

University of Ghana <http://ugspace.ug.edu.gh>

**IMPACT OF PRODUCER PRICE-RELATED REFORMS
ON THE COCOA SECTOR OF GHANA FROM 1920 TO 2022**

BY

KINSLEY DELANYO ADJEI

(10938969)

**A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES
UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF A MASTER OF PHILOSOPHY DEGREE
IN AGRICULTURAL ECONOMICS**

DEPARTMENT OF AGRICULTURAL ECONOMICS AND AGRIBUSINESS

COLLEGE OF BASIC AND APPLIED SCIENCES

UNIVERSITY OF GHANA, LEGON

NOVEMBER 2024

DECLARATION

I, Kinsley Delanyo Adjei, do hereby declare that the work presented in this thesis entitled “Impact of cocoa producer price-related reforms on the cocoa sector of Ghana from 1920 to 2022” was done exclusively by me as a graduate student at the Department of Agricultural Economics and Agribusiness, College of Basic and Applied Sciences, University of Ghana, Legon, Accra. I hereby declare that, except for specific references that have been duly acknowledged, this project is the result of my research work, and it has not been submitted either in part or whole for any other academic degree elsewhere.



.....
Kinsley Delanyo Adjei
(Student)

17 October 2025

.....
Date

This dissertation has been submitted for examination with our approval as supervisors:



.....
Professor Kwabena Asomanin Anaman
(Major Supervisor)

17 October 2025

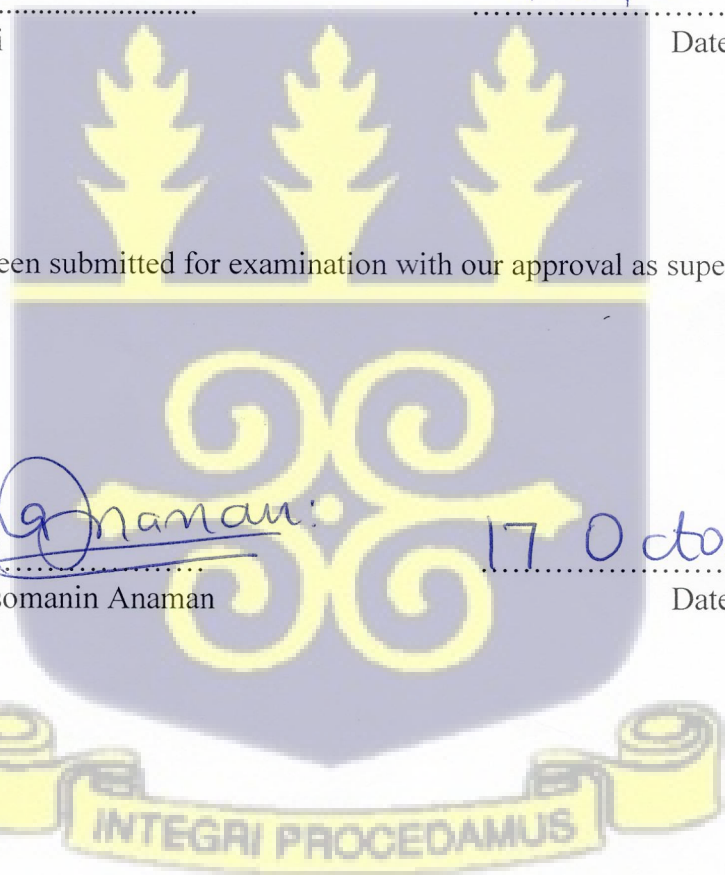
.....
Date



.....
Professor Daniel Bruce Sarpong
(Co-Supervisor)

17-10-2025

.....
Date



DEDICATION

I dedicate this thesis to my late father, Mr. Francis Adjei, my mother, Mrs. Happy Adjei and my siblings, Ms. Mavis Fafali Adjei, Mr. Evans Elikem Adjei, Mr. Philemon Hornameter Adjei and Ms. Samuella Mawumenyo Adjei.



ACKNOWLEDGEMENTS

First, I thank the Almighty God for His Guidance that allowed me to complete this study. Secondly, I am very grateful to my supervisors, Professors Kwabena Asomanin Anaman and Daniel Bruce Sarpong, for their support and constructive suggestions. I appreciate the help of Dr. Tharcisse Nkuzima, Ms. Zoe Druilhe, and Ms. Elizabeth Adorkor Gyamfi in obtaining data from the International Cocoa Organisation. I am also grateful to Professor Houssa Romain and Professor Francisca Monti for broadening my knowledge of time series econometric modelling. I am grateful to Professor Rajshri Jayaraman for her mentorship. I also express my gratitude to my exchange programme coordinators and professors at the Universite Catholique de Louvain, Belgium, Professor Daniel Bruce Sarpong, Emeritus Professor Bruno Henry de Frahan, Professor Frederic Gaspart and Professor Goedele Van den Broeck, who made my stay in Belgium worthwhile.

My gratitude is extended to all faculty members and staff members of the Department of Agricultural Economics and Agribusiness for their considerable support over my two years of Master of Philosophy studies at the University of Ghana. The names of staff members are mentioned alphabetically based on their first names as follows: Dr. Abigail Ampomah Adaku, Professor Akwasi Mensah-Bonsu, Dr. Ama Asantewah Ahene-Cudjoe, Dr Charles Yaw Okyere, Reverend Professor Edward Ebo Onumah, Mrs. Efua Yayra Goka, Ms. Emma Adom, Mr. Emmanuel Nii Anetey, Mr. Ernest Sowah, Dr. Freda Elikplim Asem, Professor Irene Susana Egyir, Dr. John Baptist Donsaanang Jatoo, Mr. Kennedy Boateng and Dr. Yaw Bonsu Osei-Asare. I also thank Messrs. Daniel Mettle, Desmond Ayertey, Emmanuel Kove, Oscar Kwame Sottie, Ms. Michelle Segla and Ms. Sarah Kekli for their support during my stay in Belgium. Finally, I thank my mother, Mrs. Happy Adjei, my brothers, Messrs. Evans Elikem Adjei and Philemon Hornameter Adjei, and my sisters, Ms. Mavis Fafali Adjei and Ms. Samuella Mawumenyo Adjei. May God richly bless you all for your support and inspiration.

ABSTRACT

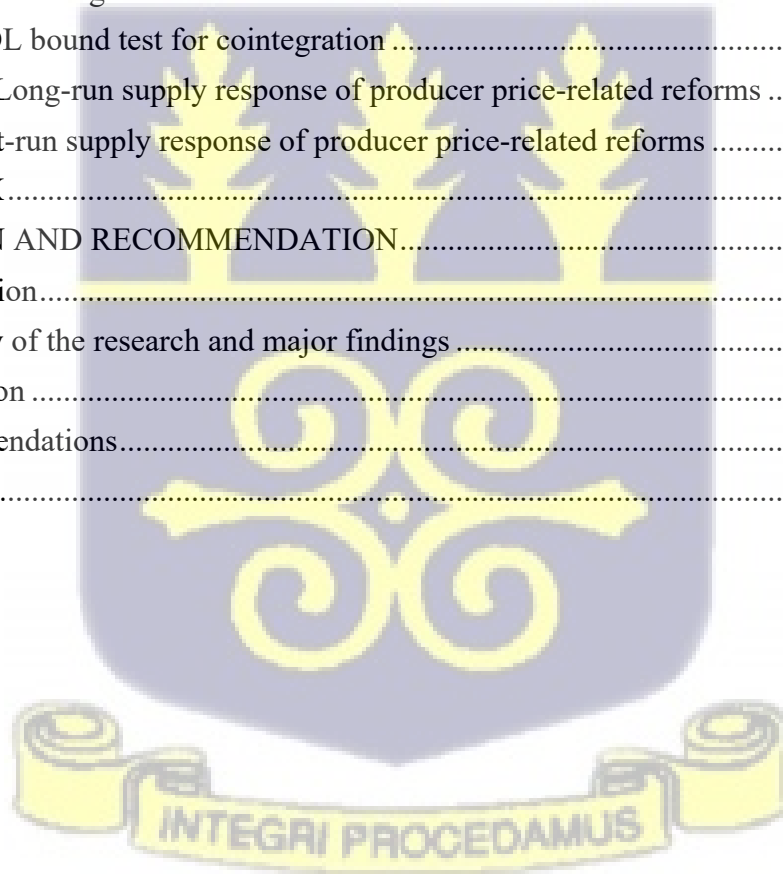
Ghana's cocoa industry has been the backbone of its agricultural economy for more than a century, providing employment, foreign exchange, and rural livelihoods. This study assesses the impact of producer price-related reforms on Ghana's cocoa sector, focusing on their influence on farmers' producer prices, the proportion of free-on-board (FOB) prices paid to farmers, price volatility, and cocoa output. This study provides critical insights into the dynamics of producer price reforms and their implications for policy and cocoa sector sustainability. Using annual data from 1920 to 2022, the analysis spans nine reform periods: the Colonial and free market era (1920-1946), the Cocoa Marketing Board (CMB) (1947-1951), Pre-Republic era (1952-1956), Nkrumah era (1957-1965), Downturn era (1966-1983), average production cost (COP) era (1984-1997), Negotiation era (1998-2000), Net FOB era (2001-2018) and the LID era (2019-2022). Data analysis employed R, Gauss, Gretl, and Microfit software, utilizing Bayesian structural time series for causal impact assessment, the Relative Price Index (RPI) for FOB price proportion, adjusted absolute mean deviation (AMAD) for price volatility, and the Autoregressive Distributed Lag (ARDL) model for long-run effects on cocoa output. The results show that market-oriented reforms yielded the strongest price incentives. The RPI, representing the farmers' share of the export price, averaged 65.23% during the Colonial era, 49.01% under the Cocoa Marketing Board (CMB) era, 50.19% in the Pre-Republic era, 64.59% during the Nkrumah era, 66.21% in the "Downturn" era, 49.92% in the Cost of Production (COP) era, 82.08% under the Negotiation era, 65.81% during the Net FOB era, and 72.71% during the Living Income Differential (LID) era. These figures indicate a general improvement in the farmers' share of export earnings over time, particularly under liberalised and negotiated pricing mechanisms. Causal impact analysis further revealed that producer prices increased by 4.6% during the Negotiation reform, 7.2% under the Net FOB reform, and only 0.66% during the LID era, suggesting that recent reforms have had limited effectiveness despite pro-poor intentions. Volatility analysis showed that price instability was highest during the Colonial and CMB eras (ranging between 40-70%) and lowest during the Net FOB and COP reforms (8.46% and 28.04%, respectively), highlighting the stabilising effects of reforms that aligned domestic pricing with global market mechanisms. The long-run ARDL estimates confirmed that Ghana's cocoa supply remains price-inelastic, with a producer price elasticity of 0.259 ($p = 0.069$), implying that a 1% increase in the real producer price raises cocoa output by just 0.26%. Rainfall (2.238; $p = 0.022$) exerted the strongest positive long-run effect, underscoring the dependence of production on climatic conditions. The trend coefficient (0.018; $p = 0.000$) suggests a gradual productivity gain over time. Among reform dummies, the Nkrumah era (0.473; $p = 0.037$) had a significant positive long-run impact, attributed to state investment in farm rehabilitation, extension services, and cooperative development. In contrast, the CMB (-0.254) and LID (-0.464) periods exhibited negative coefficients, implying weaker output responses under excessive central control and no policy transmission. The El Niño variable (-0.524; $p = 0.051$) revealed a dampening effect on output, highlighting Ghana's vulnerability to extreme weather. Cocobod should enhance the role of producer organizations, cooperatives, and civil society in price determination and promoting local value addition and processing. National regulators should undertake a comprehensive review of existing pricing arrangements along the cocoa value chain to identify inefficiencies and areas of rent loss. Also, attention should be given to the forward sales system, which determines export prices and indirectly influences farmgate prices. By revisiting this mechanism could help ensure that producers capture a greater share of the global cocoa price and benefit more directly from price upswings.

