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ORIGINAL ARTICLE OPEN ACCESS

Pass-Through of Cocoa Prices Along the Supply Chain: What's Left for Farmers in Côte d'Ivoire?

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ABSTRACT

Most cocoa farmers in Côte d'Ivoire are trapped in a cycle of poverty and farming practices that degrade the environment. This paper aims to provide an in-depth understanding of the price formation process for cocoa at each stage of the supply chain in the world's largest cocoa-producing country. By examining potential inefficiencies that affect price pass-through and could explain exceptionally low farm-gate prices, the study seeks to identify segments of the supply chain where policy or market interventions could improve outcomes for farmers. Our approach couples econometric analyses using secondary cocoa price data and primary farm household survey data with qualitative assessments of institutional factors specific to the cocoa value chain in Côte d'Ivoire. Notwithstanding the country's highly regulated system of setting cocoa prices, we do not find evidence of inefficiencies that would explain persistently low farm-gate prices. Nor do we find that the recently introduced 'Living Income Differential', a price surcharge on internationally traded cocoa, has benefited farmers. We conclude by advocating that the international cocoa industry strengthens its development programmes in cocoa-growing communities, and that the government supports these efforts with better provision of infrastructure and other public goods. Such efforts could ultimately serve to increase the opportunity cost of cocoa production, drawing farmers into other employment sectors while improving the resilience and livelihoods of those who remain.

JEL Classification: Q11, Q12

1 | Introduction

Cocoa is the main cash crop of smallholder farmers in Côte d'Ivoire, the world's largest cocoa producer. More than a third of the population lives off its production, but most farmers face precarious livelihoods that keep them trapped below the poverty line (van Vliet et al. 2021). Low incomes compel agricultural practices that perpetuate a cycle of poverty and environmental degradation, as manifested in the prevalence of child labour and high rates of deforestation due to extensive land cultivation (Busquet et al. 2021; Lambin and Furumo 2023).

As a global commodity that is consumed predominantly in countries that do not grow cocoa (IFPRI 2024), the conditions

surrounding cocoa production have attracted the attention of both producing and consuming countries to identify the causes of the persistently low incomes of cocoa farmers (EU 2020).¹ Several structural features have been highlighted, most of which defy straightforward policy remedies. Low farm productivity is seen as one culprit (FAO 2022), partly a consequence of shallow markets for credit (Suh and Molua 2022). The highly skewed distribution of value-added in the global supply chain is another, reflected in the concentration of higher-earning processing activities outside of origin countries (Fountain and Hütz-Adams 2022). A third, if oft neglected, determinant of cocoa farmers' income is the pass-through of world market prices to the farm-gate, that is, the extent to which world price signals are transmitted into domestic prices received by the farmer.²

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This paper examines price formation and pass-through along Côte d'Ivoire's cocoa supply chain to understand why Ivorian farmers receive some of the world's lowest farm-gate prices for cocoa. Given the country's highly regulated cocoa market—where prices are seasonally fixed for all national market participants—we carefully account for the institutional framework and different stages of the national supply chain shaping these dynamics. By analysing potential inefficiencies that affect price pass-through along this chain, we aim to identify intervention points that could increase farmers' share of global cocoa market value. We undertake a comprehensive analysis of potential factors at different segments of the supply chain, including regulatory mechanisms, fiscal policies, and producer-buyer relationships. Drawing on a conceptual framework that informs our understanding of price formation, we combine econometric and institutional analyses using secondary quantitative and qualitative data, as well as primary data elicited in a representative nationwide survey of farm households in 2021.

Our study thereby addresses a gap between two strands of the literature. The first strand supplies macro-level insights on the pass-through in agricultural commodity markets. Following the seminal work by Mundlak and Larson (1992), studies from this strand pool various agricultural commodities, mostly to assess variations in the degree of market deregulation and trade liberalisation (Baffes and Gardner 2003; Arnade et al. 2017). The second strand furthers our understanding of micro-economic mechanisms underlying pass-through rates in agricultural commodity markets. Most existing evidence comes from deregulated markets, some of which use short-term pass-through rates as proxy measures of competition and market power (Casaburi and Reed 2022; Bergquist and Dinerstein 2020; Hofman and Malan 2022). Other studies investigate producer-buyer pass-through more directly. For example, both Fafchamps and Hill (2008) and Kopp and Sexton (2021) find asymmetric pass-through, with international price increases transmitted more slowly and incompletely than price decreases—specifically for coffee in Uganda and rubber in Indonesia.

As part of our focus on the supply chain, our analysis also assesses the effect of the Living Income Differential (LID) on price pass-through. Jointly introduced by Côte d'Ivoire and neighbouring Ghana in 2019, the LID is a large-scale price intervention aimed at leveraging the two countries' large market share to support farm-gate prices. The LID imposes a mandatory surcharge of 400 US dollars per tonne on all cocoa bean sales, whether for exporting or domestic processing. The policy's ambition was to structure price adjustments in a way that

the full surcharge would be passed on to farmers. This was accomplished in Côte d'Ivoire by incorporating the surcharge into the country's regulatory cocoa sales mechanism, known as the Forward Sales Programme. We examine whether this price-based intervention was effective in increasing farm-gate prices. Previous studies find a temporary and modest rise in the farm-gate price at the end of 2020, followed by a drop in 2021 that was accompanied by an increase in input prices (Ruf 2022; Gilbert 2024). Boysen et al. (2023) use simulations to discuss the likely impact of adjustments to the LID, highlighting that outcomes may vary widely depending on how the policy is implemented and how chocolate manufacturers respond.

Among our main findings, we estimate the transmission elasticity of the world market price to local producer prices in Côte d'Ivoire to be close to unity, reflecting a high degree of pass-through at this juncture. We subsequently provide new insights into the different segments of the pass-through from the world market price to the farm-gate price. We identify inefficiencies at the interface between the physical and futures cocoa market, but their correction offers only limited potential for increasing farm-gate prices. Moreover, we find no evidence that the LID as a price-based intervention substantially improves farmer incomes. Absent obvious policy interventions that would increase farm-gate prices or rectify market inefficiencies, we argue that a more promising route is through building on the existing efforts of the international cocoa industry to support community development. Such efforts, when implemented in coordination with government policies that invest in human capital and infrastructure, can increase the opportunity cost of cocoa production, ultimately drawing farmers out of the sector while improving the livelihoods of those who remain.

2 | Price Formation in Côte d'Ivoire's Cocoa Value Chain

2.1 | Institutional Background

In Figure 1, we identify the main components of the cocoa value chain that shape price formation and the pass-through of the global price to the farm-gate price in Côte d'Ivoire. In the following, we introduce these components step by step, with the world market price (segment I of Figure 1) as the point of departure.³ A key subsequent link in the in-country value chain is a regulatory mechanism called the 'Forward Sales Programme'. After a more liberalised period that started in the late 1990s, the Ivorian cocoa sector was re-regulated in 2012. The *Coffee*

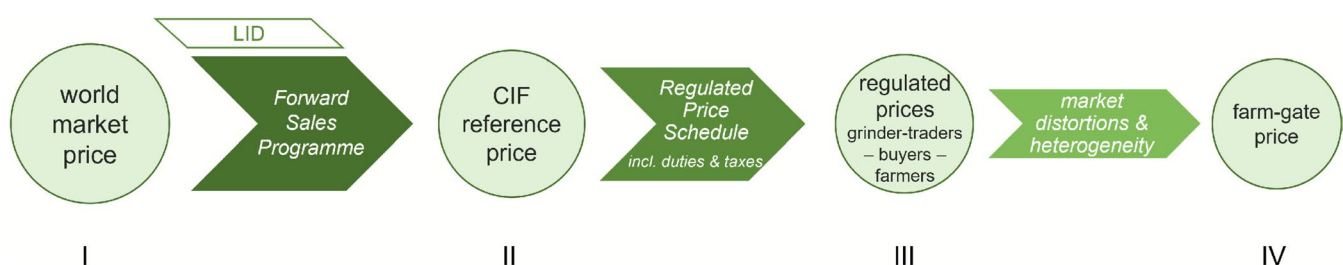


FIGURE 1 | Stylized chain of pass-through from global to farm-gate prices. CIF, cost, insurance, and freight; LID, living income differential. [Colour figure can be viewed at wileyonlinelibrary.com]

and *Cocoa Council* was established as the public institution that carries out sector regulation, stabilisation and development, including the management of the Forward Sales Programme. The programme sets regulated prices for all actors along the national value chain, from the farm to the port of export. These prices are fixed at the beginning of each crop year in October to eliminate intra-seasonal price risks. The sum of these regulated domestic margins defines what is referred to in Côte d'Ivoire as the 'CIF reference price' (Cost, Insurance, and Freight).⁴ This benchmark price, represented in segment II of Figure 1, is expressed per kilogram in local currency.

To determine a CIF reference price that ensures stable prices over the cocoa crop year, the Forward Sales Programme conducts two types of transactions: forward sales and spot sales. Forward sales account for 70%–80% of the following year's crop and are agreed with exporters over the 6 months preceding the new crop year. Spot sales during the crop year cover the remaining 20%–30% of the volume. The forward sales price in individual transactions, in turn, consists of two components. One is the quotation for cocoa at the ICE Futures Europe in London, which is the exchange for cocoa from West Africa. The second price component is the 'origin differential', a negotiated premium that reflects perceptions of cocoa quality, reliability of supply, and traceability (Aidenvironment and SFL 2018).⁵

Hence, the *Council* must manage several risks, including uncertainties related to realised cocoa bean volumes, exchange rates, and spot price developments. Moreover, the forward contracts expose the *Council* to risk from non-delivery and default that may result from factors such as crop failures, smuggling, and speculation (Tröster et al. 2019). This requires skills in both anticipating market fluctuations and negotiating, all the while operating beyond the reach of possible attempts by influential stakeholders to procure export licences at below-market prices (Oomes et al. 2016).

