the helpful comments and suggestions from Jacques Morisset (Program Leader, AFCF2) and Nabil Chaherli (Program Leader, AFCF2). The team appreciates the collaboration and assistance of the National Institue of Statistics (INS) on the household survey data. The team worked under the direction of Pablo Fajnzylber (Practice Manage, GPV01).

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1. INTRODUCTION

Côte d'Ivoire is the world's leading cocoa producer, supplying nearly 40 percent of world cocoa production. The cocoa sector is an integral part of the economy and serves as an important source of government and export revenues. As the sector provides a source of livelihood for about one-fifth of the population, developments in the sector can have significant implications for poverty reduction and shared prosperity. In fact, the deepening of poverty observed between 1985 and 2008 has been attributed in part to the fall in cocoa prices, along with other contributing factors including the sociopolitical crisis.

Cocoa pricing has always been a major focus of policy in Côte d'Ivoire. A system of administered prices prevailed for almost 40 years from 1960 to 1999, with rising international cocoa prices during the first half of this period and falling prices during the second half. From 2000 to 2011, cocoa marketing was liberalized and policymakers adopted a system of announcing indicative prices that were intended to orient cocoa market participants, in particular farmers and traders, but were not enforced. It is widely believed that liberalization did not benefit cocoa producers nor did it improve the competitiveness of the sector (Gilbert 2009). Under the indicative price regime, cocoa farmers received only 30-50 percent of the international price (Kireyev 2010).

In an effort to revitalize the cocoa sector and improve the living standards of cocoa farmers, the Government of Côte d'Ivoire initiated a new round of cocoa sector reforms in November 2011. A key component of these reforms concerns *cocoa pricing policy*. In particular, the government abandoned the indicative price regime, and reverted back to a guaranteed minimum farm-gate price. The farm-gate price is fixed twice per year for the main and secondary agricultural seasons. The stated objective is to set the farm-gate price at least equal to 60 percent of the average international CIF (cost, insurance and freight) price. The farm-gate price was initially set at CFAF 725 per kilogram for the 2012/2013 season, and in subsequent years increased to CFAF 750/kg (2013/2014), CFAF 850/kg (2014/2015), and CFAF 1,000/kg (2015/2016). While increasing cocoa farm-gate prices is expected to improve the income of cocoa-farming households, the extent and distribution of benefits is not entirely evident.

What are the likely impacts of the recent changes in cocoa farm-gate prices on household welfare and poverty? This paper proposes evidence to answer this key policy question. For a given household, the welfare and the poverty impacts of a cocoa price change depend on whether or not the household is engaged in cocoa farming, and (conditional on being engaged) on the supply and consumption responses to the price change. Farmers are expected to adjust decisions about investment and other inputs (e.g. labor) in response to cocoa price changes. Such adjustments underlie the supply response which is measured by own and cross price elasticities for cocoa and other crops. Lacking information on supply response, this paper focuses on first-order benefit incidence analysis. A detailed discussion of the analytical framework is presented in the appendix.

Essentially, the framework is based on a nonparametric approach to *benefit incidence analysis* (Benjamin and Deaton 1993, Budd 1993). There are two key outcomes to consider: (i) the probability of engaging in cocoa farming, and (ii) the welfare effect of the price change. For a given household, the welfare impact of a price change is measured by the ratio of cocoa sales to total household consumption. This is known as the *benefit ratio*. Assuming that farm households behave optimally, this ratio is the *income effect* associated with the price change. It can also be interpreted as the *elasticity* of a household's potential consumption with respect to cocoa farm-gate price.

Benefit incidence analysis is designed to show how the benefits (or burdens) from the implementation of a policy intervention are distributed among policy-relevant socioeconomic groups. Given the overall policy objective of shared prosperity and poverty reduction, it is important to examine the location of cocoa-farming households in the distribution of welfare, measured by *per capita consumption* that is adjusted for regional cost of living differences. This is achieved through non-parametric kernel estimations of the probability of being a cocoa farmer conditional on the level of per capita consumption. Similarly, the conditional expectation of the benefit ratio as a function of per capita consumption is locally estimated using kernel methods. With this information, the welfare and poverty impacts can then be simulated for a given price change.

It should be noted that a limitation of the analytical approach adopted here stems from the fact that we can estimate only the first-order welfare and poverty impacts. Within this approach, one can only capture the static effects of the policy reform and not the second-order or general equilibrium effects. A key assumption underlying the results is that socioeconomic agents remain in the neighborhood of the initial optimum after experiencing the price shock. This means that the approach is inappropriate for large price changes or in situations where agents are out of equilibrium due to institutional constraints.

To what extent is the distributional impact of the price changes pro-poor? Declaring a policy outcome pro-poor or not hinges critically on the standard of comparison. Our evaluation of the pro-poorness of the distributional change induced by the increase in the cocoa farm-gate price follows Osmani's (2005) recommendation that a distributional change be considered pro-poor if it achieves an absolute reduction in poverty greater than would occur in a *benchmark* case. The distributional impact of the price change is mediated by the distribution of the benefit ratio. The cocoa price increase will be considered pro-poor if it leads to an absolute reduction in poverty greater than it would in a hypothetical case where the benefit ratio is the same for all households.

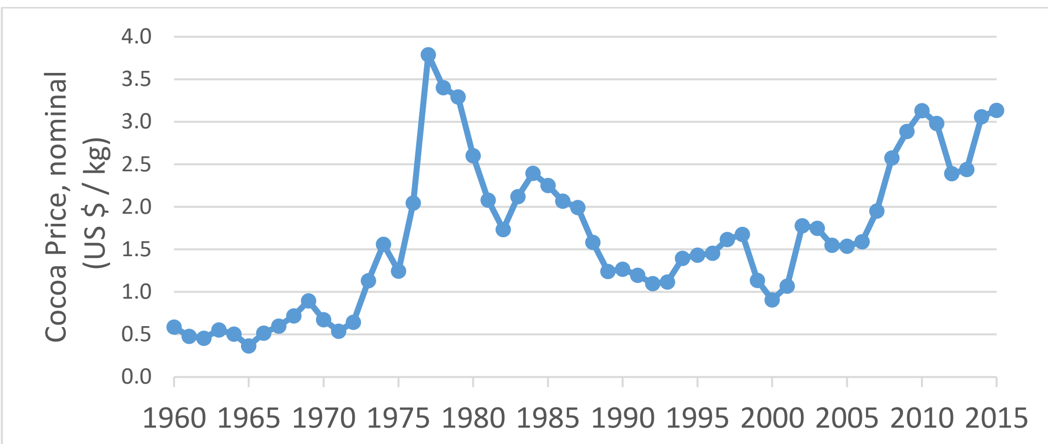
The outline of the report is as follows. Section 2 presents background information on the importance of the cocoa sector in the Ivorian economy, the history of cocoa market interventions in Côte d'Ivoire, and the linkages with poverty reduction. Section 3 discusses the results of the benefit incidence analysis focusing on the probability of being a cocoa farmer across the welfare distribution, and the relationship of the benefit ratio with per capita consumption. The section then presents the simulated welfare and poverty impacts of recent farm-gate price changes. Section 4 concludes. The Appendix includes a detailed technical discussion of the methodologies employed.

2. BACKGROUND

Agricultural development has the potential to accelerate poverty reduction in Côte d'Ivoire and the cocoa sector is a key component. Agriculture accounts for about 22 percent of GDP and more than 75 percent of non-oil exports, and is a source of income for 2 out of every 3 households (World Bank 2012). In 2006-2009, the production of cocoa beans fluctuated around 1.3 million metric tons (Kireyev 2010)[1]. In 2011-2014, it averaged 1.5 million metric tons. This level of production represents close to 38 percent of world cocoa production (George 2014).