TABLE OF CONTENTS

DECLARATION	i
DEDICATION.....	ii
ACKNOWLEDGEMENTS.....	iii
ABSTRACT.....	iv
LIST OF TABLES.....	viii
LIST OF FIGURES	ix
LIST OF ACRONYMS	x
CHAPTER ONE.....	11
INTRODUCTION	11
1.1 Background.....	11
1.2 Problem statement.....	16
1.3 Objectives	20
1.4 Relevance of the study	21
1.5 Organisation of the Study	21
CHAPTER TWO	22
LITERATURE REVIEW	22
2.1 Introduction.....	22
2.2 Evolution of the cocoa industry: Historical, cultural, and ethical perspectives.....	22
2.3 World cocoa production between the 1920s and 2020s.....	24
2.3.1 Cocoa in the early 20th century (1920-1945).....	25
2.3.2 Post-World War II era (1945-1980s).....	27
2.3.3 Certification and Sustainability Era (1990s - 2000s).....	28
2.3.4 Global shifts and emerging constraints (2000s–2020s).....	29
2.3.5 Synthesis: Production trends and the rationale for producer price reforms.....	32
2.4 Efforts to improve the livelihood of cocoa farmers.....	34
2.5 Formation of world price of cocoa.....	35
2.6 Political economy of cocoa production and pricing in Ghana.....	36
2.6.1 Path dependence and colonial legacy	36
2.6.2 Cocoa, the Economy, and the State	37
2.6.3 Cocoa, politics, and independence (1950s-1960s).....	38
2.6.4 Post-coup liberalisation and decline (Late 1960s-1970s).....	40
2.6.5 Crisis, structural adjustment, and reform (1980s-1990s).....	41
2.6.6 Climate shocks, price booms, and busts	43
2.6.7 Financialisation and international market dynamics (1990s-2010s)	44
2.6.8 Stakeholders and interest groups in cocoa pricing.....	46
2.7 Institutional price-related reforms in Ghana.....	48

2.7.1 Colonial governance (1920-1946)	48
2.7.2 Cocoa Marketing Board (1947-1960).....	49
2.7.3 Ghana Cocoa Board (COCOBOD) (1960-1983).....	50
2.7.4 Multistakeholder Producer Price Review Committee (PPRC).....	53
2.7.5 Net free on board (FOB) mechanism.....	54
2.7.6 The living income differential (LID)	56
2.8 The impact of price reforms on producer prices.....	56
2.9 International trade theories dealing with agricultural commodities	59
2.9.1 Theory of absolute advantage (Adam Smith)	59
2.9.2 Theory of comparative advantage (David Ricardo).....	59
2.9.3 Neoclassical formulations: Opportunity cost and supply response	60
2.9.4 Heckscher-Ohlin factor endowment theory	60
2.9.5 The Prebisch-Singer hypothesis and structuralist critique.....	61
2.10 Review of prior studies and methods.....	61
2.10.1 Agricultural supply response: the Nerlove tradition.....	61
CHAPTER THREE	64
METHODOLOGY	64
3.1 Introduction.....	64
3.2 Theoretical frameworks	64
3.2.1 The agricultural price fluctuation model.....	64
3.2.2 Price transmission from world to domestic markets.....	65
3.3 Conceptual Framework.....	67
3.4 Method of analysis.....	70
3.4.1 Unit root tests.....	70
3.4.2 Model selection criteria.....	75
3.5 Impact of price-related reforms on farmers' producer prices.....	76
3.6 Proportion of free-on-board prices received by farmers.....	78
3.7 Measuring the Volatility of the Producer Cocoa Price Under Each Reform.....	78
3.8 Effect of producer price reforms on cocoa output	79
3.8.1 Maki cointegration.....	79
3.8.2 Autoregressive distributed lag (ARDL) model.....	80
3.9 Study design and data sources	81
CHAPTER FOUR.....	83
RESULTS AND DISCUSSION.....	83
4.1 Introduction.....	83
4.2 Descriptive statistics	83
4.3 Tests of stationarity.....	85

4.3.1 Unit root test without structural break	85
4.3.2 Unit root test in the presence of break	85
4.4 Impact of price-related reforms on producer prices.....	87
4.4.1 Causal impact analysis on producer price related reform.....	87
4.5 Proportion of Free-on-Board prices received by farmers	91
4.6 Producer price volatility under each reform	94
4.7 Discussion of results	95
CHAPTER FIVE	101
RESULTS AND DISCUSSION OF SUPPLY RESPONSE OF PRODUCER PRICE-RELATED REFORMS ON COCOA SECTOR OF GHANA FROM 1920 TO 2022	101
5.1 Introduction.....	101
5.2 The evolution of producer prices and production across reform periods	101
5.3 Unit root test of variables.....	104
5.4 Cointegration analysis of the supply response of producer price-related reforms.....	105
5.4.1 Maki cointegration.....	105
5.4.2 ARDL bound test for cointegration	106
5.4.3 The Long-run supply response of producer price-related reforms	107
5.4.4 Short-run supply response of producer price-related reforms	108
CHAPTER SIX.....	110
CONCLUSION AND RECOMMENDATION.....	110
6.1 Introduction.....	110
6.2 Summary of the research and major findings	110
6.3 Conclusion	113
6.4 Recommendations.....	114
References.....	116



LIST OF TABLES

Table 2.1. World cocoa from 1990 to 2022 in 1000 Metric Tonnes30
Table 2.2. Producer price-related institutional changes in Ghana’s cocoa sector, 1920–202258
Table 4.1. Descriptive statistics of variables84
Table 4.2. Results of the stationarity test.....86
Table 4.3. Stationarity with structural breaks86
Table 4.5. Causal impact of producer price-related reforms on the producer price90
Table 4.6. Producer price to FOB relative index92
Table 5.1. Descriptive statistics of producer price and production price by reform era..... 103
Table 5.2. Stationarity test for variables 105
Table 5.3. Stationarity with structural breaks for variables 105



LIST OF FIGURES

Figure 1.1. Cocoa Production Trends in Ghana, La Côte D’Ivoire, and the World (1946–2022) 12

Figure 2.1. Acreage, Production and Yield of Cocoa in Ghana (1961-2021)31

Figure 2.2. Trends of Regional Cocoa Production in Ghana.....37

Figure 2.3. Ghana and World Cocoa Prices (1920-2022).....52

Figure 2.4. Ghana and World Cocoa Production (1920-2022).....52

Figure 2.5. Origin Differential in Europe and the United States of America53

Figure 3.1. Conceptual Framework68

Figure 4.4. Nominal and real cocoa prices (100=2013) in USD per tonne93

Figure 4.5. Nominal and real cocoa prices (100=2013) in Ghana cedis per tonne.....93



LIST OF ACRONYMS

ARCP	Agricultural Reform and Credit Program
ASAP	Agricultural Reform Adjustment Program
BSTS	Bayesian Structural Time Series
CMB	Cocoa Marketing Board
COCOBOD	Ghana Cocoa Board
COP	Average Producer Cost
CSSVD	Cocoa Swollen Short Virus Disease
ERP	Economic Recovery Program
FOB	Free on Board
GCCSFA	Ghana Cocoa, Coffee and Shea nut Farmers Association
GHS	Ghana Cedis
LBC	Licensed Buying Company
LID	Living Income Differential
PBC	Producer Buying Company
PPRC	Producer Price Review Committee
UGFCC	United Ghana Farmers' Cooperative Council
USD	United State Dollar
WACCB	West African Cocoa Control Board
WAM	West Africa Mills
WAPCB	West African Producer Control Board



CHAPTER ONE

INTRODUCTION

1.1 Background

Cocoa (*Theobroma cacao*) is a primary ingredient in chocolate and a major tropical cash crop traded on global markets. It is cultivated on more than 11 million hectares, which serve as a source of livelihood for smallholder farmers in over sixty countries (FAO, 2021; Kozicka et al., 2018). A bulk of global supply of cocoa originates from West Africa, which accounts for over 70% of global production. Within this, Côte d'Ivoire (46.6%) and Ghana (14.1%) together accounted for more than three-fifths (60.7%) of the world's cocoa output in 2020 (ICCO, 2022b). This concentration highlights the dependence of the global chocolate industry on West African producers. As shown in Figure 1.1, cocoa production in Ghana, Côte d'Ivoire, and the world has exhibited notable fluctuations between 1946 and 2022, highlighting both global dynamics and country-specific trends.

Cocoa arrived in Ghana under British colonial rule, with the intention of developing a tradable commodity (Higgs, 2012; Lekane & Asuelime, 2017). This shift led farmers toward a labour-intensive cash crop, which exposed cocoa farmers to external market risk since cocoa was not relied upon for domestic consumption. Cocoa production was fuelled by seasonal migrants from the northern part of Ghana, a drier and poorer region where the use of child labour resulted in a major shift in social, generational, and gender relations in southern Ghana (Allman, 1994; Sadhu et al., 2020; Yaro et al., 2021). Colonial authorities used cocoa revenues primarily for fiscal extraction, a practice that persisted post-independence, making cocoa central to public finance. This reflects the enduring colonial legacy of taxing primary exports to fund state expenditure (Ajeigbe et al., 2023; Herbst, 1993; Kolavalli & Vigneri, 2011).

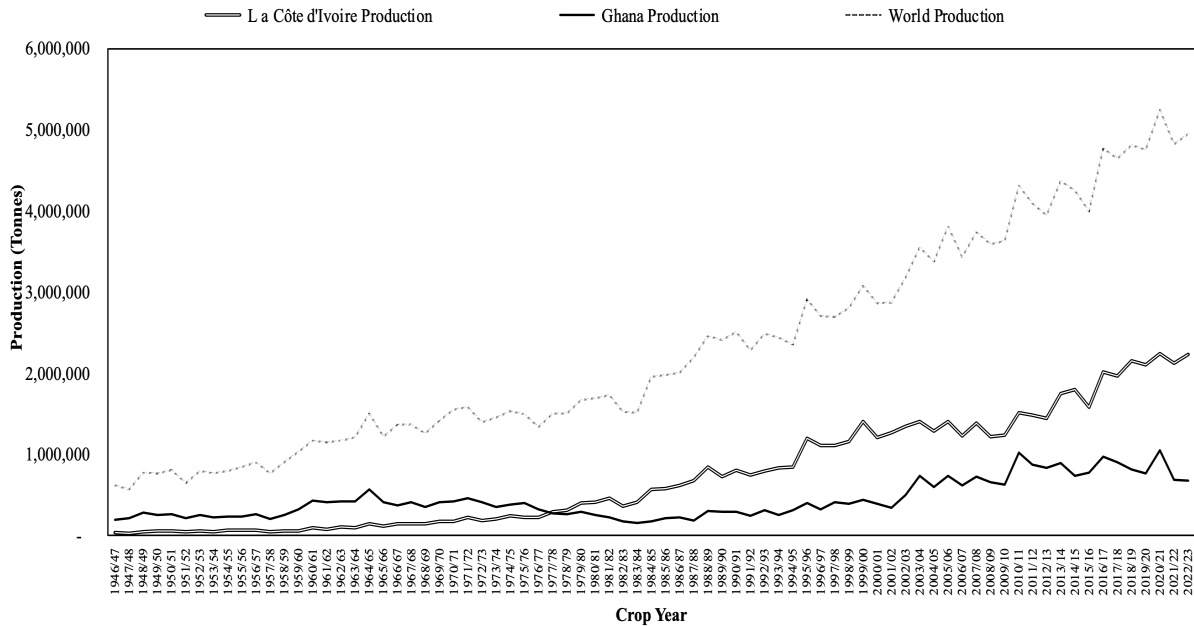


Figure 1.1. Cocoa Production Trends in Ghana, La Côte D’Ivoire, and the World (1946–2022)

Source: Author’s illustration based on data from the ICCO.