The Regulated Price Schedule, called *barème* (scale) in French, is a system established in the 1950s in Côte d'Ivoire to allocate the CIF reference price to the different actors along the value chain, which originates with smallholder farmers and the buyers who purchase their cocoa. Three main types of buyers exist: cooperatives, local intermediaries (*pisteurs*), and regional intermediaries (*traitants*).⁶ All regulated prices represented in segment III of Figure 1 are fixed at least for the entire main harvest season; sometimes revised prices are set in April for the side harvest season. In the cocoa crop year 2019/20, for example, 61% of the CIF reference price accrued to the farmers, which is in alignment with the government's goal that the farm-gate price not fall below 60% of the CIF reference price, or at least at a minimum of 50% in times of falling global prices.

Regulated farm-gate prices mean that farmers should have no room to negotiate or differentiate prices beyond premiums provided through certification.⁷ The actual farm-gate price, represented by segment IV in Figure 1, may nevertheless deviate from the regulated price due to idiosyncratic factors at the site of the transaction, including bargaining outcomes that may reflect market distortions and differences in quality and transport costs. For example, buyers only receive a lumpsum for transportation, which makes it less attractive to buy from more remote

places. It is also quite common for the farm-gate price to be unofficially reduced by domestic buyers during the side season as the quality of the cocoa beans deteriorates and the size of the beans usually shrinks, resulting in lower yields of cocoa butter (Ruf 2022).

A strong decline in the world cocoa price in 2016–2017 prompted Côte d'Ivoire and neighbouring Ghana to cooperate on further price regulations. The main intervention is the LID, designed as a surcharge on top of the world market price for cocoa. With the LID, the two countries aim to leverage their strong market position, which accounts for over 60% of global cocoa production, to increase the farm-gate price. In Côte d'Ivoire, the LID forms part of the Forward Sales Programme, at the link between segment I and II of Figure 1. The surcharge was first incorporated in the regulated price schedule for the cocoa crop year of 2020/2021. It was initially set to 400 US dollars per metric tonne of cocoa beans on top of the Free on Board price (FoB)—and thus made up a share of almost 17% of the realised FoB price of 2400 US dollars at the time. Perhaps not surprisingly, international buyers reacted by pushing through reductions in other components of the cocoa price to offset the LID (Staritz et al. 2023). As a consequence, the *Coffee and Cocoa Council* had to reduce the regulated farm-gate price at the beginning of the side season in March 2021.

On the whole, regulatory interventions seem to have done little to increase producer prices for cocoa in Côte d'Ivoire. Even though the regulated farm-gate price increased by 50% in April 2024 as a result of the tripling of world market prices over the preceding year, Ivorian cocoa farmers have received some of the lowest cocoa prices in the world over the long term. This can be taken from Figure 2, which presents producer prices in real US dollars as a percentage of the global cocoa price for major cocoa producers for the period 1991–2021. The figure shows that producer price shares vary considerably across countries and over time. Although bean quality may contribute to these differences, it is unlikely to be the main driver, as cocoa on world markets is largely a homogeneous bulk commodity: the vast majority of exports consist of standard ('ordinary') cocoa beans that are blended and priced through international futures exchanges. Only a fraction—around 12% of total world exports—consists of fine flavour cocoa, primarily from Latin American origins such as Ecuador and Peru, which constitutes a distinct niche market with its own supply and demand dynamics (ICCO 2025). Consequently, the cross-country differences seen in the figure are more likely explained by variation in marketing structures, taxation, degrees of market liberalisation, and domestic political-economic conditions than by product differentiation.⁸ In the case of Côte d'Ivoire, the producer price share fell below 50% in the mid-2000s at the time of the country's civil war, and then edged slightly above 50% as of 2010. Aside from a brief LID-induced blip in 2020, the share maintained at roughly the same level for the past 10 years.

2.2 | Role of the LID in Price Formation

The LID as the latest element in Côte d'Ivoire's price-setting regime calls for a closer look at the structure of the cocoa supply chain and its implications for price formation. The LID is

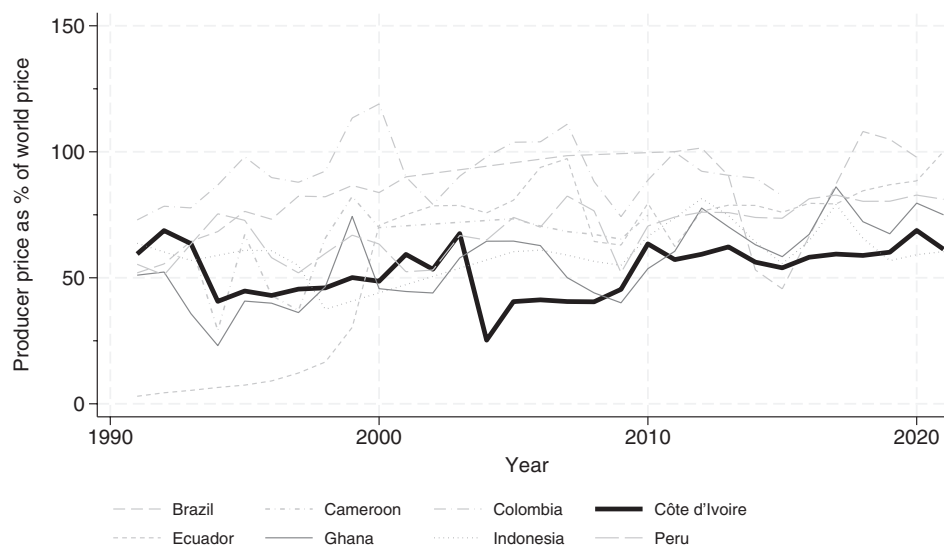


FIGURE 2 | Cocoa producer prices as a percent of the world price. Producer prices and world price in real US dollars as annual averages, based on data from FAO (2023) and IMF (2022).

effectively a surcharge added to every tonne of Ivorian cocoa exports. For international buyers, this is equivalent to a tax: Ivorian cocoa becomes more expensive, and demand falls. Because cocoa is a homogeneous commodity, buyers are quick to reduce purchases of Côte d'Ivoire cocoa when its price rises relative to that of its international competitors.

The crucial issue is how this demand reduction affects farmers. Although a fully specified formal analysis would require an equilibrium displacement model to predict the price and quantity effects of the LID (Gardner 1975; Lloyd 2017; Brester et al. 2023), the central implications can be captured through stylized economic reasoning. We illustrate these insights conceptually, referring to work by Kinnucan (2025) that formalises them within a common price transmission framework. We then discuss the applicability of these insights in light of the regulated price-setting regime in Côte d'Ivoire.

Cocoa production requires two types of inputs: cocoa beans supplied by farmers and processing services such as transport and packaging. Assuming cocoa is a homogeneous product and prices are determined in a market-based setting, the two inputs may exhibit gross complementarity—that is, a price increase for either input reduces demand for the other. Gross complementarity is more likely when substitution is limited and the absolute value of the demand elasticity exceeds the elasticity of substitution between inputs (Kinnucan 2025). The LID, intended as a subsidy to farmers, raises the world market price of Ivorian cocoa. This price increase discourages buyers and shifts export demand for cocoa inward. When inputs are gross complements, processors respond by reducing both inputs together rather than substituting one for the other. As a result, fewer beans are purchased at the farm gate. Farmers therefore face two opposing forces: the LID transfer encourages greater supply, but reduced export demand lowers the price they can obtain. Given buyer flexibility, the contraction in demand is likely to dominate the subsidy effect, so the new equilibrium is more likely to feature a lower farm-gate price—even including the LID.

This stylized reasoning can be formalised using a common Muth-type framework of price transmission as developed by Kinnucan (2025).⁹ His model can be used to show that under perfect competition, the long-run pass-through elasticity equals the inverse of the farmer's share of the export price.¹⁰ Given typical farmer shares in Côte d'Ivoire's cocoa supply chain of between 50% and 61% documented above, this implies a long-run elasticity in the range of 1.63 (i.e., $1/0.61$) to 2.00 (i.e., $1/0.50$). In the empirical analysis, we gauge whether the estimated long-run pass-through elasticity falls in this range and is thereby consistent with that of a perfectly competitive supply chain.

We note in closing that over the short run, at least, domestic price setting in Côte d'Ivoire diverges in important ways from the free-market assumptions in the above conceptual model. Farm-gate prices have long been administratively fixed, and the *barème* system also determines intermediary margins and processing input costs annually through institutional negotiation rather than market clearing. As a result, processing input prices may be partially shielded from market forces, even across seasons.

3 | Data and Methods

To trace price formation along the stylized chain in Figure 1, we draw on multiple methods and data from a mix of primary and secondary sources, applied in five steps.