Cocoa is mostly produced by smallholder farmers in the forest region located in the Southern part of the country. This region, which is characterized by reliable rainfall and better soils, produces the majority of the export crops. The global cocoa value chain runs from the smallholder to the final consumer and involves traders, exporters, the roasting and grinding industry, other processing industries (food, confectionery, cosmetic and pharmaceutical), and the government. Within the domestic segment of the cocoa market, licensed traders buy cocoa beans from about 800,000 farmers during the crop season (Kireyev 2010). Traders gather cocoa in collection centers where it is sold to licensed exporters and then transported to warehouses in Abidjan or San Pedro.

Figure 2.1: International Price of Cocoa, 1960-2015



Data Source: World Bank Commodity Price Data (2016)

Over the years, the resilience of the cocoa sector has been tested by volatile international prices as well as other factors such as low yields, excessive taxation, and sociopolitical instability. Figure 2.1 shows the evolution of world price of cocoa between 1960 and 2015 as reported by the International Cocoa Organization (ICCO). Within 8 years, from 1971 to 1979, the world price of cocoa rose quickly from about 54 cents to about US$3.8 per kg. That boom period was then followed by a 20 year period (1980-2000) characterized by an overall downward trend in the world price which reached 91 cents in 2000. The downtrend reversed itself in 2001, and the world price of cocoa has been trending upward reaching US$3.14 in 2015.

[1] From the early 1980s to 1999, cocoa production increased from 400,000 metric tons to about 1.2 million (Varangis and Schreiber 2001).

Historical Overview of Cocoa Pricing in Côte d'Ivoire

In the two decades following independence, the country experienced strong economic growth that was dubbed the "Ivorian Miracle". Between 1960 and 1979, on average, GDP grew about 8 percent per year (Abbott 2009). Average growth rate reached 10 percent at the height of the commodity boom, 1975-1979. This strong economic performance was driven by growth in commodity exports, particularly of cocoa, supported by favorable trends in world prices, in spite of a heavy export tax burden. The Government of Côte d'Ivoire established the *Caisse de Stabilisation et de Soutien des Produits Agricoles* (CSSPPA), also known as CAISTAB, in the early 1960s. At the beginning of each crop season, this marketing board set producer prices as well as the profit margins of all socioeconomic agents along the cocoa and coffee supply chains. The price and costs schedule was known locally by its French name, *barème*. The computation of the *barème* was based on the reference CIF price, a weighted average of the price obtained in forward sales in the previous season and the spot price for the current season (McIntyre and Varangis 2001). The operation of CAISTAB amounted to a quasi-export tax. In 1960-1979 farm-gate prices for cocoa represented only 47 percent of export prices (Abbott 2009). Yet, this is the period when the sector experienced a strong expansion.

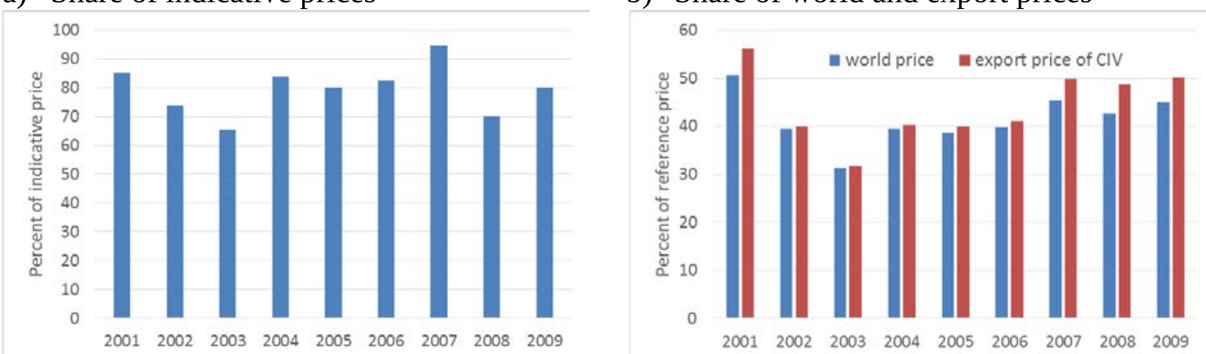
The growth of the cocoa sector over this period is explained mostly by three factors: (i) steady increase in world prices (see figure 2.1), (ii) availability of rain forest, and (iii) immigration policy. Except in 1964-1965, the world price of a metric ton of cocoa rose steadily from $485 in 1961 to the highest level ever $3,791 in 1977 (Abbott 2009). This trend in world prices allowed the government to continue increasing the producer price in nominal terms. The stability of the FCFA, due to its peg to the French Franc, also made these farm-gate price increases meaningful by precluding hyperinflation or a significant black market premium. Land tenure and immigration policies meant that cocoa production was expanded by clearing available rain forest, leading to environmental degradation.

However, starting in 1980, the price of cocoa plummeted. Excess cocoa supply on the world market due to entry of new producing countries and more efficient processing methods sustained a relative decline in the price of cocoa (Porto et al. 2011). Although there was a partial reversal in 2001 due to sociopolitical unrest in Côte d'Ivoire, changing stock-holding behavior of industries and lower yields, the world price of cocoa has never returned to the levels observed in the late 1970s. Throughout the 1980s and 1990s, CAISTAB managed to insulate cocoa and coffee farmers from the volatility of international prices. As international prices fell below the guaranteed farm-gate price CAISTAB surpluses turned into deficits. It became obvious that the prevailing pricing and marketing policies were not sustainable. This was inevitable to some the extent in that instead of sequestering the surpluses accumulated during the boom periods, these funds ended up supporting public expenditures for other activities (Barthelmy and Bourguignon 1996). Furthermore, the overvaluation of the CFA was a complicating factor to the extent that it implied a worsening of the terms of trade and a large erosion of government finances. Given the accumulated deficits, the government could not continue to guarantee producer price.

In response to these unfavorable conditions from the world cocoa market, the Government of Côte d'Ivoire initiated a reform process in 1987. This reform sought to reduce the role of the public sector in the domestic cocoa market and to encourage the creation of producers' organizations. The 1980s and 1990s are characterized by a series of efforts (with varying intensity) to *liberalize* the Ivorian economy. These efforts included a structural adjustment program, devaluation and privatization. In that context, CAISTAB was disbanded in 1999 and replaced by four different agencies to regulate and support the cocoa sector. Guaranteed farm-gate producer prices were replaced by indicative prices. In particular, the new institutional framework was designed to support cocoa farmers with market information and to help them create cooperatives in order to improve their bargaining power. While the 1994 devaluation succeeded in stimulating the economy, which grew rapidly between 1994 and 1999, by and large, the results have been disappointing in the sense that the reforms failed to improve producer prices and the competitiveness of the export crop sector. Over that period, producer prices stood at 45 percent of the export prices (Abbott 2009). It is hard to sort out the causes of this failure due to the fact that the country descended into a sociopolitical crisis shortly after the establishment of the new cocoa marketing arrangements.

Figure 2.2: Farm-gate Prices Relative to Indicative, World, and Export Prices, 2001-2009

a) Share of indicative prices　　b) Share of world and export prices



Source: Based on data from Kireyev (2010)

While the downward trend in world cocoa prices made administering producer prices untenable, the liberalization of the domestic cocoa market created the need for new institutions and services. The adoption of indicative farm-gate prices meant that prices paid by traders to farmers would vary over time, location and quality (Abbot 2013). This made it difficult for farmers to know what market prices were, and created a need for the provision of market information. Such a need was not felt when the same producer price prevailed everywhere in the country. As figure 2.2a shows, the farm-gate price actually received by cocoa farmers was consistently below the indicative price. In 2003 cocoa farmers got on average 65 percent of the indicative price. Only in 2007 did they receive a price close to 95 percent of the indicative price.

An important outcome of the cocoa pricing policy prevailing in 2001-2009 is that cocoa farmers in Côte d'Ivoire received on average 41 percent of world price and 44 percent of the export price, according to the data underlying in figure 2.2b. This is certainly the lowest share among major cocoa producing countries in West Africa[2]. In 2007-2008, for instance, farm-gate prices represented 70 percent of world prices in Ghana, 90 percent in Nigeria, and 85 percent in Cameroon (Kireyev 2010).

[2] This region produces about 70 percent of the world's cocoa supply.