For Ghana, cocoa is more than a commercial crop. It is a cornerstone of the national economy and rural development. Since the early twentieth century, cocoa has been the leading agricultural export, generating foreign exchange, fiscal revenues, and promoting rural employment (Clarence-Smith, 2000; Kolavalli & Vigneri, 2017). The Ghana Statistical Service (GSS) reported that in 2016, cocoa contributed USD 2.7 billion, equivalent to 25% of the country’s total export earnings (GSS, 2018). Between 2007 and 2017, the industry contributed an annual average of 2.5% to GDP (GSS, 2018), while FAO (2019) estimated cocoa exports at 3.9% of GDP. Beyond its macroeconomic significance, cocoa provides direct livelihoods for over 850,000 farming families (Oreamuno & Croppenstedt, 2023). In 2018, the Census of Agriculture reported that cocoa supported about 619,866 agricultural households (GSS, 2020).

Despite the economic relevance of cocoa in Ghana, the sector faces long-standing structural challenges. Production growth has historically been driven more by area expansion into forest

zones rather than by productivity gains, a process that fuels deforestation and environmental degradation (Kalischek et al., 2023; Ongolo et al., 2018). Farmers remain vulnerable to pest infestations and climate variability (Ruf et al., 2015; Schroth et al., 2016). At the household level, due to seasonality of production, incomes are unstable and often fall short of providing a living wage: between 73% and 90% of West African cocoa farmers are unable to achieve a sustainable income threshold (van Vliet et al., 2021; Boysen et al., 2023). Meanwhile, global value distribution is highly unequal, with multinational processors and chocolate manufacturers in Europe and North America capturing the largest share of industry profits. In 2022, the global chocolate market was valued at USD 56.8 billion (GCB Bank PLC, 2023), however Ghanaian farmers received only a small fraction of that wealth.

At the core of this disparity lies how producer prices are determined. The producer price, which is the share of export revenues paid to farmers, is the most critical factor affecting smallholder welfare in Ghana (Gilbert, 2009; Quarmine et al., 2014). Since the 1920s, governments and colonial administrators have repeatedly interfered in the pricing system, using it both to stabilize farmer incomes and to generate public revenue (Herbst, 1993; Kolavalli & Vigneri, 2011). These interventions have taken many forms, including the establishment of a regulatory board, known as the Cocoa Marketing Board (CMB), under British colonial rule. This was followed by various changes in government policy, from the producer price policies under Ghana's first president; Dr. Kwame Nkrumah, in the 1950s to reforms during structural adjustments in the 1980s, partial liberalization of marketing in the 1990s, Free on-Board prices (FOB) in the 2000s, and most recently, the introduction of the Living Income Differential (LID) in 2019 (Kolavalli & Vigneri, 2011; Quarmine et al., 2014; van Vliet et al., 2021). Although these reforms aimed to shield farmers from global market volatility, improve their livelihood income and state revenue, their success in providing stable and fair prices for farmers remains contested (Gilbert, 2009; Waarts et al., 2021).

The history of producer price reforms in Ghana reflects the intersection of economic policy, political priorities, and global market dynamics. During the colonial period, cocoa was traded under a largely free-market system, with farmers selling to private merchants who exported beans to Europe (Amoah, 1998; Lundstedt & Pärssinen, 2009). The producer prices paid under the colonial government were low, leading farmers to refuse selling their produce to traders, which resulted in a cocoa hold-up in 1930 and between 1937 and 1938 (Milburn, 1970; Southall, 1978). This led to the establishment of the Cocoa Marketing Board (CMB). The Board institutionalised state control over cocoa marketing and pricing, fixing producer prices at the start of each season while using export revenues as a source of public finance (Herbst, 1993; Kolavalli & Vigneri, 2011).

Following independence in 1957, the pricing system became even more central to Ghana's political economy. Under the first president of Ghana, Dr. Kwame Nkrumah, cocoa revenues were taxed to finance ambitious industrialisation and social programs, while producer prices were maintained at levels below the world market (Acquaah, 1999; Ajeigbe et al., 2023). Although this strategy generated critical public revenues, it undermined farmer incentives and contributed to widespread dissatisfaction in cocoa-growing regions. Political instability in subsequent decades, particularly during the period 1966 -1983, was accompanied by further distortions in producer pricing (Kolavalli & Vigneri, 2017). The level of inflation, exchange rate misalignments, and falling world prices eroded the real value of producer earnings, leading to reduced investment in farms and widespread smuggling of beans to Côte d'Ivoire, where farm-gate prices were higher (Gilbert, 2009; Kolavalli & Vigneri, 2017).

The economic crisis of the early 1980s and Ghana's adoption of Structural Adjustment Programs (SAPs) marked a turning point in producer price reforms. From 1984 to 1997, the government introduced a "cost of production" pricing system, under which producer prices

were set to reflect farmers' production costs while aiming to stabilise incentives (Varangis & Schreiber, 2001; Quarmine et al., 2014). These reforms were accompanied by a partial liberalisation of internal marketing, allowing private licensed buying companies (LBCs) to compete with the state in purchasing beans. However, external marketing remained under the control of CMB (rebranded as COCOBOD), which used stabilisation funds to cushion farmers from world market shocks (Grumiller et al., 2018; Kolavalli & Vigneri, 2011).

Between 1998 and 2018, further adjustments sought to enhance efficiency and align domestic pricing more closely with international markets. There were negotiations between farmers and the COCOBOD between 1998 and 2000 to establish a fair producer price for farmers. In 2001, the “net free-on-board (FOB) pricing” system was introduced, which linked farm-gate prices more directly to export revenues. It promised to transfer at least 70% of net FOB prices to farmers (Quarmine et al., 2014; van Vliet et al., 2021). In practice, however, fiscal pressures and marketing costs often reduced the share received by producers, leaving them with limited gains from international price booms (Kaplinsky, 2004). These frustrations persisted despite Ghana maintaining a reputation for quality cocoa and relative institutional stability compared to other producers.

More recently, in 2019, Ghana and Côte d'Ivoire jointly negotiated for the Living Income Differential (LID), adding USD 400 per tonne to the export price of cocoa in an effort to raise farmer incomes (Aboa, 2022; Boysen et al., 2023). While the LID represented a novel attempt at collective bargaining on the global stage, evidence suggests that traders and processors adjusted other price components, particularly the country differential, to offset its impact. Consequently, the gains to farmers have been limited (van Vliet et al., 2021; Waarts et al., 2021). This outcome illustrates the persistent difficulty of translating international price reforms into tangible improvements in farmer welfare.

Commodity dependence remains a major developmental constraint for many countries, including Ghana (Tröster et al., 2019). In the cocoa sector, volatile world prices, macroeconomic pressures, and structural exposures limit fiscal capacity while intensifying socioeconomic vulnerabilities in rural communities (Nissanke, 2019). Ghana's heavy reliance on raw cocoa exports, coupled with the limited development of a domestic processing industry, reduces economic resilience to global price swings. These conditions highlight the central role of government policies and producer price reforms in shaping both farmer incomes and the long-term sustainability of the cocoa sector.

This study, therefore, situates Ghana's cocoa economy within a century-long trajectory of producer price reforms. By systematically analysing the impact of these reforms on producer prices, farm-gate shares of export revenues, price volatility, and production outcomes, the research aims to clarify whether institutional innovations have succeeded in improving farmer welfare or whether fundamental vulnerabilities remain entrenched.

1.2 Problem statement

It is generally hypothesised that institutional innovation systems create production and price incentives for farmers (Quarmin et al., 2014). In Ghana, where cocoa is central to both the national economy and rural livelihoods, the determination, distribution, and stabilisation of producer prices has remained a persistent source of debate. Since the 1920s, successive governments have introduced producer price-related reforms defined as institutional and policy interventions to regulate farm-gate prices and revenue flows in the cocoa sector. The stated aim was to protect smallholders from the volatile global market, secure government revenue, and sustain Ghana's position as a leading cocoa exporter (Kolavalli & Vigneri, 2011; van Vliet et al., 2021, Quarmin et al., 2014). However, the effectiveness of these reforms in raising farmer

incomes and fostering long-term sectoral sustainability remains highly contested (Acquaah, 1999; Gilbert, 2009; Waarts et al., 2021).

A critical dimension of the problem is the limited share of international cocoa revenues that accrues to farmers. Historical evidence demonstrates that, during both the colonial and post-independence periods, producer prices were deliberately kept below world market levels as governments extracted rents to finance state-led development programmes (Herbst, 1993; Acquaah, 1999). Despite reforms under structural adjustment and liberalisation intended to secure farmers at least 70% of net free-on-board (FOB) prices, the realised share accruing to producers has frequently fallen below this threshold, diminished by marketing costs, exchange-rate pass-through, and fiscal burdens (Quarmin et al., 2014; Kolavalli & Vigneri, 2017). Policy remedies, notably the Living Income Differential (LID) introduced in 2019, were expected to narrow this gap. Yet market actors, traders and processors countered by rebalancing other price elements, including the country differential, thereby negating much of the anticipated gain (Waarts et al., 2021). This leakage leaves Ghanaian cocoa farmers among the least compensated participants within the global cocoa–chocolate value chain.

Price volatility further compounds these challenges. Ghana's Cocoa Board (COCOBOD) maintains a stabilisation fund that partially cushions farmers against extreme swings in world prices, but this mechanism has also constrained the extent to which producers benefit during price booms. For example, while international cocoa prices surged to a record high of USD 12,567 per tonne in London and USD 11,878 in New York in April 2024, up from USD 2,924.37 in April 2023, farm-gate prices in Ghana increased only marginally (ICCO, 2024). This asymmetric transmission of global prices reinforces perceptions among farmers that producer price-related reforms were not designed to convert favourable market conditions into

higher incomes. As a result, producers remain disproportionately exposed to global risks while excluded from global windfalls.

Beyond domestic reforms, broader structural changes in the global cocoa value chain also shape producer prices. Cocoa production has become increasingly concentrated in a few West African countries such as Ghana, while processing and trading activities are dominated by a handful of multinational firms (Boysen et al., 2023; Krauss & Barrientos, 2021; Thorlakson, 2018). This concentration gives large international buyers significant leverage in price negotiations and, together with taxes and duties imposed along the chain, further constrains the share of export revenues that accrues to farmers. These dynamics highlight the importance of examining how the organisation of the cocoa supply chain influences the stability of internal prices, the relative producer share of export earnings, and the policies that shape these outcomes (El Makhloufi et al., 2018; Kolavalli & Vigneri, 2011; Vellema et al., 2007).

The socioeconomic consequences of ineffective price reforms are severe. Persistently low and unstable incomes undermine farmers' capacity to invest in productivity-enhancing technologies, rehabilitate ageing farms, or adopt sustainable practices (Afari-Sefa et al., 2010; Laven & Boomsma, 2012). With an estimated 23% of Ghana's cocoa farms exceeding 30 years of cultivation, productivity is declining, while expansion into new forest areas has accelerated deforestation and environmental degradation (Oyekale, 2020; Suh & Molua, 2022). Farmer dissatisfaction with domestic prices has also encouraged cross-border smuggling of cocoa beans and the conversion of plantations into alternative land uses such as illegal mining. These dynamics threaten not only Ghana's export earnings but also the broader social and ecological foundations of rural livelihoods (Adombila, 2024).