3.1 | Global to Local Cocoa Price Pass-Through (I to IV)

First, we implement a simple econometric approach to assess the extent to which variations in world prices are transmitted to domestic farm-gate prices. This analysis links segment I and IV of the figure. Following Mundlak and Larson (1992), we begin by referencing the law of one price, according to which

the domestic price of the commodity at time t , P_t , equals the product of the world price, W_t , and the exchange rate, E_t : $P_t = W_t^*E_t$. Taking natural logarithms yields a log-linear model in which the coefficient of W_t is interpreted as what Mundlak and Larson (1992) call the transmission elasticity. We adopt a variant of this approach by way of error correction models (ECMs) using the two-step method of Engle and Granger (1987). Pending confirmation that the dependent and independent variables are of the same order of integration (in this case $I(1)$), the first step tests the residuals of an ordinary least squares (OLS) regression of the producer price on the world price and the exchange rate under the null hypothesis that the series are not cointegrated. Rejection of this hypothesis supports the second step, which includes the lagged residuals as an error correction term in a differenced model.

We explore four specifications of the ECM, starting with a model that measures prices in logs:

$$\Delta \ln(pFCFA_t) = \beta_0 + \beta_w \Delta \ln(wFCFA_t) + \beta_e \Delta \ln(e_t) + \gamma ECT_{t-1} + \varepsilon_t$$

where $pFCFA_t$ and $wFCFA_t$ are the producer- and world prices expressed in the local currency, FCFA, in year t . e_t is the FCFA/USD exchange rate, ECT_{t-1} is the lagged residual from the first stage, ε_t is a normally distributed disturbance, and Δ is the first-differencing operator. The coefficient β_w captures the short-run transmission elasticity. γ measures the speed of adjustment toward the long-run equilibrium whereas β_w/γ yields the long-run elasticity.

With producer and world prices measured in a uniform currency, Equation 1 allows a test of the *pricing-to-market* hypothesis, according to which producers in the home market exercise market power. One channel through which market power may be exercised is movements in the exchange rate. If the exchange rate were to increase through an appreciation of the dollar, for example, local producers may try to recover some of the increased rents that would otherwise go to dollar denominated cocoa trades further up the value chain, which would be reflected in a positive coefficient of β_e . Under the null hypothesis, conversely, any such changes in the exchange rate are already captured in $wFCFA_t$, implying that $\beta_e = 0$ (Nguyen and Kinnucan 2018).

The transmission elasticity from the logged model in Equation 1 accommodates circumstances in which price changes are passed on in a multiplicative manner. We additionally estimate a linear specification to accommodate circumstances in which price changes are passed on in an additive manner:

$$\Delta pFCFA_t = \beta_0 + \beta_w \Delta wFCFA_t + \beta_e \Delta e_t + \gamma ECT_{t-1} + \varepsilon_t, \quad (2)$$

The cocoa market may well be governed by both circumstances. For example, the LID in Côte d'Ivoire was intended to work in an additive manner, where the entire LID was supposed to be exclusively passed back to the farmer. The regulated price scheme, on the other hand, includes regulated prices for value chain actors, such as taxes and duties, which work in a multiplicative manner, implying that changes in the

global price are distributed proportionally. As a result, both measures provide a relevant reference case for the extent of pass-through.

A potential concern is attenuation bias if changes in processing input costs or the introduction of the LID alter the relationship between the farm-gate price and the world price in ways not captured by the model. This concern is mitigated by the fact that input prices in Côte d'Ivoire's price-setting mechanism cannot adjust flexibly within a crop year, making it unlikely that such costs materially affect price transmission. Moreover, the LID did not create a fundamentally new pricing mechanism, but added a fixed premium to the FoB price that is intended to be passed through to farmers via the existing administrative framework. Thus, our observed price series already reflects policy-based pricing throughout the entire period, and not a transition from market- to policy-based prices. Nevertheless, we address this concern through robustness checks that incorporate linear and non-linear time trends to capture unobserved variation, as well as a model that excludes post-LID data.

Two variants of Equations 1 and 2 are estimated, the first measuring all variables in nominal terms. The second measures the variables in real terms, deflating the domestic prices by the Ivorian consumer price index (CPI). The real exchange rate is calculated by multiplying the nominal rate by the ratio of the US CPI to the Ivorian CPI.

Data on world cocoa prices, measured in dollars, are obtained from IMF (2022), whereas data on producer prices, measured in FCFA, are obtained from FAO (2023). The FAO data do not properly reflect annual producer prices in Côte d'Ivoire for years in which the regulated farm-gate price differed between main and side season, namely the cocoa crop years 2016/2017 and 2020/2021. We therefore replace producer prices for these years by the average price of the two seasons weighted by the respective cocoa production levels, as retrieved and triangulated from different online sources. The CPI for Côte d'Ivoire and the United States is obtained from World Bank (2025) and FRED (2022), respectively, whereas the exchange rate is obtained from IMF (2023). Temporal coverage of the data spans 31 data points from 1991 to 2021.

3.2 | The Effect of the Price-Setting Mechanism on Pass-Through (I to II)

In a second, descriptive analysis, we assess the efficiency of the Forward Sales Programme as the link between segments I and II in Figure 1. Over various crop years, we compare the CIF reference price determined by the Forward Sales Programme with the benchmark price that could be fetched from forward sales. The Programme requires 80% of forward sales be made over the 6 months prior to a new crop year, with the remaining sales made over the following 6 months. To simplify our benchmark calculation, we assume that the sales are made evenly over each of these 6-month intervals. Here, we rely on commodity exchange data and documents from the public regulator of the cocoa sector in Côte d'Ivoire, the *Coffee and Cocoa Council*. In terms of commodity exchange data, we use more granular weekly data

on cocoa forward sales prices and add country-specific origin differentials from the London Cocoa Futures exchange for the years 2015 to 2021 for Côte d'Ivoire and neighbouring countries in West Africa.¹¹ The *Council* provided us with regulated price schedules for the past years, from which we retrieve the CIF reference price for the years 2015–2021.

3.3 | Pass-Through in the In-Country Cocoa Value Chain (II to III)

Third, we conduct an institutional assessment of how the *Coffee and Cocoa Council* distributes the CIF reference price across in-country value chain actors via regulated prices in Côte d'Ivoire. In the absence of information on how these different regulated prices are defined at the level of the *Council*, we rely on qualitative political economy arguments to assess the effect of the regulated price schedule as the link between segments II and III of Figure 1.

3.4 | Pass-Through of the Regulated Farm-Gate Price (III to IV)

Fourth, we use primary data from a survey of farm households in Côte d'Ivoire to assess variations in the prices that farmers actually fetch from local buyers, segments III and IV of Figure 1. The sample is representative for all cocoa-growing regions in Côte d'Ivoire using a sampling plan prepared for a previous survey by the Joint Research Centre (JRC) conducted in 2019. Our data were collected toward the end of the cocoa crop year 2020/21 in August and September 2021. The sample includes 1052 farming households, of which 972 (92%) identify as cocoa farmers and 80 (8%) as other farming households (see Bensch et al. 2022 for further details). We use these data to run OLS regressions of the farm-gate price with explanatory variables selected based on knowledge from the field and on variables that have been shown in the literature to be associated with prices. We motivate the choice of these variables in more detail in Appendix A. The choice is additionally informed by machine learning methods for variable selection, employing the *Least Absolute Shrinkage and Selection Operator (Lasso)* (Hastie et al. 2009). This provides us with a data-driven way to restrict covariate sets in regression models to variables with the highest prediction accuracy as detected by the algorithm. As a robustness check, we also estimate an OLS model using only the variables selected by the Lasso estimation to verify the robustness of our results with respect to variable selection.

3.5 | Living Income Differential and Pass-Through (I to IV)

Finally, we shed light on the impact of the LID as an intervention targeted at cocoa price formation, returning to the link between segment I and IV of Figure 1. Our key measure here is the ratio of producer prices to world market prices. We adopt a descriptive event-study design to analyse the evolution of this ratio before and after the implementation of the LID. For comparison, our analysis also covers Ghana as the second country that implemented the LID and Cameroon as a liberalised cocoa market in western Africa. For this more granular analysis, we use monthly

world market prices (IMF 2022) and monthly producer prices. For the latter, we again use the FAO (2023) producer price data and season-specific data for Côte d'Ivoire from the *Coffee and Cocoa Council*, complemented by monthly data from the *National Cocoa and Coffee Board* in Cameroon (ONCC 2022).

4 | Results and Discussion

This section presents the results of the five analyses outlined in Section 3.

4.1 | Global to Local Cocoa Price Pass-Through

We begin the analysis by exploring the time series properties of the world and farm-gate price data, implementing tests for unit roots and cointegration. As documented in Table B1, KPSS tests uniformly indicate that both the producer- and world price series are integrated of order one (Kwiatkowski et al. 1992). Augmented Dickey–Fuller (ADF) are broadly confirmatory, but with some evidence that the variables may be $I(0)$ when measured in real terms (Dickey and Fuller 1979). Cointegration tests likewise partially support application of the ECM, rejecting the null hypothesis of no-cointegration in two of the four models presented below. Although these models do not include a trend term, the appendix presents models that include a non-linear trend as a robustness check (Table B2). These models uniformly reject the null hypothesis of no-cointegration, but the trend term itself is statistically insignificant (as is the case with a linear trend term, not presented). Otherwise, the estimates obtained from the robustness check are very similar to those that follow. In addition, models that exclude the post-LID years 2020 and 2021 show that their omission has no substantial bearing on the results (Table B3).