In November 2011, the Government of Côte d'Ivoire initiated a new round of cocoa sector reforms (CTA 2012). The reforms seek to stimulate cocoa production and to secure the livelihoods of cocoa farmers through guaranteed minimum farm-gate prices. In January 2012, the *Conseil du Café-Cacao* (CCC) was established to regulate the sector and stabilize cocoa prices. The institution includes representatives of all stakeholders. The reform also involves a new marketing mechanism based on forward sales auctions aiming to ensure that at least 60 percent of the CIF price goes to cocoa farmers. The third component of the reform is a reserve fund at the Central Bank of West African States to cover risks associated with the operation of the price guarantee scheme.

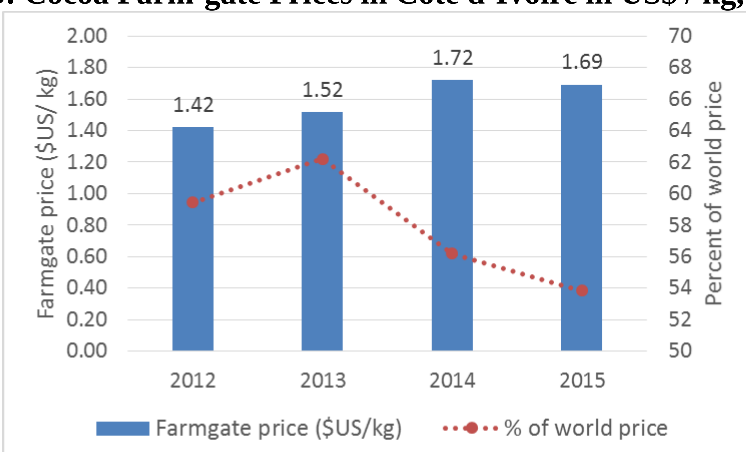
Table 2.1: World and Farm-gate Cocoa Prices in Côte d'Ivoire, 2012-2015

	World price	**Official Exchange rate**	**Farm-gate price**		
	(US$/kg)	(CFAF/US$)	(CFAF / kg)	($US/kg)	(% of world)
2012	2.39	510.5	725	1.42	59
2013	2.44	494.0	750	1.52	62
2014	3.06	494.4	850	1.72	56
2015	3.14	591.4	1000	1.69	54

Source: World Bank (Commodity Price Data based on International Cocoa Organization Secretariat).

In addition to fluctuating international cocoa prices, currency exchange rates play a role in setting farm-gate prices. The world price in US$ increased by 31 percent between 2012 and 2015, whereas the farm-gate price in CFAF increased by 38 percent, from 725 CFAF to 1000 CFAF. The discrepancy is even larger between 2014 and 2015, when the US$ world price increased by a modest 2.6 percent and the farm-gate price in CFAF increased sharply by 17.6 percent. Much of this large increase in the farm-gate price can be attributed to the recent decline of the CFAF against the dollar (Table 2.1).

Figure 2.3: Cocoa Farm-gate Prices in Côte d'Ivoire in US$ / kg, 2012-2015



Source: Calculations based on Commodity Price Data (International Cocoa Organization Secretariat; World Bank), and WDI (official exchange rate, period average).

Over the past four agricultural seasons, the farm-gate price as a share of the world price ranged from 54 to 62 percent[3], with an average value of 58 percent for the period. The farm-gate price has declined with respect to the world price in the last few years (figure 2.3). Over this period, the farm-gate price ranged from US$ 1.42 to US$ 1.69 with the maximum value of US$ 1.72 observed in 2014. Cocoa farmers sold at an average price of CFAF 830 (US$1.59) per kilogram during this period. The benefit incidence of these recent price changes will be discussed in Section 3.

Cocoa and Poverty

The importance of the cocoa sector for poverty reduction and shared prosperity is illustrated by the positive correlation between the producer price of cocoa and poverty incidence in Côte d'Ivoire in 1985-2008 (World Bank 2010). Periods of increasing poverty coincided with periods of falling prices. Similarly, periods of increasing cocoa prices matched up with periods of declining poverty. In particular, poverty among cocoa farmers follows the same pattern as the overall poverty incidence, and the former was significantly higher than the latter.

The most dramatic increase in poverty is associated with the 1989 price cut. In an effort to stabilize government revenue, CAISTAB cut the farm-gate prices for cocoa and coffee in half. Using the 1985 Living Standards Measurement Survey, Benjamin and Deaton (1993) estimate the impact of this price cut on welfare and income distribution. The cocoa farm-gate price dropped by 50 percent from CFAF 400 per kg in 1989 to CFAF 200 in 1990 and stayed at that level for the next three years. That was the first time in nearly thirty years that the government cut cocoa producer prices. As a result of this price cut, many households suffered a significant loss of income. However, because cocoa (and coffee) farmers were scattered throughout the income distribution, these cuts were not likely to have induced a significant effect on the income distribution.

Cogneau and Jedwab (2012) study the same price cuts focusing on the impact of cocoa price shock on educational and health outcomes of children of cocoa farmers. These authors use empirical strategies to control for confounders, and household level data collected before and after the price cut[4]. They present credible evidence that the cocoa price shock had a strong, significant and negative impact on school enrollment, especially for children between 5 and 7 years of age. They also find that the price shock may have increased stunting for children 5-11 years old. This assessment clearly underscores the importance of cocoa sector policies for the socioeconomic development of Côte d'Ivoire.

Clearly, indicative pricing was not as effective in improving living standards among cocoa farmers as the government had hoped. The same analysis revealed that poverty incidence was highest among farmers compared to other occupational groups. It was estimated at 60 percent among farmers, 25 percent among craftsmen, people employed in services and sales, and 10 percent among professionals (World Bank 2010). Other confounding factors such as the sociopolitical

[3]As annual prices are used in these calculations, the results can differ from those used by CCC in targeting farm-gate prices at or above 60% of world prices.

[4] In particular, they compare the variation in outcomes (e.g. school enrollment, child labor, height stature, and incidence of illness.) of cocoa farmers' children with that of similar non-cocoa farmers' children, across time and within the same geographical area.

conflict that erupted in the early 2000s have certainly played a role in the production of these outcomes. However, cocoa pricing policy was a significant contributory factor.

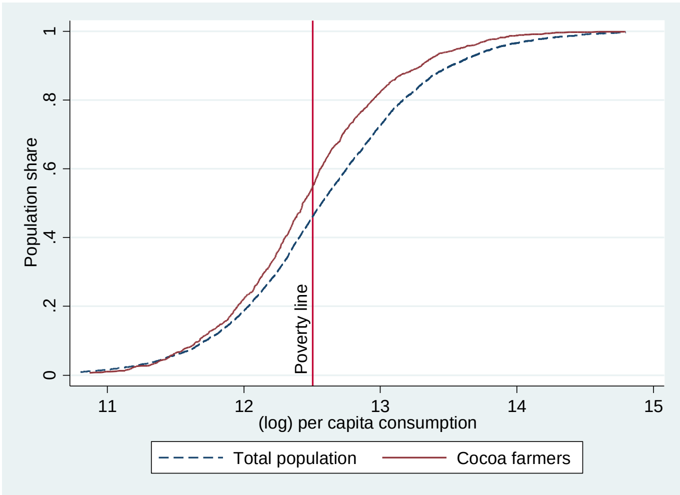
Improving smallholder farmers' income from cocoa has been one of the key policy objectives driving government intervention in the cocoa sector. Ironically, the armed conflict that erupted in 2002 and split the country into a rebel-held region in the North and a government-controlled territory in the South produced a "natural experiment" for the understanding of the potential effect of an export tax reform on the living standard of cocoa farmers. Prior to the partition, the export tax on cocoa beans prevailing over the entire country was CFAF 220 per kg. Between 2002 and 2007, that rate was maintained in the South while it dropped to CFAF 50-150 in the North. Using the 2002 and 2008 household surveys and a credible identification strategy, Soumahoro (2014) analyzes the causal effect of this exogenous variation in export tax on cocoa farmers' average consumption. He finds that the living standard of cocoa farmers in the North improved significantly as a result of their exposure to lower export taxes. The author also shows that pass-through of international prices to farmers is the key causal mechanism linking the variation in export taxes to farmers' consumption. Indeed, he shows that farmers residing in the low tax zone got, on average, an additional CFAF 39 on each kg of cocoa beans sold.