At a broader level, these challenges reflect the dual role of cocoa in Ghana's political economy: as both a livelihood source for millions of smallholders and a fiscal anchor for the state.

Successive governments have relied heavily on cocoa revenues to finance public expenditure, often at the expense of producer welfare (Herbst, 1993; Ajeigbe et al., 2023). This structural tension between revenue extraction and farmer incentives has shaped nearly a century of reform, without resolving the central problem of ensuring fair and stable farm-gate incomes.

Although existing studies have examined cocoa pricing, liberalisation, and market volatility, most focus on discrete reform episodes or relatively short timeframes (Varangis & Schreiber, 2001; Kolavalli & Vigneri, 2017; Anim-Kwapong & Anno-Nyako, 2020). What remains underexplored is a comprehensive, long-term assessment of the cumulative effects of producer price reforms across Ghana's cocoa history from the colonial free-market era (1920–1946), through the establishment of the Cocoa Marketing Board, Nkrumah's administration, price-adjustment reforms, cost of production (COP) mechanisms, to the net-FOB and LID frameworks of recent years (Kolavalli & Vigneri, 2011; Quarmin, 2012; Ludlow, 2012). Without such analysis, it is difficult to assess whether reforms have substantively improved farmer livelihoods, stabilised incomes, and incentivised sustainable production, or whether they have simply redistributed the burden of global volatility in different forms.

Ghanaian cocoa is globally recognised as high-premium quality, owing to strict post-harvest quality control measures (Anang et al., 2011; Owusu-Ansah et al., 2024; Boateng, 2022; Kotey, 2022; Adams, 2024). Because this reputation depends on consistent bean quality, farmers invest in careful production practices; this, in turn, highlights the importance of a competitive and stable producer-price system that adequately rewards farmers while securing the sector's long-term viability. Understanding the historical and contemporary dynamics of producer price reforms is therefore crucial for identifying pathways toward more equitable and resilient outcomes.

This research seeks to answer the following questions:

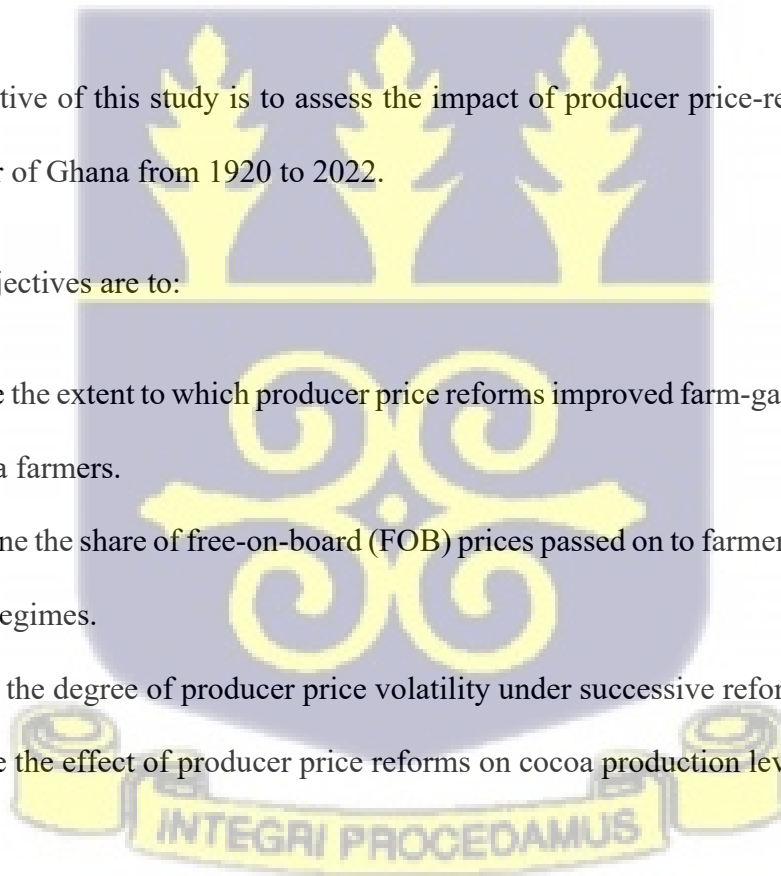
1. Have producer price-related reforms improved the farm-gate prices received by cocoa farmers across different institutional regimes?
2. What proportion of free-on-board (FOB) prices has been transferred to farmers under each reform period?
3. How has the volatility of producer prices evolved under successive reforms?
4. What has been the effect of producer price-related reforms on cocoa production outcomes in Ghana?

1.3 Objectives

The main objective of this study is to assess the impact of producer price-related reforms on the cocoa sector of Ghana from 1920 to 2022.

The specific objectives are to:

1. Evaluate the extent to which producer price reforms improved farm-gate prices received by cocoa farmers.
2. Determine the share of free-on-board (FOB) prices passed on to farmers across different reform regimes.
3. Analyse the degree of producer price volatility under successive reform periods.
4. Examine the effect of producer price reforms on cocoa production levels over time.



1.4 Relevance of the study

Cocoa is central to Ghana's economy, generating export earnings, rural employment, and fiscal revenue (Kolavalli & Vigneri, 2011). Existing literature treat specific episodes or reforms in isolation, leaving limited longitudinal evidence on how state marketing institutions especially the Cocoa Marketing Board/COCOBOD, and subsequent liberalisation have shaped farmer incentives and sector performance over time. By tracing producer-price reforms from 1920 to 2022, a period spanning colonial control, post-independence state-led marketing, and partial liberalisation, this study provides an integrated assessment across shifting political economic contexts. It shows, first, how reform design affected farmgate incentives, incomes, and the uptake of productivity and sustainability practices (Quarmin, 2012); second, how institutional arrangements and market opening influenced marketing efficiency, public revenue, and Ghana's international competitiveness (Williams, 2009); and third, how enduring constraints political interference, price rigidity and instability, and quality control challenges have limited reform payoffs (Ludlow, 2012; Anang et al., 2011). The findings offer an evidence base for policies that improve farmer welfare, strengthen institutional performance, and support sustainable growth of Ghana's cocoa sector.

1.5 Organisation of the Study

The thesis is organised into five chapters. Chapter 1 introduces the background and motivation, states the problem, poses the research questions, and derives the objectives that structure the inquiry. Chapter 2 reviews literature on global cocoa production, the political economy of the sector, Ghana's pricing institutions and reforms, their effects on producer prices, and relevant trade theories. Chapter 3 explains the methodology: theoretical and conceptual frameworks, research design, data sources, variables, and procedures for collection and statistical analysis. Chapter 4 presents and interprets the results. Chapter 5 synthesises the findings, draws conclusions, offers recommendations, and outlines directions for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature on the impact of price-institutional reforms on the cocoa sector of Ghana. This chapter begins with the evolution of the cocoa industry, history, cultural and ethical perspectives. It was followed by world cocoa production between 1920 and 2022, then the political economy of cocoa, the formation of world price, the institutional producer price-related reforms in Ghana and the impact of price reforms on producer price. The final parts of the chapter review the empirical evidence of the international trade theories dealing with agricultural commodities.

2.2 Evolution of the cocoa industry: Historical, cultural, and ethical perspectives

Cocoa, also called cacao, comes from the seeds of the cacao tree (*Theobroma cacao*). These seeds are used to produce chocolate, cocoa butter and other cocoa solids. The cacao tree was cultivated more than 3,000 years ago by the Maya, Toltec, and Aztec people in Mexico and other hot areas of America (Colombo *et al.*, 2012; Lentz, 1991; Poelmans & Swinnen, 2016). The Maya people of Central America held the tree in high regard and considered chocolate made from its seeds to be the meal of the gods. This belief can be reflected in the tree's scientific name, Theo, which means "god," and Broma, which means "food." (Frydenborg, 2015; Colombo *et al.*, 2012). Cacao trees grow best in shaded, wind-protected regions in tropical zones near the equator, with high temperatures, high precipitation and humidity (Läderach *et al.*, 2013; Swales, 1999; Waldburger *et al.*, 2019). A single cacao pod contains 20 to 60 beans and a white pulp; each bean contains approximately 55% cocoa butter (Anoraga *et. al.*, 2024; Fowl & Coutel, 2017).

Aztecs and Mayans enjoyed cocoa beverages due to their health benefits and ability to heal diseases (Gürsoy & Heperkan, 2020; Dillinger et al., 2000). In Aztec society, cocoa was highly valued, used in elite and sacred rituals, and even served as a form of currency for barter trade (Dreiss & Greenhill, 2008; Foster & Cordell, 1992). After the cultivation of cocoa had spread to other European courts, cocoa was seen as a stylish beverage in France and England by the 17th century. The earliest cocoa shipment to European regions occurred in 1585, from Veracruz, Mexico, to Cadiz, Spain (Bond, 2011; Harwich, 2020; Toffano, 2021). The Spaniards were the first to add sweetness and flavours such as vanilla, cinnamon flavours, and honey to their cocoa beverage to improve taste and consumption (Clarence-Smith, 2000; Forster & Cordell, 1992)

The mass production of chocolate was primarily made possible by the industrial revolution (Poelmans & Swinnen, 2016; Cidell & Alberts, 2006). Technological developments made chocolate bars possible, increasing their accessibility to more people. The production of cocoa powder and the ultimate fabrication of solid chocolate resulted from modifications in processing techniques called Coenraad van Houten's invention in 1820, a process to separate cocoa butter from liquor to make a lighter and more nutritious cocoa powder (Chrystal, 2021; Li, 2018; Rosenblum, 2006). To accommodate the growing demand, European powers planted cocoa plantations in their colonies, especially in West Africa. This created ethical questions and resulted in worker exploitation (Robin, 2012; Ludlow, 2012).

Cocoa production in large quantities in Africa started in the nineteenth century. The initial cultivation occurred around the 1820s, initiated by the Portuguese in São Tomé and Príncipe (Rosenblum, 2006; Poelmans & Swinnen, 2016). Cocoa farming spread from Equatorial Guinea in the 1850s to Nigeria in the 1870s, Ghana in 1879 through Tetteh Quarshie, and the Ivory Coast in 1905. (Rosenblum, 2006; Poelmans & Swinnen, 2016). However, the Ivory

Coast and Ghana have emerged as the leading global cocoa producers due to favourable climate for cocoa production (Läderach *et al.*, 2013; Swales, 1999; Waldburger *et al.*, 2019).

Concerns regarding, ethical and sustainability in the cocoa sector has increased significantly in the 21st century. Various initiatives and certification schemes have emerged to address pressing challenges such as child labour, deforestation, and the need for fair farmer remuneration (Boysen *et al.*, 2023; van Vliet *et al.*, 2021; Perez *et al.*, 2021). Despite these ethical and sustainability concerns, cocoa and chocolate remain valued for their health benefits ((Bello-Bravo *et al.*, 2022; Berlan, 2012; Cadby & Villacis, 2021; Thorlakson, 2018). Flavanols in cocoa exhibit antioxidant, anti-inflammatory, and anti-blood clotting properties, which contribute to the prevention of cardiovascular diseases and may play a role in cancer reduction, while also offering positive psychological effects (Fernández-Murga *et al.*, 2011; Rousseau, 2016; Beckett, 2019).