Table 1 presents the econometric estimates as well as the cointegration test statistics from the logged and linear ECMs, with variables expressed in nominal terms (columns 1 and 3) and in real terms (columns 2 and 4). Across the models, the R^2 s indicate a satisfactory fit, indicating that more than 50% of the variation in domestic prices are explained by variation in the explanatory variables. All of the coefficients on the error correction term are statistically significant and of the expected sign, suggesting that between 60% and 67% of the deviation from the long-run equilibrium relationship between producer and world prices in the previous year is corrected in the current year. Conversely, as might be expected, none of the coefficients on the exchange rate are statistically significant, constituting evidence against the *pricing-to-market* hypothesis that local producers exercise market power.

Turning to the estimates of the world price, the short-run point estimate of the transmission elasticity in Models 1 and 2 ranges between 0.94 and 0.97 and is significant at the 1% level. Dividing the short-run estimates by the negative of the estimated coefficients of the ECT yields long-run elasticities of 1.53 and 1.56, which are statistically significant at the 1% level. These estimates fall just outside the range of 1.63–2.00 predicted by the theoretical framework presented in Section 2.2, providing some support for the hypothesis of a perfectly competitive supply chain. We conclude that the LID does not appear to have a distortionary effect on cocoa prices over the long run.

TABLE 1 | Econometric results of the error correction model.

	$\Delta \ln(pFCFA_{nom})$	$\Delta \ln(pFCFA_{real})$	$\Delta pFCFA_{nom}$	$\Delta pFCFA_{real}$
	Coeff./SE	Coeff./SE	Coeff./SE	Coeff./SE
$\Delta \ln(wFCFA_{nom})$	0.970*** (0.161)	—	—	—
$\Delta \ln(wFCFA_{real})$	—	0.939*** (0.218)	—	—
$\Delta wFCFA_{nom}$	—	—	0.527*** (0.054)	—
$\Delta wFCFA_{real}$	—	—	—	0.496*** (0.091)
$\Delta \ln(e_{nom})$	-0.288 (0.215)	—	—	—
$\Delta \ln(e_{real})$	—	-0.216 (0.393)	—	—
Δe_{nom}	—	—	-142.258 (202.677)	—
Δe_{real}	—	—	—	-304.699 (368.512)
ECT_{t-1}	-0.634*** (0.228)	-0.602*** (0.182)	-0.668*** (0.230)	-0.597*** (0.176)
Number of observations	30	30	30	30
R^2	0.609	0.568	0.697	0.642
Cointegration test statistic	-3.667*	-3.533	-3.801**	-3.505

Note: SEs are in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively. The subscript *nom* indicates that the variable is measured in nominal values whereas the subscript *real* indicates it is measured in real values.

Even over the short-run, the sizable magnitudes of the transmission elasticities suggest that percentage changes in world prices are largely transmitted to percentage changes in domestic prices. This conclusion may seem curious in light of the heavy role of the state in the regulation and taxation of Côte d'Ivoire's cocoa markets. It bears noting, however, that while such interventions affect the local *level* of cocoa prices, this does not preclude domestic prices from moving *proportionally* with world prices (Mundlak and Larson 1992). Indeed, the regulatory impact on the pass-through is more clearly gleaned from the linear models estimated using nominal and real values in columns 3 and 4. These models both suggest a pass-through rate that straddles about 0.5. Referencing Model 3, a one FCFA increase in the world price is associated with a 0.53 FCFA increase in the local producer price. This estimate aligns with the government's aim—introduced toward the end of our observational period in 2012—of ensuring that farmers receive approximately 60% (and not less than 50%) of the CIF reference price.

4.2 | The Effect of the Price-Setting Mechanism on Pass-Through

The Forward Sales Programme as the mechanism that sets the CIF reference price is the first critical link affecting the pass-through from global to farm-gate prices in Côte d'Ivoire. The efficiency of the Forward Sales Programme in securing a high CIF

reference price crucially depends on the *Council's* performance in managing the associated risks and challenges (see Section 2). Although this performance is difficult to assess directly,¹² some insight can be gleaned by benchmarking the outcome of the Forward Sales Programme, the CIF reference price. Figure 3 presents such a benchmarking exercise. The left axis measures the ratio of the CIF reference price to a benchmark price that is received when 80% of forward sales are made evenly in the 6 months preceding the crop year and the remaining sales are made in the following 6 months. For reference, the right axis of Figure 3 also shows annual averages of the two components of the ratio, the CIF reference price and the price at the London Cocoa Futures exchange—including the origin differential.

Under frictionless exchange, we would expect that the ratio of the CIF reference price to this benchmark is close to one, also considering that stock exchange fees are negligible. In fact, the ratio averages substantially below one, at 0.92 over the six cocoa crop years up to 2021. To provide an idea of the potential increase in the farm-gate price through a tighter alignment of the CIF reference price with the benchmark, we take the example of the cocoa crop year 2019/2020. The ratio in that crop year was 0.91, which corresponds to a difference of 128 FCFA/kg. In a thought experiment where the difference is entirely allocated to farmers in analogy to the LID announcements, the farm-gate price could have been increased by 16%.¹³ One has to acknowledge that the benchmark can only imperfectly represent the counterfactual of

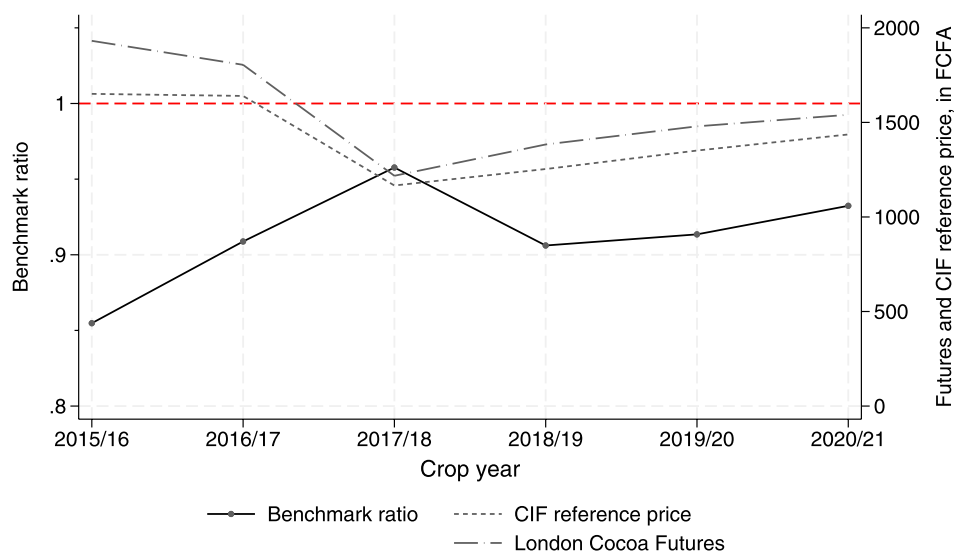
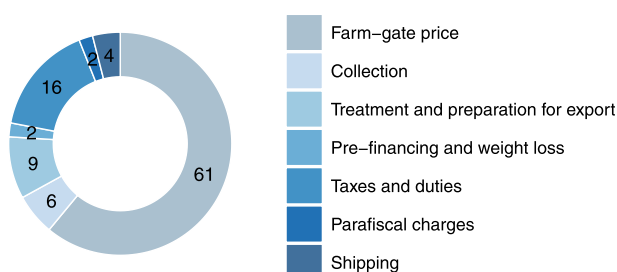


FIGURE 3 | Ratio of CIF reference prices to average London prices of cocoa futures including origin differential, by crop year. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]



Share in CIF reference price in %

FIGURE 4 | Regulated prices across in-country cocoa value chain in 2019/2020, as percentage of CIF reference price. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

frictionless exchange, and that at least part of the difference is likely to be actual transaction costs. Nevertheless, these figures suggest at least some scope for leveraging meaningful efficiency improvements through optimisation of the *Council's* transactions on the forward market.

4.3 | Pass-Through in the In-Country Cocoa Value Chain

The regulated price schedule as the second link in our analysis of pass-through defines the distribution of the CIF reference price among all actors of the in-country value chain. Hence, the distribution is determined by regulatory fiat rather than by market forces, where the step of determining this distribution remains opaque. Figure 4 shows the distribution from individual farmers up to the port of destination for the cocoa crop year 2019/2020, during which regulated prices remained unchanged between the main and side seasons.

In the crop year shown, 61% of the CIF reference price accrued to the farmer, who should in principle receive this payment instantly at the time of selling the unprocessed beans to intermediaries. As these buyers are not paid for the cocoa until it is

shipped by the exporters, they must receive pre-financing, as also indicated in Figure 4. Beside small variations in the share of taxes and duties, Figure 4 roughly represents the relative distribution of the regulated prices for all cocoa crop years starting from 2012/2013, when regulation was re-introduced in Côte d'Ivoire to maintain the share for farmers at 60%. A key lever for the government to maintain these shares has been the registration tax paid by exporters, which varied between 0% and 5% and was 3% in the cocoa crop year 2021/2022. In the main season of 2020/2021, the share of the farm-gate price was exceptionally high at 65%, a temporary effect of the LID that will be further discussed in Section 4.5.

The question arises as to whether the regulated price schedule results in lower farm-gate prices than would emerge under a less regulated system. One possible mechanism could be that the regulated price schedule shields low-efficiency enterprises and services from competitive pressures, allowing excessive margins that reduce farm-gate prices. Although it is not possible to observe how margins would behave under a less regulated system, sector reports provide some insights into the financial conditions along the national value chain and characterise margins as constrained (KPMG 2018; Aka Zebra Sas 2021). Moreover, regulated prices for individual activities such as collection, treatment, and shipping have evolved proportionally to the CIF reference price in recent years. Although this does not rule out all inefficiencies, it suggests that price-setting mechanisms have maintained relative stability rather than imposing disproportionate constraints on farm-gate prices. However, as the number of actors willing to enter licensed segments of the value chain is not observable, the extent to which competition would lower costs under a different regulatory framework remains uncertain.