While recent increases in the guaranteed cocoa farm-gate prices are expected to increase the income of cocoa-farming households, the extent and distribution of benefits is not entirely evident. In the following section, the likely poverty and distributional impacts of the recent price increases will be discussed.

3. BENEFIT INCIDENCE ANALYSIS

Benefit incidence analysis seeks to estimate the distributional effects of an intervention among policy-relevant socioeconomic groups. The analysis here focuses on households at different segments of the welfare distribution. We therefore start with a description of the distribution of per capita consumption based on the 2015 ENV household survey.

Figure 3.1: Distribution of Economic Welfare Among Cocoa Farmers and the Total Population in Côte d'Ivoire, 2015



Source: Authors' calculations based on 2015 ENV data.

Poverty and Inequality Profile

Cocoa farmers tend to be less well off than the general population. Figure 3.1 shows the cumulative distribution functions (CDFs) of (log) per capita consumption for the overall population and for cocoa farming households. The fact that the CDF for the overall population lies nowhere above that for cocoa farmers[5] over a wide range of the support (below the poverty line) shows that it is more likely to find poor households among cocoa farmers than in the general population. Even among non-poor households, cocoa-farmers tend to be less well-off. A comparison of the distribution of per capita consumption in rural areas with that in urban areas (not shown) also indicates that the living standard of rural households tend to be lower than that of urban households, confirming that poverty is predominantly a rural phenomenon in Côte d'Ivoire.

Poverty is higher among agricultural households than non-agricultural households, and among rural areas than urban areas (table 3.1). According to official poverty estimates for 2015, 46 percent of the population lives below the poverty line. Poverty is concentrated in rural areas with 57 percent of rural areas living in poverty, compared to 35 percent in the urban areas. Consistent with figure 3.1, poverty is higher among cocoa farmers than in the general population for all measures considered here. While poverty incidence is higher among cocoa farmers in the South, the intensity and severity of poverty is higher among cocoa farmers in the North.

Table 3.1: Profile of Poverty and Inequality in Côte d'Ivoire in 2015

	Poverty headcount (%)	Poverty gap index	Squared poverty gap	Gini
Agricultural household	56.5	20.3	9.9	37.3
Cocoa farmer	54.9	18.8	8.9	35.6
in the South *	55.2	18.9	9.0	35.8
in the North *	52.7	20.4	9.8	31.1
Non-cocoa farmer	57.0	20.8	10.3	37.8
Non-Agricultural household	35.5	12.1	5.9	41.0
Rural	56.7	21.4	11.0	38.1
Urban	35.4	11.0	4.9	40.3
Côte d'Ivoire	46.2	16.3	8.0	40.6

* For this analysis, South includes the districts of Bas-Sassandra, Comoe, Lacs, Lagunes, Goh-Djiboua, Montagnes, and Sassandra-Marahoue, and excludes autonomous districts of Abidjan and Yamoussoukro. North includes Denguele, Savanes, Vallée du Bandama-Bouake, Woroba, and Zanzan districts.
Source: Authors' calculations based on the 2015 ENV data.

As far as inequality is concerned, the overall Gini coefficient suggests that inequality in Côte d'Ivoire remains stable in the neighborhood of 40 percent. It is higher in urban areas than in rural

[5] In other words, the distribution for everyone other than cocoa farmers (which also coincides with the overall distribution) dominates the distribution for cocoa farmers.

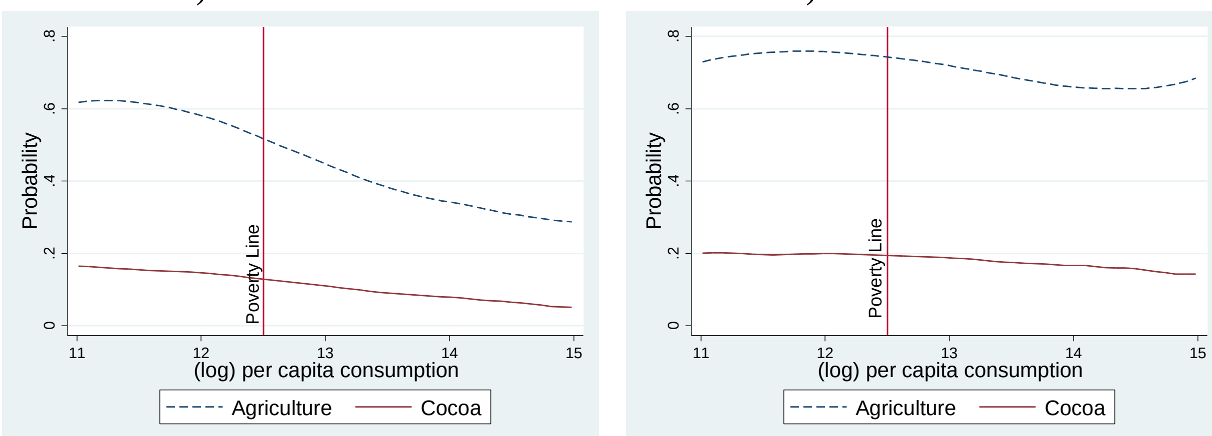
areas, and higher among non-cocoa farmers than among cocoa farmers. If one focuses on cocoa farmers, the results indicate that inequality is higher in the South than in the North.

The Likelihood of Engaging in Cocoa Farming

The welfare impact of commodity price changes or shocks depends on two basic factors: *exposure* and the *response* to the shock by socioeconomic agents. Understanding exposure to cocoa price shocks requires measuring the share of the poor and non-poor households that are engaged in cocoa production. The curves presented in figure 3.2a and 3.2b provide this information for the entire population and for rural households, respectively. The curves show the probability of households engaging in agriculture or cocoa farming as a function of per capita consumption.[6]

Figure 3.2: Participation in Agriculture and Cocoa Farming in Côte d'Ivoire, 2015

a) All households b) Rural households



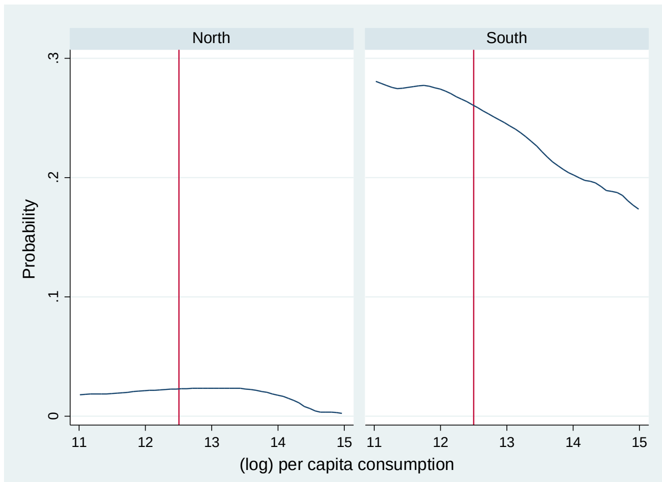
Source: Authors' calculations based on 2015 ENV data.

In the overall population, poor households are more likely than non-poor households to engage in agriculture or in cocoa farming (figure 3.2a). The probabilities of engaging in agriculture and in cocoa farming are the highest among the poorest households and fall steadily as per capita consumption increases. At the maximum, poor households are close to 60 percent likely to engage in agriculture compared to 30 percent for the richest households. While the likelihood of engaging in cocoa farming is higher for poor households than for non-poor households, it is far below the probability of engaging in agriculture at all levels of per capita consumption. Its maximum value is slightly below 20 percent and declines as welfare increases.