2.3 World cocoa production between the 1920s and 2020s

The trajectory of world cocoa production over the last century reflects the interaction of global economic shocks, shifting consumer demand, and structural transformations in producing countries. Major disruptions such as the Great Depression, the two World Wars suppressed international trade, deepened commodity prices, and exposed cocoa producers vulnerability of cocoa producers to external volatility (Findlay & O'Rourke, 2007; Eichengreen, 2019; Clarence-Smith, 2000; Muojama, 2016). Despite these setbacks, three broad phases of expansion can be observed. The first, from the early 1900s to the mid-1940s, was driven by Europe and North America's growing appetite for chocolate. The second, between 1945 and 1980, was sustained by high international prices and postwar prosperity. The third, beginning in the 1980s, reflected both rising demand in emerging economies, especially in Asia, and the

liberalisation of agricultural markets under structural adjustment programmes (Clarence-Smith, 2000; Poelmans & Swinnen, 2016, 2019).

Across these phases, cocoa shifted from being primarily a colonial cash crop to a central pillar of national economies in West Africa and beyond. In the colonial period, cocoa cultivation was integrated into global trade but offered little protection for farmers against price collapses. By the late twentieth century, however, cocoa had become deeply embedded in strategies for rural livelihoods, employment, and foreign exchange generation. In the twenty-first century, the emphasis has increasingly moved beyond expansion alone toward questions of sustainability, equity, and resilience. Current debates centre on how to balance productivity with environmental protection, fair compensation, and social well-being within cocoa-producing regions (Akrofi-Atitianti et al., 2018; Jagoret et al., 2012; Koning & Jongeneel, 2006; Nijmeijer et al., 2019; Sostizzo, 2017).

2.3.1 Cocoa in the early 20th century (1920-1945)

The early twentieth century marked the transition of global cocoa production from Latin America to West Africa. Before 1920, Latin America accounted for over half of world cocoa output, led by Brazil (13.31%), Ecuador (8.91%), and the Dominican Republic (5.25%). Within a decade, Africa became the dominant producer, accounting for 68% of global cocoa production (Kay, 1972; Poelmans & Swinnen, 2019). Ghana (then known as the Gold Coast) led this transformation, contributing more than one-third of the world's supply by the 1930s. Unlike the plantation-dominated systems promoted in Latin America, cocoa in Ghana expanded through smallholder farmers (Austin, 1996; Clarence-Smith, 2000).

Between 1918 and 1923, Ghana was the leading cocoa producer in the world, accounting for 36.82% (155,800 tonnes), followed by Nigeria at 9.93% (42,000 tonnes), South Trinidad and

Principe (4.11%) 17,400 tonnes, the Spanish Equatorial Zone at (1.18%) 5,000 tonnes, Cameroon (0.73%) 3,100 tonnes, and Côte d'Ivoire (0.45%) 1,900 tonnes (Kay, 1972). There was a tenfold increase in cocoa production from 53,000 tonnes to 632,000 tonnes between 1900 and 1940 (Clarence-Smith, 2000; Poelmans & Swinnen, 2019).

Technological and agronomic factors reinforced this shift. The cultivation of a more productive bean variety, the Forastero bean, further fueled the spread, with Ghana (Gold Coast) emerging as a hub for this growth (Ross, 2014; Clarence-Smith, 2000; Dand, 2011). The interwar period between the First and Second World Wars saw a decline in cocoa prices, rendering cocoa production less attractive in Latin America (Kofi, 1976; Staritz et al., 2022). Between 1938 and 1943, world cocoa was mainly from Ghana (36.7%), Brazil (19.0%) and Nigeria (15.8%) (Kay, 1972). The other cocoa producers in the world were Dominican Republic (3.58%), and Cameroon (3.5%). This decline in Latin America emphasised the advantage of West Africa's smallholder production system, favourable climate and soil conditions in West Africa made it well suited for cocoa cultivation (Asare, 2016; Chauveau, 1997).

Crucially, this period also revealed early tensions between farmers' market responses and colonial policy interventions. In Portuguese and French colonies, forced labour was used on large plantations, while in British colonies cocoa remained smallholder-led, supported through infrastructure investment but with limited price intervention (Chauveau, 1997; Ross, 2014). The absence of effective stabilisation mechanisms left African farmers exposed to global price volatility, as seen in the collapse of cocoa prices during the Great Depression. Cocoa bean quality standards were established in the early 20th century to guarantee the quality and consistency of finished chocolate products (Hancock & Fowler, 1994). This experience laid the groundwork for the later introduction of marketing boards and price control systems in the mid-twentieth century, designed to buffer producers from such shocks.

2.3.2 Post-World War II era (1945-1980s)

The cocoa industry experienced significant changes after World War II. This was a period of war and independence of several cocoa-producing developing economies from their colonial masters. The postwar decades brought both institutional innovation and new challenges to the global cocoa economy. As newly independent producers sought to stabilise volatile world prices, governments created national marketing boards and international frameworks such as the Alliance of Cocoa Producing Countries (COPAL) in 1962. These initiatives aimed to harmonise producer policies and defend export earnings, but efforts to influence prices through supply restrictions in 1964 -1965 proved largely ineffective (Frankel, 1974; Muojama, 2018). Still, the wider postwar economic boom marked by rising chocolate consumption in Europe and North America in the 1950s to 1960s stimulated growth, supported by improvements in cultivation, disease resistance, and postharvest practices (Grivetti & Shapiro, 2011).

Ghana illustrates the mixed outcomes of these reforms. Its hybrid system, in which the state retained control over exports while liberalising purchase from farmers to the private sectors (Poelmans & Swinnen, 2019; Ahoba, 2021). This reflected a deliberate attempt to safeguard producer incomes while preserving fiscal stability (Poelmans & Swinnen, 2019; Ahoba, 2021). Initially, this approach supported farmer incentives, but by the 1970s, declining output revealed its limitations. Price distortions encouraged large-scale smuggling to neighbouring Côte d'Ivoire and Togo, while the swollen shoot virus devastated plantations, reducing Ghana's production by nearly 60% between 1960 and 1980 (Buliř, 2002; Danquah, 2003). By 1978, Côte d'Ivoire had surpassed Ghana as the world's leading producer (Danquah, 2003; Odijie, 2016).

The volatility of world markets compounded these structural weaknesses. Cocoa prices spiked in the 1970s, generating windfalls for producer governments, but the collapse of the

International Cocoa Agreement's buffer stock system in the 1980s exposed farmers once again to sharp downturns (Gilbert, 1996). For Ghana, this crisis highlighted the risks of dependence on cocoa exports and the shortcomings of its marketing institutions. The subsequent Economic Recovery Programme (1983-95) sought to reverse decline by reforming producer incentives, rehabilitating diseased farms, and strengthening extension services, laying the foundation for renewed growth in the 1990s.

2.3.3 Certification and Sustainability Era (1990s - 2000s)

From the 1990s, the cocoa sector entered a period defined not only by expansion but also by growing scrutiny of its social and environmental costs. Rapid farm expansion was strongly associated with deforestation, particularly in West Africa, where cocoa cultivation contributed to the loss of over two million hectares of forest between the late 1980s and 2000s (Gockowski & Sonwa, 2011; Ruf et al., 2015). At the global level, cocoa accounted for the clearance of 2–3 million hectares of tropical forest between 1998 and 2008 (Kroeger et al., 2017). These patterns reinforced concerns around biodiversity loss, child labour, and unsustainable farming practices, prompting international debates on ethical sourcing and sustainability standards (Kalischek et al., 2023; Saj et al., 2017).

In response, new certification schemes and sustainability initiatives emerged, including Fairtrade, Rainforest Alliance, and UTZ, alongside the promotion of climate-smart agriculture and agroforestry models (Akrofi-Atitianti et al., 2018; Jagoret et al., 2012; Nijmeijer et al., 2019). These efforts sought to reframe cocoa production around environmental and social safeguards, while also offering price premiums intended to strengthen farmer incentives. However, critics argue that certification has delivered uneven benefits, often failing to offset low producer prices or to curb deforestation on a significant scale (Kroeger et al., 2017; Ruf, 2011).

Production trends during the 1990 and 2022 era reflected both continuity and structural shifts. Côte d'Ivoire consolidated its position as the world's largest supplier, nearly tripling output by 171% between 1990 and 2022, while Ghana also expanded by 123.1%, though with greater volatility (refer to Table 2.1). Other key cocoa-producing countries, including Ecuador (296.4%), Ghana (132.1%), Cameroon (152.2%), Nigeria (75%) and Indonesia (20%) experienced positive growth between 1990 and 2022. Brazil however, experienced a decline of 40% in output. Global production increased by 97.6% during this timeframe.

2.3.4 Global shifts and emerging constraints (2000s–2020s)

Since 2000, global cocoa output has continued to expand, though at a slower pace and with notable geographic rebalancing. Between 2000 and 2022, world production increased by 72.9%, largely driven by sustained growth in West Africa and an extraordinary surge in Ecuador, where production expanded nearly fourfold (refer to Table 2.1). In contrast, Indonesia, the leading Asian producer in the 1990s, experienced a steep decline of 54.1%, signalling a structural retreat of Asia's role in the global cocoa economy.

Between 2000 and 2022, Côte d'Ivoire, Ghana, Cameroon, Brazil, and Ecuador continued to lead in terms of growth. Also, Latin American producers such as Ecuador and Peru experienced notable growth, driven in part by quality-differentiated and specialty cocoa markets (Mithöfer et al., 2017; Villacis & Barrera, 2022). Overall, global output nearly doubled between 1990 and 2022, emphasising the tension between rising demand and the sector's sustainability challenges.

From 2010 onward, growth slowed further. Between 2010 and 2022, world output rose by just 14.9%, with Ghana and Indonesia recording sharp declines (–33.7% and –59.1% respectively). For the first time in decades, global cocoa production contracted between 2020 and 2022 (–5.5%), reflecting climatic shocks, disease pressures, and macroeconomic instability (refer to

Table 2.1). Ghana's decline was especially severe (–35.1%), while Côte d'Ivoire and Nigeria also recorded modest contractions. Other producing countries such as Latin American producers such as Ecuador (+20.5%) and Brazil (+10%) expanded during this period, highlighting a gradual diversification of supply beyond West Africa.

Table 2.1. World cocoa from 1990 to 2022 in 1000 Metric Tonnes

Crop Year	Côte d'Ivoire	Ghana	Cameroon	Nigeria	Indonesia	Ecuador	Brazil	Peru	World
1990/91	804	293	115	160	150	111	368	11	2506
1995/96	1200	404	135	158	285	103	231	15	2915
2000/01	1212	395	133	177	392	89	163	24	2865
2005/06	1408	741	171	210	585	118	162	31	3811
2010/11	1511	1025	229	240	440	161	200	54	4309
2011/12	1486	879	207	245	440	198	220	61	4095
2012/13	1449	836	225	238	410	192	185	70	3943
2013/14	1746	897	211	248	375	232	228	81	4370
2014/15	1796	740	232	195	325	261	230	92	4251
2015/16	1581	778	211	200	320	232	140	105	3994
2016/17	2020	969	246	245	290	300	174	116	4768
2017/18	1964	905	250	250	240	287	204	135	4647
2018/19	2154	812	280	270	220	322	176	141	4794
2019/20	2105	771	280	250	200	342	201	151	4735
2020/21	2248	1047	293	290	170	365	200	156	5244
2021/22 (est.)	2121	683	295	280	180	365	220	170	4826
2022/23 (est.)	2180	680	290	280	180	440	220	170	4953
Percentage (%) Change									
1990-2022	171.1	132.1	152.2	75.0	20.0	296.4	-40.2	1445.5	97.6
2000-2022	79.9	72.2	118.0	58.2	-54.1	394.4	35.0	608.3	72.9
2010-2022	44.3	-33.7	26.6	16.7	-59.1	173.3	10.0	214.8	14.9
2020-2022	-3.0	-35.1	-1.0	-3.4	5.9	20.5	10.0	9.0	-5.5

Source: ICCO and Author's own computation

Figure 2.1 shows the trajectories of cocoa production, yields, and cocoa acreage in Ghana. It revealed a reduction in the area suitable for cocoa production, decreasing from about 1,830,000 in 1965 to about 686,531 hectares in 1994. Cocoa yields increased to 4.21 tonnes per hectare in 1989 from 2.08 tonnes per hectare in 1984, contributing to a moderate rise in cocoa production in the country. Starting from the early 2000s, especially in 2001, cocoa production was driven by an expansion in acreage. However, by 2011, the sector experienced notable yield gains, even as the growth of cocoa production slowed due to a reduction in the acreage used in cocoa production.