Another possible source of excessive margins is the parafiscal charges on cocoa, which partially cover services provided to farmers such as input provision, training, and quality control (Staritz et al. 2023). A recurrent critique is that such parastatal services are vulnerable to corruption or patronage and tend to

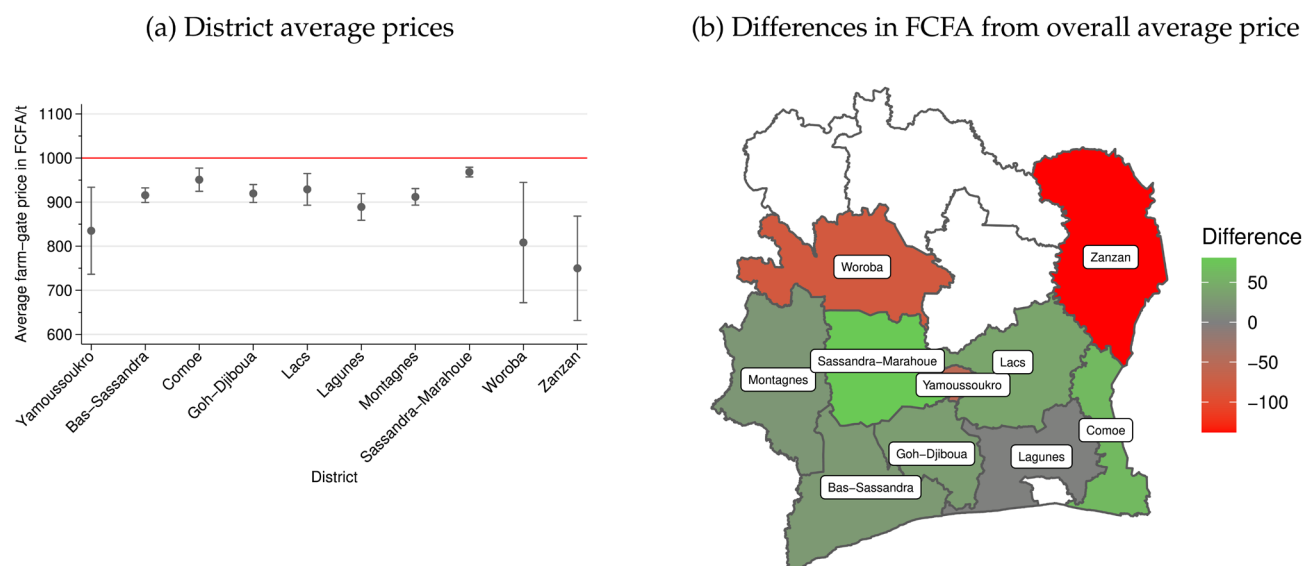


FIGURE 5 | Price variation at district level for the main season 2020/2021. The white areas on the map were not surveyed as cocoa production in these regions is sparse. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

be rendered less efficiently (Kolavalli and Vigneri 2017; Bymolt et al. 2018). Although cocoa farm productivity has remained relatively static, giving some credence to efficiency concerns, it also bears noting that the physical quality of cocoa beans has significantly improved over the last years. This is not only acknowledged by grinders and traders (Maile 2020) but is also reflected in price comparisons with less regulated neighbouring markets. For example, the difference in the price including the origin differential paid for cocoa beans from Côte d'Ivoire and Nigeria at the London exchange increased from 0.7% to 4.6% in the period 2015 to 2019.¹⁴ A similar increase in the gap of origin differentials can be observed when comparing Côte d'Ivoire with Cameroon. Thus, the parastatal services appear to add real value to Ivorian cocoa beans, which would justify the parafiscal charges.

A final concern is that regulation may impose an excessive tax burden on the sector and thereby on farmers. Unlike other cocoa-producing countries such as Ecuador or Cameroon, Côte d'Ivoire relies heavily on cocoa as a taxable export product. Taxes and duties are relatively high compared to other countries and totalled 16% in the cocoa crop year 2019/2020 (Figure 4). With a contribution of more than 10% to total national tax revenues, they are an important source of government revenue, making cocoa farming the most heavily taxed income-generating activity in the country (World Bank 2019). Given that the farm-gate price is set as a proportion of the export price, relatively high export taxes may contribute to Côte d'Ivoire's farm-gate price being lower than that of international competitors.

4.4 | Pass-Through of the Regulated Farm-Gate Price

Our farmer survey reveals that average farm-gate prices remain below the regulated price, suggesting incomplete compliance with the regulated price. For the main cocoa season 2020/2021,

the year of the farm household survey, the *Coffee and Cocoa Council* had set a regulated farm-gate price of 1000 FCFA/kg for the main season and 750 FCFA/kg for the side season, equivalent to 1.8 and 1.3 US dollars/kg, respectively. Some 32% of farmers reported a per-kg price for the main season below 1000 FCFA, with a low of 500, whereas 4.6% of farmers reported a price higher than 1000, with a high of 1100. The average price is 922 FCFA during the main season and 637 FCFA during the side season, thus 8% and 15% below the guaranteed price, respectively.

Focusing on the main season, Figure 5 presents variation in cocoa price levels across cocoa-growing districts in Côte d'Ivoire. Panel (a) presents the average price across districts whereas Panel (b) presents a cartographic depiction of the extent to which regions deviate from the mean price. Consistent with the law of one price, transportation costs may play some role in the observed differences (von Cramon-Taubadel and Goodwin 2021), also considering that the regulated price schedule involves a flat price for the collection of the raw cocoa from the farmers. The road network extending into rural areas of the country is relatively sparse and poorly maintained, making transportation from more remote regions costly in terms of fuel expenses, vehicle maintenance, and travel time. Depending on the number of buyers available to farmers, and thus the market power of the buyers, farmers with low-quality beans may risk not being able to sell their cocoa beans at all (Gaia Cacao 2021) and thus may be willing to accept a lower price. Distance to the border to neighbouring Ghana could also explain certain observed price differences, such as above-average prices in the eastern district of Comoé. The option of cocoa smuggling to Ghana when prices are higher there might force buyers in Côte d'Ivoire to offer higher prices to receive the amount of cocoa promised to the traders.

Other factors, not all of which are readily observable, likely also play a role in farm-gate price variability. We assess these factors in the OLS regression presented in Table 2, where we regress

TABLE 2 | Econometric results on correlates with cocoa prices in main season.

	Cocoa price (FCFA)	
	Coeff.	SE
Land ownership	−17.933**	(8.978)
Degree of crop diversification (#)	−22.972	(13.956)
Awareness of LID	11.659	(9.983)
Household head aged 57 years or more	−20.872**	(9.906)
Formal education	−5.609	(8.860)
Born in village	−18.732*	(9.952)
Born outside the country	−0.108	(10.970)
Top quartile of household expenditures	8.320	(10.900)
Certified cocoa	21.166**	(9.217)
Main source about agricultural markets: Individual	−5.363	(10.933)
Main source about agricultural markets: Cooperative	17.529	(18.520)
Number of buyers in village during main season (#)	−0.215	(0.204)
Cooperative as buyer	13.336	(8.761)
Private or traitant as buyer	−11.877	(23.145)
Access to house: Track in good condition all year	−2.912	(13.475)
Access to house: Track in good condition in dry season	−11.630	(13.291)
Access to house: Path	−29.706	(21.666)
District dummies	Yes	
Number of observations	851	
R^2	0.12	

Note: Variables for which the unit is not given in brackets are binary variables. Robust SEs are in parentheses. ** and * denote statistical significance of a two-sided t -test at the 5% and 10% levels, respectively.

the farm-gate price in the 2020/2021 main season as reported by the farmers on a set of covariates (see Appendix A for a detailed description of the choice of covariates). Referencing the R^2 at the bottom of the table, these explanatory variables explain about 12% of the variance in the farm-gate price. Although the coefficients of slightly more than half of the variables are mostly small and imprecisely estimated, four of the estimated coefficients reach statistical significance at conventional levels.

First, land ownership is negatively associated with prices. One mechanism that may partially explain this result works through investment. As Bros et al. (2019) show based on an econometric analysis of household data from Côte d'Ivoire, farmers whose tenure status is insecure have a higher propensity to invest in land improvements, presumably as a way of retaining control over the

parcel. To the extent that land ownership lowers this propensity, bean quality may be negatively impacted, which in turn could explain lower prices. A similar logic may apply to the two demographic variables indicating an elderly household head and being native to the place of residence. Bros et al. (2019) argue that being native discourages investment, and a comparable mechanism may also be at play for older household heads. Our estimates suggest that these attributes are negatively associated with prices. Last, a statistically significant—and in this case positive—effect is observed for cocoa certified by a voluntary sustainability standard such as *Fairtrade*.¹⁵ The estimate of 21 FCFA corresponds to around 2% of the average per-kg cocoa farm-gate price.