[6] Each curve is a probability regression where the dependent variable is a binomial variable indicating whether or not the corresponding household engages in the activity under consideration, and log per capita consumption is the explanatory variable. The regression estimates the probability of engaging in the activity as a weighted average of the values of the dummy dependent variable near a chosen value of per capita consumption (see methodological appendix for details). These averages are computed over the entire welfare distribution in a manner analogous to a moving average. The weights are given by the chosen kernel function is such a way that observations that are far from the focal point receive smaller weights relative to observations that are near the focal point. Distance is measured in terms of the chosen bandwidth which will determine the smoothness of the resulting curve.

Cocoa farmers are found throughout the welfare distribution. The probability of engaging in agriculture is slightly higher for poor rural households than for non-poor households. Similarly, the probability of engaging in cocoa farming among rural households decreases only slightly as per capita consumption increases, and it remains at nearly 20 percent throughout the welfare distribution (figure 3.2b). The wide gap between the probability of engaging in agriculture and that of engaging in cocoa farming indicates the importance of other agricultural activities besides cocoa farming.

Figure 3.3: Regional Participation in Cocoa Farming in Rural Côte d'Ivoire, 2015



Source: Authors' calculations based on 2015 ENV data.

Consistent with the fact that cocoa cultivation is better suited to the southern region of Côte d'Ivoire, the probability of engaging in cocoa farming is much higher in the rural South compared to the rural North (figure 3.3). While some cocoa farmers exist in the North, cocoa cultivation is extremely limited in that region. Furthermore, the downward slope to the curve for the South indicates that the probability of farming cocoa is greater than 25 percent among poor households and it declines gradually to less than 20 percent among non-poor households as per capita consumption increases.

Welfare Impact of Cocoa Farm-gate Price Increases

While the probability of participation provides information about the share of households engaging in cocoa farming, the benefit ratio is the core measure that summarizes the extent of the welfare impact of a cocoa price shock. Since the benefit ratio is the proportion of cocoa income to total consumption, it can be interpreted as the extent of a household's exposure to cocoa price shocks.

Relatively speaking, poor cocoa farmers are more exposed to price shocks, both positive and negative, than non-poor cocoa farmers. Among active cocoa farmers reporting cocoa income, the benefit ratio as a function of (log) per capita consumption clearly exhibits an inverse relationship (figure 3.4a).[7] Among poor cocoa farmers, the benefit ratio ranges from about 75 percent to about

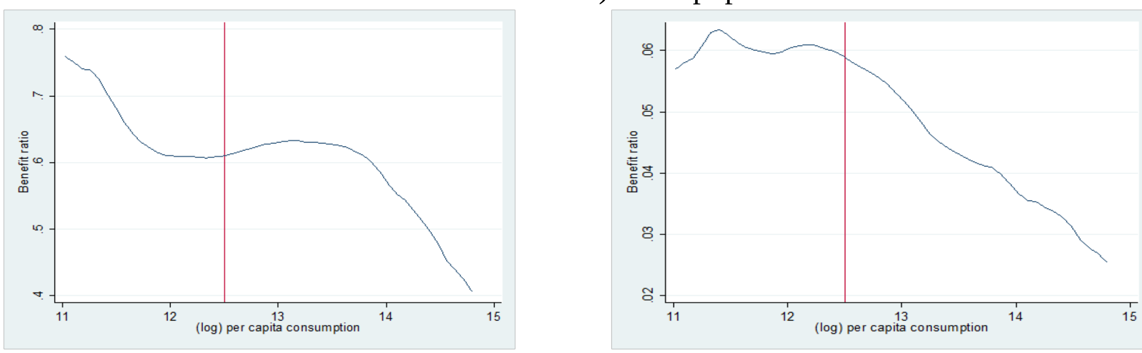
[7] The plot is a non-parametric kernel regression of the benefit ratio on log per capita consumption. It is computed in a manner analogous to the probability of participation. Thus it is a local measure of the response of household welfare

60 percent. Past the poverty line, that is, for non-poor households, the benefit ratio remains above 60 percent for a significant segment and then falls steadily to about 40 percent for the richest cocoa farmers. The level of the income elasticity curve suggests that on average cocoa farmers stand to gain significantly from the increase in farm-gate price. The fact that the curve is downward sloping with respect to per capita consumption indicates that poorest cocoa farmers benefit more on average from price increases, relative to non-poor cocoa farmers. In a similar fashion, poor cocoa farmers risk to lose more from price decreases.

To illustrate this in terms of welfare gains, consider a 20 percent increase in the cocoa farm-gate price. The welfare gains among poor households would range from about 12 to 15 percent, while, the welfare gains among non-poor cocoa households would range from about 8 to 12 percent.

Figure 3.4: Benefit Ratio of Cocoa Farm-gate Price Changes

a) Active cocoa farmers b) Total population



Source: Authors' calculations based on 2015 ENV data.

The benefit ratio for the overall population (figure 3.b) is also downward sloping but much smaller in magnitude compared to that for cocoa farmers. It hovers around 6 percent for poor households. Past the poverty line, the benefit ratio falls steadily towards 2 percent. Thus, the welfare gains for the overall population would be expected to be limited reflecting the fact that cocoa farming households represent only a fraction of the overall population.

The increase in farm-gate prices can offer significant welfare gains for cocoa farmers. Figure 3.5 shows the distribution by quintile of nominal per capita consumption before and after the 17.6 percent price increase for the 2015/16 season. The absolute gains increase with per capita consumption, and it is estimated that among the poorest (first quintile), cocoa farmers gain about CFAF 10,000 per person on average from the cocoa price increase compared to CFAF 64,000 per person among the richest (fifth quintile). Given that cocoa farmers are found throughout the distribution, the figure illustrates that the price increase has minimal effect on distributional changes. Moreover, the Gini coefficient bears no significant changes (35.4 to 35.5).

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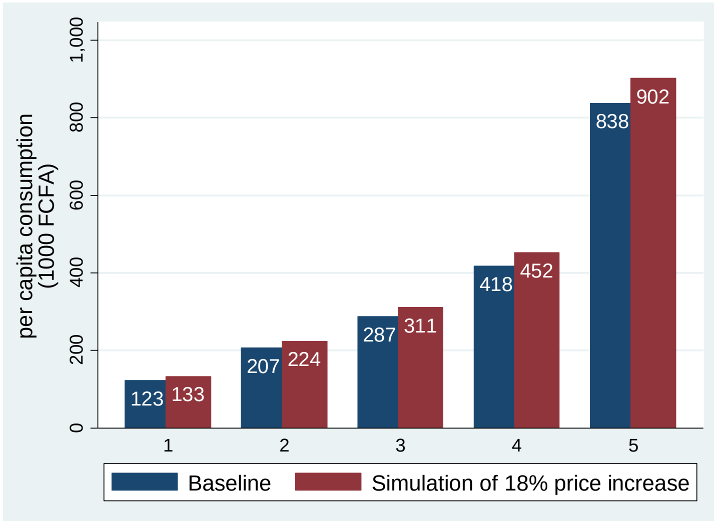
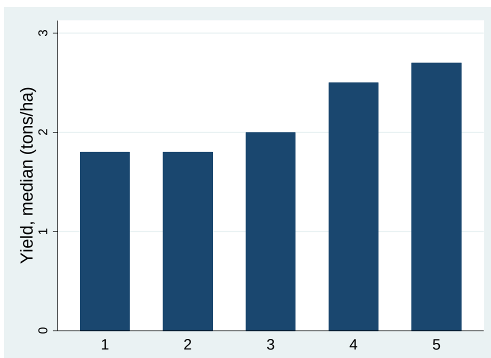
to a change in the cocoa farm-gate price. This estimation is sensitive to outliers, so benefit ratios were limited to a value less than 2.5 based on the empirical distribution of benefit ratios in the data.

Figure 3.5: Simulation of Average Welfare Gains among Cocoa Farming Households by Consumption Quintile



Source: Authors' calculations based on 2015 ENV data.

Figure 3.6: Median Cocoa Yield by Consumption Quintile, 2015[8]



Source: Authors' calculations based on 2015 ENV data.