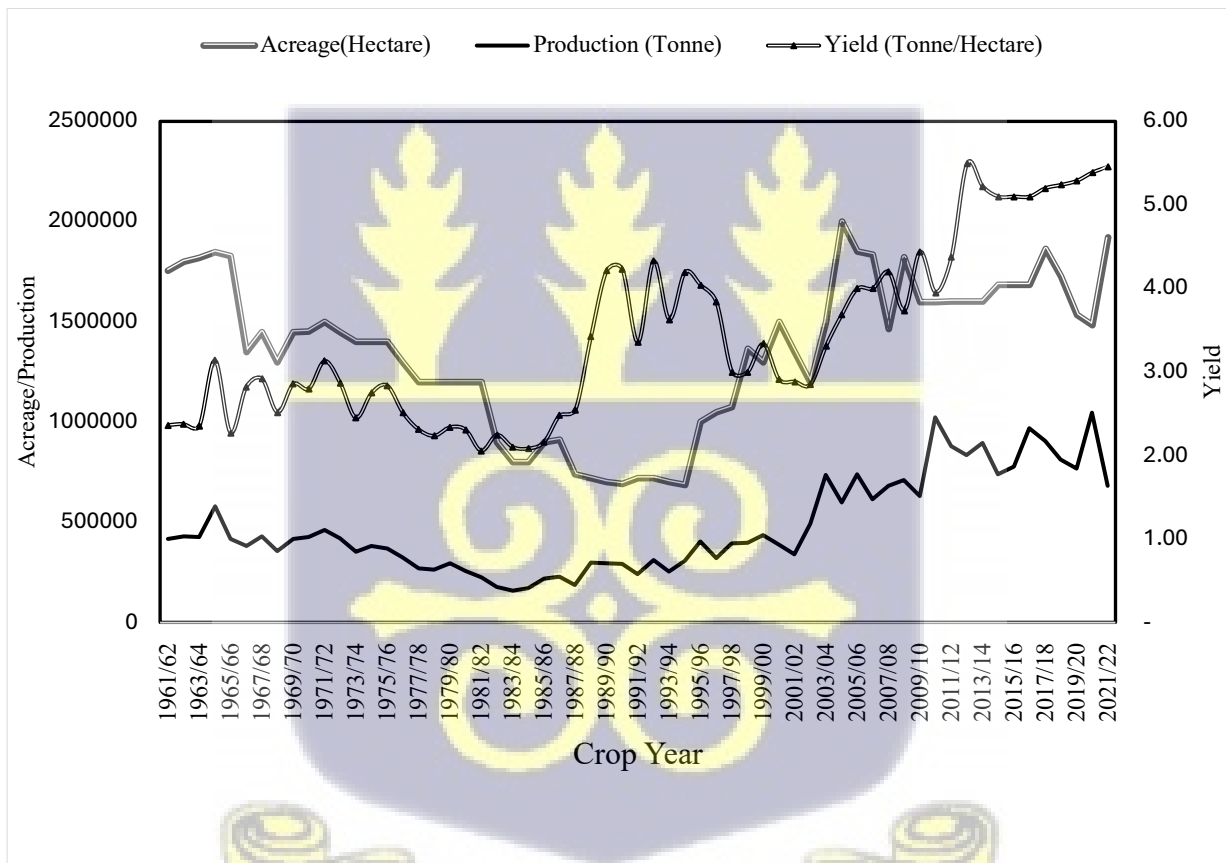


Figure 2.1. Acreage, Production and Yield of Cocoa in Ghana (1961-2021)

Source: The author's illustration is based on data from ICCO and FAOstat

2.3.5 Synthesis: Production trends and the rationale for producer price reforms

The evolution of world cocoa production between the 1920s and 2020s reveals both connections and important shifts, each of which shaped the rationale for producer price reforms. In the early twentieth century, production relocated from Latin America to West Africa, where smallholder farmers rapidly expanded cultivation in Ghana and Nigeria. Although this model proved more resilient than the plantation-based systems of Latin America, farmers remained highly exposed to fluctuations in world markets. The collapse of cocoa prices during the Great Depression demonstrated the vulnerability of producer incomes in the absence of effective stabilisation mechanisms. The lesson from this period was clear: market integration alone did not guarantee income security for producers, thereby justifying subsequent interventions in pricing policy (Austin, 1996; Clarence-Smith, 2000).

After 1945, governments and international organisations experimented with institutional solutions to these vulnerabilities. National marketing boards and collective arrangements such as the Alliance of Cocoa Producing Countries (COPAL) sought to stabilise prices and safeguard export revenues. Ghana's hybrid system of partial state control, in contrast to Côte d'Ivoire's more liberal approach, illustrates divergent strategies for balancing farmer incentives with fiscal needs (Poelmans & Swinnen, 2019; Ahoba, 2021). While these reforms achieved periods of stability, they also revealed inherent limitations. Price distortions encouraged smuggling, while disease outbreaks eroded production. The broader lesson of the postwar era was that stabilisation mechanisms could mitigate volatility, but they were insufficient to eliminate the structural fragility of cocoa-dependent economies.

From the 1990s, the focus of reform shifted toward sustainability and ethical concerns. Certification schemes such as Fairtrade and Rainforest Alliance introduced price premiums and linked market access to environmental and labour standards (Kroeger et al., 2017; Ruf, 2011).

While these initiatives represented an important reorientation of the global cocoa economy, their impact on producer welfare has been mixed. Price premiums were often too small or inconsistently delivered to offset chronically low producer prices, and deforestation pressures continued despite certification efforts (Gockowski & Sonwa, 2011). The key lesson of this era is that sustainability reforms cannot be separated from pricing structures: without meaningful improvements in producer incomes, certification risks address symptoms rather than underlying causes.

The most recent period, from the 2000s to the 2020s, has been marked by both growth and new constraints. Côte d'Ivoire consolidated its position as the dominant producer, while Ghana experienced volatility and eventual decline. At the same time, Latin America, particularly Ecuador and Peru, re-emerged as significant suppliers, while Indonesia's output collapsed. Since 2010, however, global cocoa growth has slowed, and for the first time in decades, production contracted between 2020 and 2022, driven by climate shocks, disease pressures, and macroeconomic instability. These developments highlight both the resilience of West Africa's production model and its fragility in the face of ecological and economic stress. The lesson from this era is that reforms must increasingly address structural vulnerabilities, soil fertility decline, climate change, and global demand shifts alongside price stabilisation.

Taken together, a century of cocoa production history stresses a persistent dilemma: how to secure fair and stable returns for producers in a volatile global market. Each reform era, from marketing boards to certification schemes, sought to mitigate instability, but none has fully resolved the challenge. This trajectory not only demonstrates the significance of producer price reforms to the evolution of the cocoa economy but also frames the key question for contemporary debates: whether future reforms can simultaneously ensure farmer welfare, fiscal stability, and environmental sustainability.

2.4 Efforts to improve the livelihood of cocoa farmers

The vulnerability of cocoa producers to volatile world prices has prompted repeated attempts to secure farmer incomes through both international policy frameworks and market-based reforms. Between 1972 and 1988, the International Cocoa Agreement (ICA) aimed to stabilise cocoa prices through a buffer stock system coordinated by 30 member countries. While ambitious, the scheme was undermined by inadequate financing and unrealistic price targets, which resulted in its suspension (Gilbert, 1996; Gibson, 2007).

The collapse of the ICA coincided with the wider commodity decline of the late 1970s and early 1980s, when the oil shock, declining global prices, and rising interest rates pushed many sub-Saharan African economies into crisis. In response, the World Bank and IMF introduced Structural Adjustment Programmes (SAPs), which included currency devaluation, liberalisation, and fiscal austerity (Poelmans & Swinnen, 2019; Ahoba, 2021). These measures reshaped cocoa pricing: while liberalisation increased export competitiveness, it weakened state-led stabilisation and left farmers to enjoy high prices more exposed to global market fluctuations (Musila & Yiheyis, 2015; Keho, 2017; Varangis & Schreiber, 2001).

In the late 2000s, civil society groups implemented sustainability certification schemes like Fairtrade and Rainforest Alliance to improve cocoa farmers' incomes (Fountain & Hütz-Adams, 2018; Thorlakson, 2018). These schemes aim to increase farmer incomes through price premiums, minimum prices, and agricultural training, often enhancing productivity and quality through advisory services and cooperative strengthening (Hütz-Adams & Schneeweiß, 2018). However, premiums are limited due to low demand, with only 20-60% of certified cocoa beans sold as certified (Fountain & Hütz-Adams, 2018).

Organic certification also increased farm income by 18.3% with Rainforest Alliance certification and up to 114.3% with Fairtrade and organic certifications in the French market

for premium dark chocolate (FAO, 2020). However, the overall impact on farm net income remains to be determined due to limited data on certified versus non-certified cocoa production costs (Hütz-Adams & Schneeweiß, 2018). Certification access is often restricted to large farmers or cooperatives, leaving smaller or poorer farmers excluded (Hütz-Adams et al., 2016; KPMG, 2013). Barriers to certification include direct certification costs and compliance requirements. Although certified farmers may earn higher incomes than non-certified ones, the difference is often minimal and incomes remain below the poverty threshold (Fountain & Hütz-Adams, 2018; Ingram et al., 2018).

Despite efforts to improve income for smallholder cocoa farmers in Côte d'Ivoire and Ghana, many farmers still live below a living income (Boysen et al., 2023; van Vliet et al., 2021; Waarts et al., 2021). This is due to the failure to address individual poverty drivers and structural constraints (Boysen et al., 2023). Beside rising production costs and declining returns, cocoa remains a preferred crop due to its stability, which discourages diversification to other crops. This reliance on cocoa helps governments secure revenues and maintain raw material supplies (van Vliet et al., 2021).

2.5 Formation of world price of cocoa

The price of cocoa depends on the distribution levels, locations and actors in the cocoa supply chain. Each stage, starting from the farmer, local intermediaries, processors, chocolate manufacturers, retailers, and the direct consumer, adds value, cost, and market dynamics, leading to price variability. The variety, type and quality of the raw or unprocessed cocoa beans are also major factors leading to price volatility. Despite these differences, cocoa is largely traded as a homogenous commodity priced based on a single “Fair Average Quality, (FAQ) world price, which serves as a standard (Gilbert, 2016; Maile, 2020). Cocoa has limited uses and lacks substitutes, making supply and demand the two major factors influencing its market

(Dand, 2011), with long-term price patterns connected to cocoa production cycles (Tothmihaly, 2018). The two major platforms based on cocoa futures and options are the Intercontinental Exchange (ICE) US in New York, USA and ICE Europe in London, UK. Future contracts on these exchanges allow traders to buy or sell a specific amount of cocoa at a particular price for future delivery. The ICE platform also supports the trade of other commodities such as coffee, wheat, soybeans, or maize are traded (Malie, 2020).