Aside from these moderately influential factors, it is of interest to note that none of the variables indicating access to agricultural price information is statistically significant. This holds equally for when information on prices is obtained from the village chief, neighbours or friends, as well as when it is obtained from a cooperative. The number of cocoa buyers reported to visit the village, which can be viewed both as a source of information and as capturing seller power, is likewise statistically insignificant. Moreover, with a negative but insignificant coefficient on the degree of diversification, our results do not confirm a downward pressure on farm-gate prices due to a higher dependency on cocoa, as discussed by Oomes et al. (2016).¹⁶ Finally, poorer road access to a farmers' home—which serves as the selling point for more than 2/3 of farmers in the sample—is not significantly correlated with cocoa prices. Although Figure 5 indicates that prices tend to be negatively correlated with the distance of cocoa growing regions from the nearest port, our econometric results provide no evidence that greater remoteness of selling points within regions is significantly correlated with lower farm-gate prices.

Our robustness check employing Lasso identifies more variables as relevant than the variables included in our main estimation (Table A1). At the same time, all variables included in our more parsimonious main estimation are confirmed as relevant by the Lasso estimation. Overall, the OLS regression based on the Lasso variable selection largely confirms the direction, magnitude, and significance of our identified price determinants.

4.5 | LID and Pass-Through

The final part of our analysis returns to the link between segment I and IV of Figure 1 and the role of the LID. Given that the motivation behind the LID was to increase farmers' shares in cocoa world market prices, we assess its effectiveness in achieving this goal. Figure 6 tracks the evolution of producer prices covering the period before and after the implementation of the LID. The vertical axis measures the percentage point change in the ratio of farm-gate prices to world market prices relative to September 2020, that is, the month right before its implementation, when it is set at zero. In addition to Côte d'Ivoire, the figure presents the trajectory for two other countries: Ghana, which introduced the LID contemporaneously, and Cameroon, a liberalised West African cocoa exporter that serves as a benchmark. At $t=0$ in September 2020, the ratio itself was nearly identical between Côte d'Ivoire and Ghana at

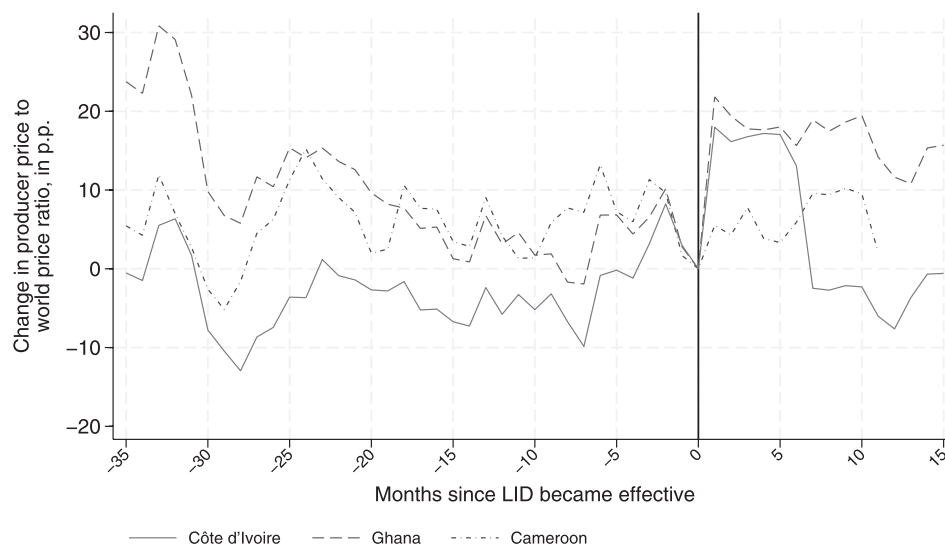


FIGURE 6 | Ratio of farm-gate prices to world market prices around LID implementation. All prices are expressed nominally in US dollars. The LID became effective with the beginning of the cocoa crop year 2020/21 in October 2020. $t=0$ therefore denotes September 2020. At that point in time, the ratio amounted to 60.4% in Côte d'Ivoire, 59.0% in Ghana, and 69.3% in Cameroon, whereas the world market price was 2460 US dollars.

60%, but considerably higher at almost 70% in Cameroon (not shown in the figure).

In the period following introduction of the LID, the world market price was fairly stable. This implies that changes in the ratio were mainly due to changes in farm-gate prices measured in nominal US dollars. In accordance with announcements, Côte d'Ivoire and Ghana converted the LID of 400 US dollars per tonne of cocoa to their local currencies in the first main season. This led to a significant increase of about 20 percentage points in the farm-gate-to-world price ratio in both countries, up from ratios of 60% (Figure 6).

However, this initial spike is followed by a clear drop in the ratio even below the level in September 2020 (Figure 6). Côte d'Ivoire could not maintain the premium and reduced the regulated farm-gate price at the beginning of the side season in March 2021.¹⁷ This primarily owed to the *Coffee and Cocoa Council's* inability to push the LID through in their price negotiations with international buyers. Market uncertainties and a slump in demand due to the Covid-19 pandemic likely exacerbated the situation, even if the development of the ratio in Ghana and Cameroon suggests that the farm-gate price in these countries escaped this source of pressure. In the second year following implementation, the cocoa crop year 2021/2022, official documents by the *Coffee and Cocoa Council* reveal that it did not even specify an LID in the regulated price schedule. Thereafter, the absolute ratio in Côte d'Ivoire dipped further, recovering to a level of 60% at the end of our observation period in 2021.

Côte d'Ivoire's medium-term experience with the LID is thus sobering, as the desired increase in the pass-through to the farm-gate could not be sustained. Figure 6 suggests that Ghana was more successful in this endeavour. Here, the ratio was still more than 10 percentage points higher than it was when the LID was

implemented one and a half years hence. As higher revenues from sales to the world market in Ghana vis-à-vis Côte d'Ivoire are unlikely, the increase seems to be funded by national public sources. Indeed, public audit data for the fiscal year 2020/2021 provide suggestive evidence that Ghana's national regulatory institution, *COCOBOD*, has subsidised the cocoa sector with about 400 million US dollars (SIGA 2021). Given Ghana's production of about 1 million tonnes (ICCO 2024b), this subsidy is equivalent to the LID of 400 US dollars per tonne of cocoa. Thus, it appears that the increase in the farm-gate price in Ghana was due to the injection of public funds into the national value chain by *COCOBOD*, rather than due to the LID.

5 | Conclusion

This paper examined price transmission along the cocoa value chain, with an eye toward identifying regulatory and market inefficiencies that negatively bear on the price received by farmers. Starting with an analysis of the transmission of world cocoa prices, our results demonstrate a covariation of domestic cocoa prices and world prices, with a short run transmission elasticity that is close to one for Côte d'Ivoire. The corresponding long-run elasticity reaches 1.56, which theoretical considerations suggest is consistent with a perfectly competitive market. Our analysis of the absolute pass-through, which yields an estimate of about 0.50, implies that the regulator meets its goal of maintaining the farm-gate price at around 60%, but not below 50%, of the world price. Subsequent analyses along the different main components of the cocoa price formation uncover no instances in which Côte d'Ivoire's regulatory framework, including the introduction of the LID, has substantially impacted price transmission.

Indeed, we find that even a market share of global cocoa production of over 60% between Côte d'Ivoire and Ghana does not appear to provide sufficient leverage in the cocoa market

to influence farm-gate prices. The failure of the LID in Côte d'Ivoire highlights the challenge of enforcing price mark-ups that benefit farmers. The desire to establish a cocoa cartel—sometimes nicknamed 'COPEC' (Boysen et al. 2023)—along the lines of OPEC seems to have dim prospects, in particular due to the fact that raw cocoa—unlike crude oil—is a semi-perishable commodity whose production cannot be quickly ramped up and down. As such, regulatory measures that prop up prices will unlikely prevent the covariation of domestic cocoa prices and world prices in the long run, as we demonstrated in our analysis of the transmission of world cocoa prices. Instead, ensuring that undistorted market signals reach farmers is critical to affording them with the information needed to make optimising decisions with respect to crop choice and diversification.

The decisive question is how to maintain such signals while providing cocoa farmers with a living income. As it is, current estimates indicate that below 10% of cocoa farmers in Côte d'Ivoire earn a living income and less than 25% earn above the poverty line (True Price 2018; Tyszler et al. 2019; Fountain and Hütz-Adams 2022). Our analysis shows that government regulators may leverage moderate price increases by tightening some of the identified inefficiencies that remain in the pricing mechanisms underpinning the cocoa value chain. For example, a deeper analysis of the forward sales price-setting mechanism adopted by Côte d'Ivoire may expose ways to improve the Forward Sales Programme. However, as our benchmark analysis suggests a potential increase in the farm-gate price by about 16% for the crop year 2019/2020, overcoming these inefficiencies seems insufficient to lift farm-gate prices to a level at which living incomes are guaranteed. Similarly, as suggested by the econometric analysis of farm survey data, certification has so far led to only very modest increases in farm-gate prices. Finally, the assessment of the LID exemplifies the challenge of unilateral efforts to encourage cocoa consumers—be these downstream processors or end consumers—to pay a price premium on cocoa. As discussed in our conceptual framework, government policies like the LID may even work against farmers' interests by exacerbating price pressures at the farm gate.

Our results reflect the broader trade-off between efficiency and prices in global agricultural value chains noted by Dalheimer and Bellemare (2025). Even though cocoa farmers in Côte d'Ivoire produce efficiently and at scale, they remain trapped in poverty because much of the value added is captured further downstream in the chain. In this sense, low farm-gate prices can coexist with efficient price transmission: farmers may be receiving a market-consistent share under current global structures, but that share is small.