While the benefit ratio indicates that poor cocoa farmers would gain more in terms of welfare relative to non-poor cocoa farmers, the lower estimated cocoa yield among poorer households (figure 3.6) is a reminder that there may be supply side factors that constrain the ability of the poor to increase production and take greater advantage of price increases. After all, cocoa revenue is the product of the quantity supplied and the going price. For a given farm-gate price, farmers could increase revenue by increasing productivity. They could also increase profit by reducing cost. The estimated yield by consumption quintile in figure 3.6 shows median yield increasing from the

[8] The calculated yield levels from the 2015 ENV data appear higher than one might expect for cocoa. This may be due to measurement errors, in particular for the plot areas reported by respondents for cocoa production, which is often a challenge with household surveys.

poorest to richest quintiles. The yield levels estimated from the 2015 ENV data are much higher than expected and likely due to measurement errors often associated with land area in household surveys. Assuming this error is independent of welfare level, the trend of increasing yield at higher welfare levels may still hold. These considerations suggest that pro-poor pricing policy would be more effective if accompanied by well-targeted extension services to improve yield and quality of cocoa production. In general, such a policy should account for the key constraints facing cocoa farmers.

Poverty Impact

Given their higher average benefit ratios, poorer cocoa farmers stand to earn the largest relative gains from cocoa price increases. Conversely, they also stand to lose most in the case of an adverse price shock. How much poverty reduction can an increase in the cocoa producer price deliver? We simulate the poverty implications of a farm-gate price increase on the basis of the estimated benefit ratios for each household. Since the benefit ratio is the income from cocoa sales over total household consumption, we estimate the increase in consumption by multiplying the initial per capita consumption by the benefit ratio and the *real* percentage change in farm-gate prices. With the resulting simulated per capita consumption for all households, the poverty indicators can then be estimated using the original poverty line.

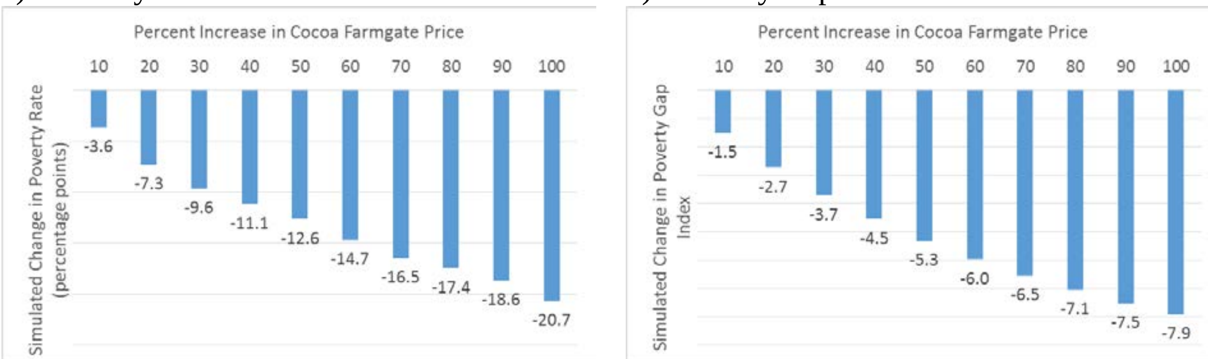
With respect to the increase in farm-gate prices from 850 CFAF (2014/15 season) to 1000 CFAF (2015/16 season), representing a 17.6 percent increase in nominal prices, simulation results indicate a 6 percentage point drop in the poverty rate among cocoa farming households from 55 percent in 2015 to 49 percent in 2016, all else being equal. This assumes that the quantity of cocoa produced by a household remains the same. Similarly, the poverty gap index, representing the depth of poverty, falls from 18 to 16. This poverty simulation accounts for inflation between 2015 and 2016, estimated at 2.1 percent[9]. These are significant gains in poverty reduction among cocoa farmers consistent with the welfare gains discussed above.

The simulated poverty impact among cocoa farmers can be extended to a series of hypothetical real cocoa price increases ranging from 10 to 100 percent. The impact of these real price changes on the poverty headcount rate and on the poverty gap index are presented in figure 3.7a and 3.7b, respectively. It is clear that increasing the cocoa farm-gate price has great potential to reduce poverty among cocoa farmers. The larger the price increase, the greater the induced poverty reduction for both measures, the headcount and the poverty gap index. In particular, poverty incidence among cocoa farmers is projected to fall by 3.6 percentage points for a 10 percent price increase and by 20.7 percentage points for a 100 percent increase, all else being equal. Similarly, the poverty gap index decreases by 1.5 to 7.9 points, respectively.

[9] Inflation, average consumer prices, from IMF World Economic Outlook database (3/2016 update).

Figure 3.7: Simulation of Poverty Impacts among Cocoa Farmers of Real Farm-gate Price Increases

a) Poverty Headcount b) Poverty Gap



Source: Authors' calculations based on 2015 ENV data.

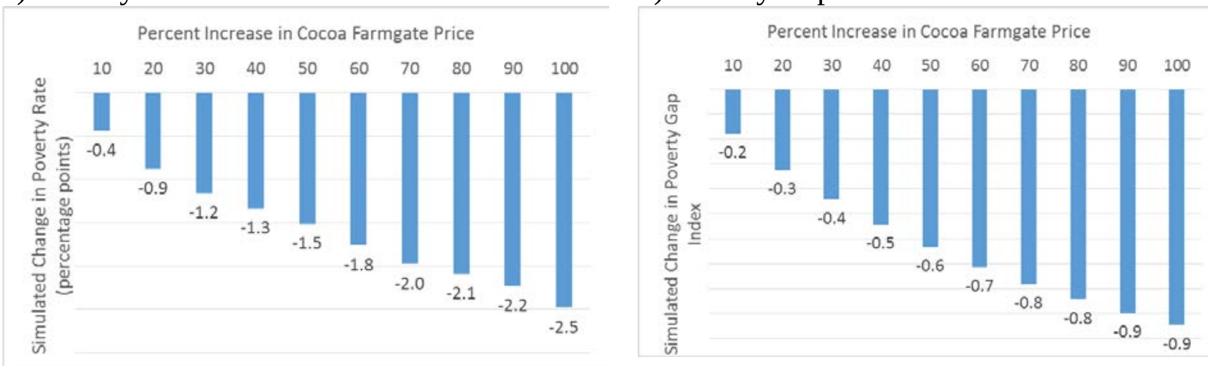
Turning to the poverty impacts for the overall population, the farm-gate price increase between the 2014/15 and 2015/16 seasons translates into a relatively small drop in the poverty rate of less than one percentage point, from 46.1 percent to 45.4 percent[10]. Also, the overall poverty gap index exhibits only a slight decrease from 16.2 to 15.9. Both of these changes are statistically insignificant. The overall reduction in poverty is relatively small due to the fact that cocoa revenues contribute a relatively small share of the total consumption in the general population. The configuration of the benefit ratio or income elasticity curve for the overall population indicates that those who gain the most are located far below the poverty line and their gain in welfare is not big enough to bring them past the poverty line. The small reduction in overall poverty may also be explained by that fact that the methodology focuses on first-order effects and does not account for general equilibrium effects.

The simulated poverty impact for the total population can also be extended to a series of hypothetical real cocoa price increases. The pattern of poverty reduction in the general population depicted in figure 3.8 is similar to the one estimated for cocoa farmers. However, as one might expect, the magnitudes are smaller for the general population due to the smaller share of cocoa farmers in the overall population. It can be seen from figure 3.8 that when the increase in the real farm-gate price ranges from 10 to 100 percent, the overall poverty incidence would decrease by 0.4 to 2.5 percentage points. Similarly the poverty gap index would fall by about 0.2 to 1 percentage points. One must keep in mind, though, the methodology used for these simulations is valid for small changes in the cocoa price. The poverty impact estimates associated with a price change ranging from 50-100 percent may therefore be significantly biased. Nevertheless, such estimates are still useful in highlighting the limitations of increasing the cocoa farm-gate price as the only tool for reducing poverty in Côte d'Ivoire.