2.6 Political economy of cocoa production and pricing in Ghana

2.6.1 Path dependence and colonial legacy

Cocoa was introduced to Ghana, by the British colonial administration in the late nineteenth century. Cocoa production experienced rapid growth, making Ghana a primary producer by the mid-1920s (Poelmans & Swinnen, 2019). Its production was primarily focused in the Eastern Region (Ministry of Finance, 1999, p. 6). It reached the Ashanti and Brong Ahafo by the 1940s and the Western Region by the 1980s (Department of Cooperatives, 1990). Between 1923 and 1932, cocoa consistently accounted for approximately 77% of Ghana's total exports (Department of Cooperatives, 1990, p. 11). Figure 2 shows the shift of cocoa production to other regions.

This expansive settlement pattern has left a durable geographic imprint on cocoa production. Ghana claimed the title of the world's largest cocoa producer during the period until Côte d'Ivoire surpassed it in 1977-78 (Gyan & Bajan, 2022; Odijie, 2016). Historically, Ghana specialised in bulk rather than fine/flavour cocoa, aligning its output with the requirements of mass chocolate manufacturing (Maile, 2020). Ghana supplies roughly 14.1% of raw cocoa to the global industry (ICCO, 2022; Maile, 2020). This early technological and market orientation under colonial rule established an upstream role that still shapes Ghana's position in the value chain.

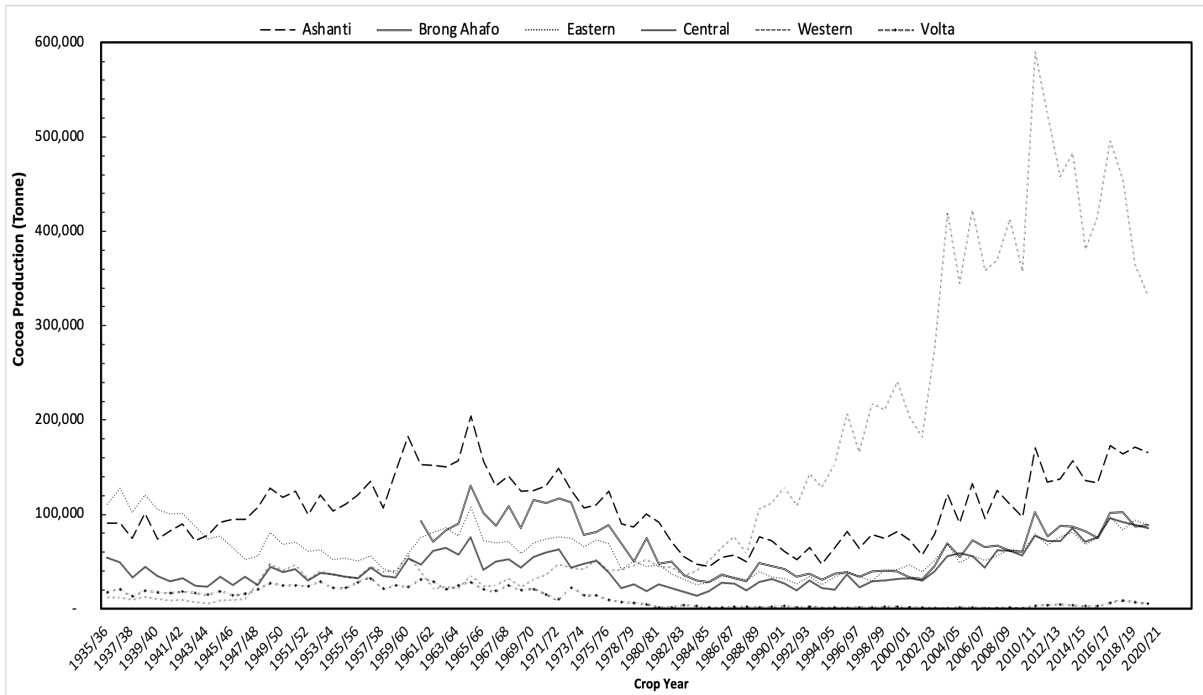


Figure 2.2. Trends of Regional Cocoa Production in Ghana

Source: Author’s illustration based on data from COCOBOD and Kotey *et al.*, 1974

Despite Ghana’s scale in bean production, domestic processing and consumption remain limited. European demand structures dominate downstream segments: the Netherlands is the largest bean importer; Switzerland and Belgium host major chocolatiers; and Germany and France rank among the largest consumers after the United States (ICCO, 2022; Maile, 2020). This Europe-centred demand geography reinforces Ghana’s upstream specialisation and the incentive to export beans or semi-processed intermediates rather than finished products (Maile, 2020).

2.6.2 Cocoa, the Economy, and the State

Cocoa has long been the backbone of Ghana’s economy, not only as the largest agricultural export but also as a cornerstone of fiscal stability and foreign exchange management. Unlike gold and crude oil, where contractual arrangements often return a small fraction of total earnings to the state, cocoa revenues flow more directly through the Central Bank of Ghana,

making them a vital source of government income (Bank of Ghana, 2025; Benneh & Anaman, 2022; USDA, 2025). Throughout much of the twentieth century, cocoa contributed over half of Ghana's export revenues, enabling the state to finance infrastructure, public sector wages, and social services (Austin, 1996; Ofosu-Asare, 2011).

This dependence on cocoa revenues has historically tied the fortunes of the Ghanaian state to fluctuations in international cocoa prices. Periods of high prices provided governments with windfall revenues, strengthening state capacity, while collapses in world prices quickly translated into fiscal crises and political instability (Benneh & Anaman, 2022; Bulř, 2002). The centrality of cocoa to Ghana's balance of payments also meant that cocoa earnings were closely linked to the strength of the national currency. For instance, foreign exchange from cocoa exports helped stabilise the cedi, while declines in cocoa output or prices often forced the government into devaluations or external borrowing (Van Huellen, 2015).

The political significance of cocoa lies not only in its macroeconomic role but also in its capacity to shape state legitimacy. Governments have historically used cocoa revenues to fund development projects and extend patronage, bolstering their authority among rural producers and urban constituencies alike (Anaman & Bukari, 2021). At the same time, policies that suppressed farm-gate prices in order to retain greater state revenue often provoked farmer discontent, smuggling, and political opposition. As such, the political economy of cocoa in Ghana reflects a persistent tension between the state's reliance on cocoa as a fiscal lifeline and farmers' dependence on it as a livelihood.

2.6.3 Cocoa, politics, and independence (1950s-1960s)

During the independence era, cocoa revenues played a decisive role in Ghana's political and economic trajectory. Under Kwame Nkrumah and the Convention People's Party (CPP), cocoa

export earnings financed ambitious infrastructure and industrialisation projects, including schools, roads, and state-owned enterprises (Anaman, 1988; Austin, 1996). Cocoa thus became not only the engine of economic growth but also a political resource that underpinned the CPP's legitimacy and capacity to deliver on its development agenda (Anaman & Bukari, 2021).

Also, the dependence on cocoa exposed the state to international price shocks. Between 1963 and 1965, world cocoa prices collapsed from over USD 500 to a record low of USD 211 per tonne, drastically reducing government revenues and farmer incomes (Benneh & Anaman, 2022; Kolavalli & Vigneri, 2011; Wilson, 1984). For the Ghanaian state, this downturn created a balance-of-payments crisis, limited the ability to sustain development expenditures, and contributed to growing political discontent. For farmers, suppressed incomes weakened trust in the government's pricing mechanisms and reinforced perceptions that the state was extracting rents at their expense (Ofosu-Asare, 2011; Vigneri, 2011).

The political implications of this crisis were significant. Nkrumah's vocal critique of Western economic dominance, expressed most forcefully in *Neocolonialism: The Last Stage of Imperialism* (1965), coincided with the cocoa price collapse. Scholars argue that Western hostility to Nkrumah's socialist orientation intersected with Ghana's economic vulnerability to destabilise his government (Benneh & Anaman, 2022). By 1965, Ghana still accounted for 37.5% of global cocoa output, making the state highly dependent on the crop at the very moment international prices undermined its economic base (Kay, 1972).

The February 1966 military coup, which ended Nkrumah's rule, reflected this intersection of economics and politics. Although Cold War geopolitics shaped the external environment, the coup was enabled by domestic fiscal fragility linked to cocoa dependence. The sharp decline in cocoa revenues weakened the state's financial foundation and undermined its social contract with farmers, while at the same time eroding its capacity to resist external pressures (Anaman

& Bukari, 2021; Van Huellen, 2015). Thus, cocoa was both an economic pillar of Ghana's independence project and a source of political vulnerability when global markets turned against it.

2.6.4 Post-coup liberalisation and decline (Late 1960s-1970s)

The overthrow of Nkrumah in 1966 marked a turning point in Ghana's cocoa political economy. The new military government, under pressure from the International Monetary Fund (IMF), pursued modest liberalisation policies, including the suspension of subsidies for cocoa inputs and tighter fiscal management in late 1969 (Van Huellen, 2015). These measures were designed to stabilise the macroeconomy and reduce the fiscal burden of state intervention, but they came at the expense of cocoa producers, who faced declining farm-gate prices.

In 1969, Ghana transitioned from military rule back to party politics, but macroeconomic pressures persisted (Gocking 2005, 158). With world prices falling, the government invited a new IMF program in 1971, which imposed currency devaluation and austerity (Gocking 2005, 158). A military coup in 1972 did not arrest the downturn; the new regime launched Operation Feed Yourself in 1972, which while aimed at the food crisis, ultimately encouraged some cocoa farmers to abandon the cash crop (Gocking 2005, 168). During 1974–1977, inflation surged, foreign exchange shortages intensified, imports went unpaid, rural infrastructure eroded, food production fell, urban food prices rose, and cocoa smuggling to Côte d'Ivoire and Togo, where producer prices were up to five times higher than in Ghana, became widespread where farmers received more competitive returns (Bulíř, 2002; Mikell 1989, p. 202).

This erosion of farmer incentives contributed to Ghana's declining share of global cocoa output. By the mid-1970s, Côte d'Ivoire had surpassed Ghana as the world's leading cocoa producer, reflecting the comparative advantage enjoyed by producers across the border where

farm-gate prices were higher and state taxation less burdensome (Clarence-Smith, 2000; Ofoosu-Asare, 2011). As well as ecological challenges such as the spread of swollen shoot disease and the aging of cocoa trees (Austin, 1996). At the same time, the government's reliance on cocoa revenues created a persistent tension between state fiscal needs and farmer welfare. By taxing cocoa exports through low farm-gate prices, the state sought to maximise foreign exchange and revenue for budgetary support. However, this strategy undermined farmer livelihoods and weakened the legitimacy of the cocoa marketing system. Farmer discontent, combined with declining output, constrained the government's ability to maintain both fiscal stability and rural support, reinforcing the vulnerability of Ghana's cocoa-dependent economy (Benneh & Anaman, 2022).

2.6.5 Crisis, structural adjustment, and reform (1980s-1990s)

By the late 1970s and early 1980s, Ghana's cocoa sector was in severe decline. The country faced high inflation, food shortages, mounting debt, and collapsing export revenues, with cocoa output falling to its lowest levels since independence (Ofoosu-Asare, 2011; Van Huellen, 2015). Low world prices compounded these challenges, but domestic pricing policies also played a role: farm-gate prices were kept artificially low to capture foreign exchange for the state, further discouraging production and encouraging smuggling to neighbouring countries where returns were higher (Bulíř, 2002). The combination of fiscal crisis and dwindling output made reform unavoidable.

In response, Ghana adopted Structural Adjustment Programmes (SAPs) under the guidance of the International Monetary Fund (IMF) and the World Bank. These programmes sought to restore macroeconomic stability by restructuring state institutions and liberalising markets (Boafo-Arthur, 1999). In the cocoa sector, reforms targeted the Ghana Cocoa Board (COCOBOD), which was seen as bloated and inefficient. Between 1987 and 1990,

COCOBOD's workforce was reduced by around 70%, with the dismissal of tens of thousands of employees, including the exposure of nearly 10,000 "ghost workers" on its payroll (Ofosu-Asare, 2011). Subsidies for inputs such as fertilisers and pesticides were withdrawn, and internal marketing was partially liberalised, though the state retained its monopoly on cocoa exports.