To identify strategies that could improve farm incomes, it is useful to consider how the local cocoa sector—contrary to the vision of 'COPEC'—bears some hallmarks of a perfectly competitive market. The sector comprises many price-taking producers selling a homogeneous product, with free entry and exit. In the long run, equilibrium in such a market is characterised by zero economic profit, defined as revenue minus opportunity costs. Viewed in this light, interventions that raise revenues or decrease explicit costs—for instance, via better local transport and logistics—may yield positive economic profit in the short run. However, over the long run, they draw

new entrants into cocoa production, increasing supply and depressing world prices until economic profit returns to zero. A more durable strategy necessitates policies that are instead targeted at increasing the opportunity costs of cocoa cultivation, which would draw farmers to employment outside the sector while increasing the long run equilibrium price for those who remain.

This is a tall order, requiring public investments in human capital, infrastructure, and structural changes to the economy that encourage exit from cocoa production. Such investments, judiciously targeted, would simultaneously improve the livelihoods and resilience of farmers who stay in the cocoa business while minimising unintended distortions of their cocoa production decisions. Recognising the challenges that African countries face in competing within globally integrated manufacturing markets (Rodrik 2016), recent research has explored alternative pathways for economic transformation, including a more prominent role of the service sector (Diao et al. 2019; Herrendorf et al. 2022; Fan et al. 2023).¹⁸

Greater complementary involvement of the international cocoa industry also appears essential to supporting structural change. Several major cocoa processors and chocolate manufacturers have sought to take more responsibility through corporate sustainable sourcing programmes such as 'Forever Chocolate' by Barry Callebaut or the 'Cocoa Life Programme' by Mondelēz, but these efforts should be ramped up in order to create tangible impacts on farmers (Thorlakson 2018). Ultimately, the combination of government policies that create opportunities for cocoa farmers to exit the sector, coupled with community development supported by the international cocoa industry, can lead to the structural change needed to improve the livelihoods in communities in which cocoa farming households reside.

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Disclosure

Permission to Reproduce Material From Other Sources: The authors declare to have permission to reproduce the secondary data used in this paper as described in the enclosed replication package.

Ethics Statement

The survey received research clearance from ARTCI (Autorité de Protection des données à caractère de Côte d'Ivoire/Côte d'Ivoire Data Protection Authority).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data and code used in this study are available at <https://doi.org/10.7807/COCOA:PRICES:SUPPLY:CHAIN:V1>.

Endnotes

¹ For example, in 2022, the per capita consumption of cocoa beans and cocoa products in North America, Australia, New Zealand, and the European Union was 2–3 kg each (FAO 2024). In contrast, cocoa producing countries such as Ghana, Cameroon, Nigeria, and Ecuador all show consumption levels close to 0. An exception is Côte d'Ivoire with a per capita consumption of almost 10 kg in 2022, largely due to a high rate of cocoa grinding compared to other cocoa producing countries. Nevertheless, in the 2021/2022 cocoa season, about 43% of the world's cocoa bean grindings, also often used as a proxy for cocoa bean consumption, were in Europe and the United States (ICCO 2024a).

² This direction of price transmission more precisely refers to the pass-back, which is simply the reciprocal of the pass-through from the farm-gate to the world market (Kinnucan 2022).

³ The literature suggests that interventions in international spot and futures cocoa exchanges offer little scope for substantial improvements in efficiency—and, by extension, the pass-through to the farm-gate price. Ohemeng et al. (2016) fail to reject market efficiency based on an analysis of cocoa cash and futures exchanges over the period 1981 to 2009. Oomes et al. (2016) similarly find that, notwithstanding an increase in market concentration among cocoa processors, there is no evidence that market power is exploited to keep prices artificially low. More recently, Bensch et al. (2022) apply multivariate time-series models and machine learning approaches to identify the price determinants for cocoa price trends and daily cocoa returns, concluding that market efficiency at the cash and futures markets cannot be rejected.

⁴ Despite the term 'CIF', which conventionally refers to the cost of delivery to the port of destination, the Ivorian usage refers to the total value realised at the port of export.

⁵ For the cocoa crop year 2019/2020, Côte d'Ivoire's premiums reported at the London futures exchange averaged 12% of average future prices.

⁶ *Traitants* are typically located closer to the ports in the south of the country. Like cooperatives, they often have a warehouse to store the beans before delivering them to the final set of actors in the in-country value chain, the companies that handle the export. 70% of cocoa is exported as unprocessed cocoa beans, with the remainder processed into nibs or semi-finished cocoa products—namely liquor, butter, or powder—before shipment. A total of around 120 such 'grinder-traders' (Staritz et al. 2023) exist in Côte d'Ivoire, with 10 companies handling two-thirds of all exports (Ermgassen 2021).

⁷ Regarding certification, see e.g., Fountain and Hütz-Adams (2018); Ingram et al. (2018); Sellare et al. (2020).

⁸ Hence, product differentiation is also unlikely to play an important role in price transmission (Nguyen and Kinnucan 2018).

⁹ We are grateful to a reviewer for pointing out the relevance of this model and working out its application in detail.

¹⁰ This result holds under the additional assumptions that processing input prices are exogenous (i.e., unaffected by quantity and thus constant) and that input cost shares remain fixed, as can be shown as

follows. Using the notation of Kinnucan (2025), the pass-through elasticity is defined as the proportional change in the farm-gate price w_1 relative to the proportional change in the output price p , i.e., $\frac{E(w_1)}{E(p)}$.

Rearranging equation (7) from Kinnucan (2025) yields:

$$\frac{E(w_1)}{E(p)} = \frac{1 - (1 - K_1) \frac{E(w_2)}{E(p)} - \frac{E(\phi_2)}{E(p)}}{K_1},$$

where w_2 is the processing input price, ϕ_2 is the cost share of the processing input, and K_1 is the farmer's cost share. Two standard assumptions in equilibrium displacement models allow simplification of the expression: (i) processing input prices are treated as exogenous and thus held constant ($E(w_2) = 0$) and (ii) the cost share of processing inputs is treated as stable and thus also held constant ($E(\phi_2) = 0$). The above expression then reduces to $\frac{E(w_1)}{E(p)} = 1/K_1$, that is the inverse of the farmer's share.

¹¹ Since we lack spot price data, we assume that spot sales occur periodically upon the dates of maturity of forward contracts. This allows us to take forward sales prices for spot sales as well, considering the convergence of forward and spot prices at maturity of the forward contracts. In line with the procedures of the *Coffee and Cocoa Council*, we convert all price and origin differential data from British pound to the local currency, FCFA, according to the daily exchange rate.

¹² International auditing firms detected governance issues in 2014 and 2017 relating to the management of contracts with exporters and modalities of the Forward Sales Programme. However, the World Bank later concluded that the firms' recommendations were implemented, which it had set as a prerequisite for a financing agreement with the *Council* in 2018.

¹³ If the difference was instead distributed among value-chain actors proportionally to the existing regulated price schedule, this increase would amount to 12%.

¹⁴ Similarly, the price difference increased to 4.8% when extending the analysis to the period from 2015 to 2021, which includes the introduction of the LID.

¹⁵ In our sample, as many as 31% of cocoa farmers sell at least some certified cocoa. Sellare et al. (2020) stress the interaction of certification and cooperatives for agricultural yields.

¹⁶ The degree of diversification is captured by the Shannon Diversity Index, where a higher value indicates a higher degree of diversification (Sibhatu and Qaim 2018; Tesfaye 2022).

¹⁷ Figure C1, which expresses farm-gate prices in current international dollars using purchasing power parity (PPP) conversion factors to make them more comparable from the farmers' perspective, confirms this finding.

¹⁸ Given evidence that income elasticities are highest in services (Comin et al. 2021; McCullough 2025), interventions that foster service sector productivity could offer particularly promising avenues for broader economic development.

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Appendix A

A. Covariate Set and Additional Regression Results for Analysis of Farm-Gate Prices

The covariate set used in our econometric analysis of correlates with farm-gate prices is based on variable choices informed by our knowledge from the field and on variables that have been shown in the literature to be correlated with prices. Although *certified cocoa* is expected to increase farm-gate prices through premium payments (Sellare et al. 2020), land tenure security, captured by *land ownership*, as well as being a local rather than a migrant (captured by the binary variables indicating whether the interviewed farmer was *born in village* or *born outside the country*) have been shown to be negatively associated with investment, which in turn could negatively affect bean quality and thus prices received (Bros et al. 2019). For similar reasons, we include the *top quartile of household expenditures*, *formal education*, and age of the household head (specifically, by a binary variable on *household head aged 57 years or more*) as explanatory variables. In addition, several studies have pointed to the importance of different channels through which price information is conveyed, including radio, television, telephone, and the internet (Jensen 2007; Donner 2008; Muto and Yamano 2009). Specifically for cocoa, Wilcox and Abbott (2006) suggest the importance of farmer group/cooperative membership in countering buyer market power. We capture these aspects by controlling for farmers' *main source (of information) about agricultural markets* and two binary variables on the *type of buyer*. Similarly, we hypothesize that farmers with *awareness of LID*—that is, who are aware of the introduction of the then-new Living Income Differential (LID)—receive higher prices on average. We also include controls for the degree of local competition proxied by the *number of buyers in village during the main season*, and the degree of income diversification from crop sales, the latter variable being measured by a *Shannon diversity index* (Sibhatu and Qaim 2018; Tesfaye 2022). Higher values of the index indicate a higher degree of diversification, which Oomes et al. (2016) argue would afford farmers more bargaining power and an increased farm-gate price. Finally, we also include a variable capturing the condition of access to the farmer's home. As just over two-thirds of cocoa farmers report that they sell the cocoa beans from their homes, this variable of infrastructure quality can be considered a proxy for the remoteness of the point of sale. As

intermediaries are paid a flat price for the collection of cocoa beans from the farmer, transportation cost may induce intermediaries that have higher fuel and maintenance expenses to remote areas to deduct some of these costs from the farm-gate price (von Cramon-Taubadel and Goodwin 2021).