[10] These poverty estimates differ slightly from those in Table 3.1 due to the exclusion of 72 observations with a benefit ratio above 2.5, which were considered outliers. Sensitivity analysis of the simulations with and without dropping indicate that the results are robust. Also, the poverty impact simulations are based on the increase in farm-gate in real prices rather than nominal prices to account for the fact that the poverty line would need to be updated for inflation between 2015 and 2016.

Figure 3.8: Simulation of Poverty Impacts for the Total Population of Real Farm-gate Price Increases

a) Poverty Headcount b) Poverty Gap



Source: Authors' calculations based on 2015 ENV data.

An important normative question arises about the pro-poorness of the outcome associated with the current cocoa price policy reform. Is the outcome pro-poor? If so, to what extent? Generally speaking, a policy outcome is considered pro-poor if it is favorable to the poor in some sense. The pro-poorness of a policy intervention hinges critically on the chosen value judgments. The relative approach to pro-poorness focuses on *relative gains* in welfare and declares a policy outcome pro-poor if the poor gain more relative to the non-poor. The configuration of the income elasticity curve indicates that any increase in the cocoa farm-gate price would be pro-poor in this sense for the general population and for cocoa farmers. The absolute approach to pro-poorness assesses policy outcomes on the basis of absolute gains so that an intervention is pro-poor if it leads to poverty reduction for some choice of a poverty measure. Again, our results clearly show significant poverty reduction among cocoa farmers and a small reduction in the general population for the reasons discussed above. Therefore, the policy outcome should also be considered somewhat pro-poor according to the absolute approach.

To assess the extent of pro-poorness in the context of the absolute approach, we compare the poverty reduction associated with the price increase to a benchmark case where all relevant households have the same benefit ratio, namely the median benefit ratio. The poverty incidence among the cocoa farmers in the benchmark case is about 49.3 percent. Thus the cocoa price increase will be considered significantly pro-poor since it leads to an absolute reduction in poverty that is greater than in the benchmark case of distributional neutrality. In the case of the general population, the price increase is weakly pro-poor because the induced poverty reduction (45.3 percent) is not significantly different from the benchmark outcome (45.4 percent).

4. CONCLUSION

Incidence analysis based on the 2015 ENV household survey data suggests that recent increases in the cocoa farm-gate price lead to significant welfare gains and some poverty reduction among cocoa farmers, *ceteris paribus*. Furthermore, the current guaranteed farm-gate price setting scheme provides cocoa producers with a higher share of the international cocoa price compared to the previous period of non-binding indicative prices. These positive findings lend support to the recent interventions by policymakers in Côte d'Ivoire in the domestic cocoa market.

A broader policy question that should be addressed in this context is: *What is the most effective way to intervene in the cocoa sector*? Answering this question must account for both the constraints that the sector faces and the overall policy objective of poverty reduction and shared prosperity. The concluding remarks made here are therefore limited to key considerations that policymakers may want to take into account as they search for strategies to improve the capacity of the cocoa sector to drive poverty reduction and boost shared prosperity in Côte d'Ivoire.

Any evaluation of public sector interventions should first address the question of whether there is a rationale for the government to intervene in the activity in question (Devarajan et al. 1997). Welfare economics suggests that market failure and equity are the two basic justifications of government intervention. Thus government intervention is warranted if it is aimed at a significant market imperfections or at addressing equity issues. Indeed, whenever there are imperfections of competition or information, or when markets are incomplete or nonexistent there is a potential for government actions to improve living standards (Stiglitz 1997). The Government of Côte d'Ivoire does indeed have a rationale for setting the cocoa farm-gate price. In a market economy, prices play an *allocative* role as well as a *distributive* role. This dual role of prices combined with relatively high poverty among cocoa farmers, provides the government a clear rationale for designing a cocoa price policy. However, evidence-based policymaking requires that such a decision be based on a rigorous situation analysis followed by a careful comparison of feasible options in terms of the associated costs and benefits.

The finding that the recent increase in cocoa farm-gate prices is somewhat pro-poor among cocoa farmers is encouraging. It is likely that this poverty impact could be amplified with additional policy interventions to increase the capacity of cocoa farmers to respond adequately to a change in incentives transmitted from the world market. There is evidence that reducing taxation on export crops and allowing meaningful *pass-through* from world market prices to farm-gate prices are effective instruments to ensure that farmers respond optimally to changing market circumstances. While cocoa taxation has been declining since 2010, the current rate of about 22 percent of the CIF price is still higher than the one faced by other economic activities and significantly above the tax rates observed in neighboring cocoa producing countries (World Bank 2015).

While poor households, and particularly poor cocoa farmers stand to gain most from a cocoa farm-gate price increases, they also stand to suffer most from an adverse price shock. Given the volatility in international prices and exchange rates, history tells us there will certainly be periods when the government might not be able to guarantee a decent farm-gate price. This possibility creates a need to have other mechanisms, such as social protection systems, in place for such circumstances to sustain the poverty reduction gains that are made.

The overall policy goal of poverty reduction and boosting shared prosperity means that policy interventions in the cocoa sector must be embedded in a coherent policy framework for agricultural and rural development. One of the facts highlighted in this paper is that poverty is concentrated in rural areas. Since cocoa farmers are only a fraction of the rural population, this fact dampens the overall poverty effect of the farm-gate price increase. While an expanded analysis of other major commodities would be helpful, it would be important to also confront factors which constrain the performance of the rural economy. A key constraint to agricultural development in Côte d'Ivoire is low productivity of the cocoa sector. Productivity constraints stem from such factors as limited access to inputs, lack of relevant research and development, weak extension services, poor transportation and storage infrastructure, and generally poor provision of relevant public goods. These issues should be addressed through a coherent policy framework that can be implemented effectively by accountable institutions to increase the role of agriculture as an engine of inclusive growth in Côte d'Ivoire.

5. APPENDIX

Methodology

This appendix presents the methodological approach we follow to analyze the first-order welfare and poverty impacts of cocoa pricing policy reform in Côte d'Ivoire. We frame the analysis within the logic of *benefit incidence analysis* which seeks to answer the following basic question: Who benefits from the price change induced by the reform, and to what extent? Answering this question entails mapping the net benefits from the policy reform onto the distribution of the living standard. To do this, we need to estimate the distribution of the living standard from the available household data, namely the 2015 household survey. We use per capita consumption (adjusted for regional price differences) as a measure of the living standard of a household. Furthermore, we need to compute the following measures and their association with per capita consumption: (i) the probability of being engaged in cocoa farming, (ii) the extent of exposure to cocoa price shocks, and (iii) the income effect of a price shock. We follow Benjamin and Deaton (1993), Deaton (1989), and Budd (1993) who use nonparametric kernel methods to estimate density functions and to analyze the association between the outcomes of interest and per capita consumption. The estimation of the poverty impact is based on Essama-Nssah (2007).

Kernel Averaging

Let y be a response or outcome variable of interest that is believed to depend on another variable x. Suppose we are interested in the relationship between y and x. The conditional expectation function (CEF) provides a natural framework for summarizing empirical relationships because within the class of all functions of some variables x, the CEF is the best predictor of an outcome variable y given x (Angrist and Pischke 2009). However, in many situations, global parametric models of association between variables do not fit the data very well. In such cases, *smoothing methods* allow the fitted curve to take a more general form that might better fit the data at hand (Loader 2005). In other words, smoothing methods allow the data "to speak for themselves" as much as possible.

All nonparametric estimation methods used in this paper are based on kernel averaging. This is a smoothing technique which is akin to taking a moving average. The basic idea behind these techniques involves sliding a "*window*" across the data along the x-axis and taking some average of the response variable for all observations in the window. The result is an estimate of the value of the response variable associated with the mid-point of the band (or window). The choice of the size of the window, or the *bandwidth* determines how near observations have to be to a particular value of x in order to contribute to the average at that point (Deaton 1989)

Let $m(x) = E(y|x)$ represents the conditional expectation function of y given x. Suppose we have a sample on n observations on both variables. Then, a local estimate of the regression corresponding to a point x can be generally written as follows,

$$\widehat{m}(x) = \sum_i^n w_i(x, x_i) y_i \qquad \text{(A1)}$$

Where $w_i(x, x_i)$ is some weighing function. This weighing function generally depends on the bandwidth and may be specified in such a way that observations outside the window receive a weight of zero.