Table A1 presents our robustness check employing Lasso, which identifies some more variables as relevant than the variables included in our main estimation. We abstain from including these variables in our main estimation, for example due to stronger reverse causality concerns with variables such as the *amount of cocoa sold during the main season*.

TABLE A1 | Econometric results on correlates with cocoa prices in main season based on Lasso.

	Cocoa price (FCFA)	
	Coeff.	SE
Amount of cocoa sold during main season (kg)	−0.004***	(0.001)
Amount of cocoa sold during side season (kg)	0.001*	(0.000)
Amount of cocoa sold during entire crop year (kg)	0.006*	(0.003)
Income from selling cocoa during entire crop year (FCFA)	0.000***	(0.000)
Cocoa farming as main activity	35.232*	(18.100)
Land ownership	−23.702***	(8.887)
Area of land owned (ha)	0.172***	(0.037)
Total area of land parcels (ha)	−0.343***	(0.052)
Number of cultivated plots (#)	5.776	(3.900)
Degree of crop diversification (#)	−23.945*	(14.505)
Distance to plots (km)	0.012	(1.151)
Deforested land (ha)	−0.420***	(0.065)
Recently increased area of cultivated land	32.612***	(12.455)
Paid workers on plots	−19.409	(16.075)
Awareness of LID	14.644	(10.259)
Number of adults in household (#)	−2.736	(1.995)
Household head aged 57 years or more	−18.634*	(10.374)
Formal education	−4.370	(8.830)
Born in village	−21.018**	(9.408)
Top quartile of household expenditures	16.741	(11.678)
Fertiliser use	−9.249	(9.193)
Certified cocoa	18.150*	(9.417)
Main source about agricultural markets: Individual	−0.441	(10.884)
Main source about agricultural markets: Cooperative	28.966	(18.481)
Number of buyers in village during main season (#)	−0.268	(0.202)
Cooperative as buyer	11.346	(9.060)
Private or traitant as buyer	−14.137	(23.883)
Electricity access at home	28.866**	(12.075)
Access to house: Track in good condition all year	3.358	(13.483)
Access to house: Track in good condition in dry season	−12.506	(13.533)
Access to house: Path	−26.166	(21.743)
District dummies	Yes	
Number of observations	851	
R ²	0.166	

Note: Variables for which the unit is not given in brackets are binary variables. Robust SEs are in parentheses. ***, ** and * denote statistical significance of a two-sided *t*-test at the 1%, 5% and 10% levels, respectively.

Appendix B

Stationarity Tests Between the Farm-Gate and World Prices and ECM Robustness Test

TABLE B1 | Stationarity tests.

	ADF test		KPSS test	
	Levels	First differences	Levels	First differences
$\ln(pFCFA_{nom})$	-2.040	-5.901***	4.071***	0.484
$\ln(wFCFA_{nom})$	-2.382	-4.952***	4.096***	0.743
$\ln(pFCFA_{real})$	-2.878*	-5.932***	4.142***	0.075
$\ln(wFCFA_{real})$	-3.165**	-5.148***	4.164***	0.146
$pFCFA_{nom}$	-1.775	-5.358***	2.542***	0.826
$wFCFA_{nom}$	-2.024	-4.600***	2.921***	0.454
$pFCFA_{real}$	-2.793*	-5.423***	3.433***	0.132
$wFCFA_{real}$	-3.285**	-5.127***	3.789***	0.122

Note: ***, ** and * denote statistical significance of the augmented Dickey-Fuller (ADF) and KPSS tests at the 1%, 5% and 10% levels, respectively.

TABLE B2 | Econometric results of the error correction model with non-linear year trend.

	$\Delta \ln(pFCFA_{nom})$	$\Delta \ln(pFCFA_{real})$	$\Delta pFCFA_{nom}$	$\Delta pFCFA_{real}$
	Coeff./SE	Coeff./SE	Coeff./SE	Coeff./SE
$\Delta \ln(wFCFA_{nom})$	0.982*** (0.182)	—	—	—
$\Delta \ln(wFCFA_{real})$	—	0.988*** (0.209)	—	—
$\Delta wFCFA_{nom}$	—	—	0.529*** (0.060)	—
$\Delta wFCFA_{real}$	—	—	—	0.499*** (0.087)
$\Delta \ln(e_{nom})$	-0.301 (0.245)	—	—	—
$\Delta \ln(e_{real})$	—	-0.268 (0.382)	—	—
Δe_{nom}	—	—	-159.400 (213.660)	—
Δe_{real}	—	—	—	-319.736 (356.279)
ECT_{t-1}	-0.830** (0.334)	-0.830*** (0.202)	-0.915*** (0.288)	-0.835*** (0.197)
Year	-0.000 (0.018)	0.002 (0.019)	581.694 (7660.867)	1280.926 (9582.315)
Year $\times$ Year	0.000 (0.001)	0.000 (0.001)	10.034 (235.330)	-6.961 (282.228)
Number of observations	30	30	30	30
R^2	0.665	0.640	0.754	0.706
Cointegration test statistic	-4.539*	-4.561*	-4.815**	-4.571*

Note: SEs are in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

TABLE B3 | Econometric results of the error correction model excluding post-LID years.

	$\Delta \ln(pFCFA_{nom})$	$\Delta \ln(pFCFA_{real})$	$\Delta pFCFA_{nom}$	$\Delta pFCFA_{real}$
	Coeff./SE	Coeff./SE	Coeff./SE	Coeff./Std. Err.
$\Delta \ln(wFCFA_{nom})$	0.961*** (0.161)	—	—	—
$\Delta \ln(wFCFA_{real})$	—	0.940*** (0.221)	—	—
$\Delta wFCFA_{nom}$	—	—	0.521*** (0.052)	—
$\Delta wFCFA_{real}$	—	—	—	0.496*** (0.091)
$\Delta \ln(e_{nom})$	-0.271 (0.233)	—	—	—
$\Delta \ln(e_{real})$	—	-0.194 (0.400)	—	—
Δe_{nom}	—	—	-123.311 (219.910)	—
Δe_{real}	—	—	—	-278.675 (369.978)
ECT_{t-1}	-0.673** (0.254)	-0.650*** (0.194)	-0.725** (0.268)	-0.654*** (0.190)
Number of observations	28	28	28	28
R^2	0.621	0.583	0.720	0.660
Cointegration test statistic	-3.677	-3.588	-3.890**	-3.613

Note: SEs are in parentheses. *** and ** denote statistical significance at the 1% and 5% levels, respectively.

Appendix C

Living Income Differential and the Evolution of Farm-Gate Prices in PPP

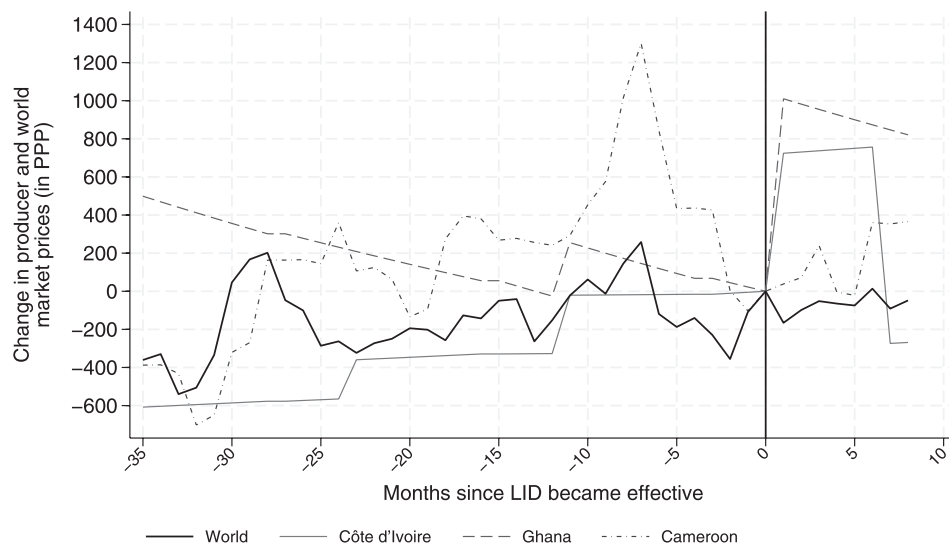


FIGURE C1 | Evolution of farm-gate and world market prices measured in current international dollars around the implementation of the LID. Annual purchasing power parity (PPP) conversion factors are taken from World Bank (2022) and converted to monthly data by intra-year interpolation. As conversion factors are only available until 2021, interpolation can only be computed until the middle of 2021 and the graph ends after May 2021. The LID became effective with the beginning of the cocoa crop year 2020/2021 in October 2020. $t=0$ therefore denotes September 2020. At that point in time, farm-gate prices in current international dollars were 3384 in Côte d'Ivoire, 3688 in Ghana and 4153 in Cameroon, whereas the US world market price was 2458.