The estimator (A1) is referred to a kernel estimator when a kernel function is used as weighing function. Given a point x in the domain of the function describing the expected response, one may define a simple smoothing window as the open interval $(x - h, x + h)$ where h is the bandwidth. The kernel estimate of the expected response is a weighted average of the values for the response variable corresponding to the observations (on the predictor) within the smoothing window. The weights are equal to:

$$w_i(x, x_i) = \frac{K\left(\frac{x_i - x}{h}\right)}{\sum_{j=1}^{n} K\left(\frac{x_j - x}{h}\right)} \qquad \text{(A2)}$$

Where K() is a kernel function.

As a weighting function, the kernel function should have the following properties: (i) be positive, (ii) integrate to unity over the band, (iii) symmetric around zero so that points below x get the same weight as those an equal distance above, (iv) decreasing in the absolute value of its argument. The two commonly used kernel functions in applied work are the Gaussian and the Epanechnikov. The Gaussian Kernel is defined by the following expression.

$$K(u) = \frac{1}{\sqrt{2\pi}} exp\left(\frac{u^2}{2}\right) \qquad \text{(A3)}$$

This weighing function uses all the information in the sample in the computation of each local average, but let the weights decline with the distance between x and x_i.

The Epanechnikov kernel is defined as:

$$K(u) = \frac{3}{4}(1 - u^2)I(|u| \leq 1) \qquad \text{(A4)}$$

Where I() is an indicator function which is equal to 1 if the argument is true, and zero otherwise. This kernel uses a moving window within the sample selecting only the data points within a fixed bandwidth.

The kernel estimator implied by the weights given by (A2) is known as the Nadaraya-Watson estimator (Ahamada and Flachaire 2010). Furthermore, kernel averaging can be interpreted as running a weighted regression of an outcome variable on a constant, where the weights are given by some kernel function.

Kernel Density Estimation

The nonparametric estimation of the density function presented in the text is based on the idea of kernel averaging. All one needs to do is to choose some interval or “band” and to count the points in the band around each x and normalize the count by the sample size multiplied by the band’s width. Again, the whole procedure can be viewed as sliding the band (or window) along the x-axis, calculating the fraction of the sample per unit within the band, and plotting the result as an estimate of the density at the mid-point of the band (Deaton 1997).

The kernel estimator for a density function $f(x)$ can be written as follows:

$$\hat{f}(x) = \frac{1}{hn}\sum_{i=1}^{n} K\left(\frac{x_i - x}{h}\right) \tag{A5}$$

Where again h is the bandwidth representing the smoothing parameter, n is the sample size and $K()$ is some kernel function. In this context, the response variable is the relative frequency associated with observations on a given variable.

The Probability of Engaging in Cocoa Farming

The relevant response variable in this case is a binary variable taking the value of 1 if the household engages in cocoa farming and zero otherwise. The conditional expectation of this binary variable given per capita consumption is the probability of interest. It can be locally estimated through kernel averaging as explained above. These probability regression help us determine who are engaged in cocoa farming and where they are located in the income distribution (Benjamin and Deaton 1993). On the basis of this information, we can tell how many of the poor households are engaged in cocoa farming.

The Degree of Exposure to Cocoa Price Shocks

Heckman (2008) suggests that policy intervention may be viewed as a mechanism which assigns *incentives* (e.g. taxes, subsidies or resource endowments) and *eligibility* for treatment. These incentives and eligibility are bound to affect the behavior of relevant socioeconomic agents. These considerations underscore the importance of individual behavior and social interaction in explaining policy outcomes. Potential outcomes therefore depend on reactive decisions made by individuals in response to incentives created by the *rules of the game* that govern policy implementation.

The welfare and poverty impacts for a household of a change in the farm-gate price of cocoa therefore depend on the degree of exposure to cocoa price shocks. This degree of exposure is a function of whether or not the household in engaged in cocoa farming, and conditional on being engaged on the supply response to the price shock. In principle, the supply response is determined by own and relevant cross price elasticities for cocoa. This information is not available. We therefore stick to the much simpler approach that assumes optimal behavior on the part of the household both on the production and the consumption side.

Under this assumption, the supply response induced by a small change in the cocoa price is equal to the derivative of the profit function with respect to price (Benjamin and Deaton 1993). This is simply equal to the observed output, say, q. This is the degree to which a given household is exposed to cocoa price shocks.

A Measure of Welfare Impact

Let y stand for household income composed of profit from farming activities (including cocoa farming), labor earnings and other income (e.g. transfers). Thus the change in farm household income induced by the change in farm-gate cocoa price is equal to the observed output multiplied by the change in price. That is: $dy = qdp$, where p is the farm-gate cocoa price. High output farmers are more exposed to changes in cocoa prices, *ceteris paribus*.

The change in *household welfare* induced by this change in income is also derived under the assumption that the household behaves optimally on the consumption side. In particular, the household buys the best consumption bundle it can afford given total income. Thus, the proportional change in consumption expenditure, c, that is consistent with the change in the farm-gate price is equal to the following expression (Benjamin and Deaton 1993).

$$dlnc = \frac{qdp}{c} = \frac{pq}{c} dlnp \tag{A6}$$

By definition of elasticity, (A6) implies that, the ratio of sales to total consumption is equal to the elasticity of the farm household's potential consumption with respect to the farm-gate price. Formally, we express that fact as:

$$\eta_{cp} = \frac{pq}{c} \tag{A7}$$

To analyze how the welfare impact varies with per capita consumption, we run a kernel regression based on (A1) and (A2).

Poverty Impact

To assess the poverty implications of the farm-gate we must choose a measure of poverty. Let z stand for the poverty line and x for per capita consumption. Also let $\psi(x|z)$ be a measure of poverty for household with real per capita consumption equal to x. Assume that: the poverty measure is equal to zero when *per capita* consumption is greater or equal to the poverty line, and that the measure is a decreasing convex function of *per capita* consumption given the poverty line. This means that the first-order derivative of this measure with respect to x, is negative given z. In other words, $\psi'(x|z) = \frac{\partial\psi(x|z)}{\partial x} < 0$. Given the definition of (A7), the change in poverty for this household induced by the price change can be approximated by (Essama-Nssah 2007): $\frac{\partial\psi(x|z)}{\partial p} \cong x\eta_{cp}\psi'(x|z)$.

For changes in aggregate poverty, we use members of additively separable measures defined by the following expression.

$$\theta = \int_0^z \psi(x|z)f(x)dx \tag{A8}$$

This class of poverty measures includes the Foster, Greer and Thorbecke (FGT) family characterized by the following deprivation function: $\psi_\alpha(x|z) = \left\{\max[\left(1 - \frac{x}{z}\right), 0]\right\}^\alpha$. When α is equal to zero, one or two, equation (A8) leads respectively to a measure of poverty incidence (head count), depth (deficit) or severity.

The change in overall poverty induced by a change in farm-gate prices can be estimated as follows.

$$\Delta\theta = \int_0^z x\eta_{cp}(x)\psi'(x|z)f(x)dx \qquad \text{(A9)}$$

Whether or not this change is considered *pro-poor* depends on the standard of comparison selected. If one follows the absolute approach to pro-poorness, then the above variation in poverty would be pro-poor as long as it is negative. Following Osmani (2005), an alternative approach would be to decide that a change in the farm-gate price is pro-poor if it induces an absolute change in poverty that is considered an improvement relative to what would have been observed in a benchmark case. Such a benchmark could be the case where a percentage change in the farm-gate price would have the same impact on real income for all. See Essama-Nssah (2007) for an elaboration on this point in the context a poverty-focused evaluation of commodity tax options.

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