One major institutional innovation was the creation of the Producer Price Review Committee (PPRC), which was tasked with annually recommending producer prices based on global market conditions. The PPRC included representatives of government, COCOBOD, and farmer organisations, but decision-making power remained largely in the hands of the state (Van Huellen, 2015). While the reforms modestly increased farm-gate prices relative to the 1970s, producers continued to receive only a fraction of world market prices, ensuring that the government captured the bulk of cocoa rents (Bulir, 2002).

For farmers, the outcomes of adjustment were mixed. On the one hand, liberalisation reduced the inefficiencies associated with COCOBOD's overstaffing, increased transparency in pricing, and improved service delivery through extension programmes (Ofosu-Asare, 2011). On the other hand, the removal of subsidies raised production costs, and the persistent gap between world and farm-gate prices limited the benefits of reform. For the state, adjustment restored export revenues and re-established Ghana as a reliable supplier of cocoa on world markets, but at the cost of heightened rural discontent and continuing farmer vulnerability to global price fluctuations (Benneh & Anaman, 2022).

The political economy of this era therefore reflected a delicate balance between international conditionalities, state fiscal imperatives, and farmer livelihoods. While structural reforms revitalised the cocoa sector in the short term, they entrenched the dominance of state and

international actors in price-setting, leaving farmers with limited bargaining power in the distribution of cocoa rents

2.6.6 Climate shocks, price booms, and busts

Beyond institutional reforms and global market dynamics, climatic variability has been a recurring driver of volatility in Ghana's cocoa economy. Extreme weather events, particularly those associated with the El Niño phenomenon, have repeatedly disrupted production and influenced both domestic politics and international price trends. The 1962/63 El Niño brought severe drought conditions that reduced yields and contributed to a temporary balance-of-payments crisis, weakening the Nkrumah government at a time of already declining cocoa revenues (Benneh & Anaman, 2022). Subsequent episodes in 1977/78 and 1982/83 were among the most severe in Ghana's recorded history, producing widespread droughts, forest fires, and flooding that destroyed large areas of cocoa farms (Hütz-Adams, 2018).

These climatic shocks reverberated in international markets. The 1977/78 drought significantly reduced West African production, pushing global cocoa prices to unprecedented levels of over USD 4,300 per tonne the highest nominal price on record (Benneh & Anaman, 2022; Hütz-Adams, 2018). While this temporarily boosted Ghana's foreign exchange earnings, the benefits to farmers were limited by state-controlled pricing mechanisms that retained the bulk of windfall gains for fiscal purposes (Buliř, 2002). Similarly, the 1982/83 El Niño coincided with broader economic turmoil, compounding Ghana's crisis and reinforcing the case for the structural reforms that followed.

From the 1990s onwards, however, the volatility of cocoa prices was increasingly shaped by structural supply and demand factors rather than isolated weather events. Improved yields in producing countries, consolidation among international buyers, and the growing role of

derivative markets contributed to downward pressure on prices and lower stock-to-use ratios (Maile, 2020). For Ghana, this shift meant that even as climatic shocks continued to affect production, the broader trend was one of persistently low real cocoa prices, which constrained both government revenues and farmer incomes.

The political economy implications of these dynamics are twofold. First, climatic shocks exposed the vulnerability of Ghana's cocoa-dependent economy to environmental variability, often triggering fiscal crises and deepening rural hardship. Second, the state's capture of windfall revenues during price booms reinforced tensions with farmers, whose share of the gains remained limited. Together, these factors highlight the extent to which cocoa producers in Ghana remain at the intersection of ecological uncertainty and global market forces, with both shaping the distribution of value between the state and rural households.

2.6.7 Financialisation and international market dynamics (1990s-2010s)

From the 1990s onwards, the global cocoa economy became increasingly shaped by processes of financialisation, whereby commodity futures markets were transformed into investment assets dominated by non-commercial actors. Traditionally, futures contracts had been used by cocoa grinders, traders, and chocolate manufacturers to hedge against price risks by securing future supplies at predetermined prices (Hütz-Adams et al., 2016). However, the entry of institutional investors and financial speculators shifted market dynamics, as cocoa futures began to be traded less for risk management and more for profit-seeking.

The scale of this transformation was profound. By the early 2010s, trading volumes in cocoa futures were estimated to be more than ten times greater than actual global cocoa output, with non-commercial participants accounting for nearly two-thirds of open positions (Oomes et al., 2016). This surge was facilitated by the rise of commodity index funds, such as the Goldman

Sachs Commodity Index, and by regulatory changes that relaxed position limits on derivatives trading (Purcell, 2018). Scholars remain divided on whether this trend has increased volatility or merely reflected underlying market fundamentals. Some argue that financial investors contribute to price distortions and speculative bubbles (Gilbert & Pfuderer, 2014; Tröster et al., 2019), while others find little conclusive evidence of systematic destabilisation (Cheng & Xiong, 2014).

For Ghana, financialisation has had indirect but significant consequences. The Ghana Cocoa Board (COCOBOD) relies on forward sales contracts to secure foreign exchange and stabilise revenues, selling a large share of the crop before harvest. This strategy insulates the state from short-term price swings but also exposes farmers to the downside of global volatility: when world prices rise after forward contracts are signed, Ghanaian farmers do not benefit from the windfall (Van Huellen, 2015). Conversely, when prices collapse, COCOBOD's forward sales provide a measure of stability, though at the cost of perpetuating the gap between farm-gate and world prices.

The political economy of financialisation thus reinforces Ghana's structural position within the global cocoa value chain. Multinational buyers and financial actors exert growing influence over international price formation, while Ghana's state-managed forward sales mechanism mediates but does not eliminate the impact of volatility on domestic stakeholders. Farmers remain the weakest link, as they are largely excluded from both global financial markets and national price-setting, leaving them dependent on state decisions that prioritise fiscal stability over producer welfare (Hütz-Adams et al., 2016; Van Huellen, 2015).

2.6.8 Stakeholders and interest groups in cocoa pricing

The political economy of cocoa pricing in Ghana is best understood through the competing interests of multiple stakeholders, whose relative power determines how value is distributed across the supply chain. At the centre of this system is the Government of Ghana, primarily represented by the Ghana Cocoa Board (COCOBOD), the Bank of Ghana, and the Ministry of Finance. Through its monopoly over cocoa exports and its control of the Producer Price Review Committee (PPRC), the state seeks to stabilise foreign exchange earnings, maintain fiscal revenues, and ensure macroeconomic stability (Ofosu-Asare, 2011; Van Huellen, 2015). This often entails setting farm-gate prices below world market levels, thereby capturing rents for state expenditure.

By contrast, cocoa farmers and their associations, including the Ghana Cocoa Farmers' Association and various cooperative groups, push for higher farm-gate prices and improved service provision. Farmers view pricing as a matter of livelihood security, given that cocoa accounts for the primary source of income for millions of rural households (Buliř, 2002; Kozicka et al., 2018). However, their bargaining power remains limited: while they are nominally represented in the PPRC, decision-making authority largely rests with government officials, and farmer organisations often lack the cohesion and resources to exert strong influence (Ofosu-Asare, 2011).

International financial institutions (IFIs), notably the International Monetary Fund (IMF) and World Bank, have historically shaped Ghana's cocoa pricing policies through conditional lending. Structural Adjustment Programmes in the 1980s and 1990s promoted liberalisation, subsidy removal, and COCOBOD restructuring, reflecting IFI priorities of efficiency and fiscal discipline (Boafo-Arthur, 1999; Van Huellen, 2015). These interventions entrenched the influence of international actors in Ghana's domestic political economy of cocoa.

Another key set of stakeholders is multinational companies involved in cocoa grinding, trading, and chocolate manufacturing. These firms dominate global value chains and exercise considerable influence over Ghana through purchasing power and market concentration (Fold, 2002; Gilbert, 2009). Their primary interest is securing reliable, affordable supplies of raw cocoa, which often aligns with the government's goal of ensuring stable exports but contrasts with farmers' demands for higher prices.

Since the 1990s, financial investors and speculators have also become important actors through their role in international derivatives markets. Although Ghanaian farmers and cooperatives do not participate directly in these markets, the volatility created by speculative trading indirectly shapes domestic pricing decisions. COCOBOD's reliance on forward sales contracts means that Ghana is structurally dependent on world price dynamics that are increasingly influenced by non-commercial investors (Oomes et al., 2016; Purcell, 2018).

Finally, civil society organisations and non-governmental organisations (NGOs) have emerged as vocal stakeholders, particularly through sustainability and certification initiatives such as SEND Ghana, Fairtrade, and Rainforest Alliance. These groups advocate for higher producer prices, minimum income guarantees, and environmentally sustainable practices (Fountain & Hütz-Adams, 2018). Nevertheless, their impact remains uneven: while some certified farmers benefit from premiums, participation is often limited to larger cooperatives, leaving many smallholders excluded (Ingram et al., 2018).

Taken together, these stakeholders illustrate the contested nature of cocoa pricing in Ghana. The state prioritises fiscal and macroeconomic stability, multinationals focus on supply security, and IFIs promote liberalisation, while farmers and civil society demand higher prices and better livelihoods. The asymmetry of power across these actors explains why farmers

consistently receive only a fraction of global cocoa value, highlighting the structural inequities embedded in Ghana's cocoa political economy.

2.7 Institutional price-related reforms in Ghana

2.7.1 Colonial governance (1920-1946)

From 1927 to 1938, there were four occurrences of 'cocoa hold-ups' by the Asantes with the most significant ca occurring in 1930 and 1937-1938 (Milburn;1970; Southall,1978). These hold-ups extended to other parts of the country. These events involved coordinated refusals by farmers and traders to sell cocoa to European firms, expressing their objection to the establishment of price-fixing cartels by the latter (Bourret, 1949; Frankel, 1974; Howard, 1976; Milburn;1970; Southall,1978). The dominance of European-controlled firms and the exploitative trade practices frequently encountered by numerous Africans in this enterprise were sources of frustration (Alence, 1990).

In mid-1937, the major cocoa buyers on the Gold Coast, Cadbury and the United Africa Company, established terms for cocoa purchases (Frankel, 1974; Howard, 1976). Thirteen other firms joined this agreement. About 94% of cocoa sold were based on this agreement (Frankel, 1974; Howard, 1976). However, early October 1937, the agreement elicited widespread concern among Africans who perceived the absence of competition as a potential avenue for exploitation (Bourret, 1949; Frankel, 1974; Howard,1976; Milburn, 1970; Southall,1978).

During the colonial era, the free-market system was practised. The European firms controlled local procurement and export, and Cadbury was the leading British cocoa manufacturer (Bourret, 1949; Frankel, 1974; Howard,1976). The British colonial Department of Agriculture intervened by encouraging cooperative enterprises in Ghana's cocoa industry to ensure the production of high-quality cocoa (Department of Cooperative, 1990). The cooperative that

produces high-quality cocoa beans can demand higher cocoa prices. The department of agriculture also provided credit, and farm inputs to the farmers as incentives but was opposed by the European traders. They feared the colonial government cooperative promotion could exclude them from cocoa purchase (Department of Cooperative, 1990; pp. 9-16).

The cooperative led to the first successful cocoa hold-up in 1930-1931, which successfully led to a steady increase in supply and price (Milburn, 1970, p. 59). In 1937, a second cocoa hold-up opposed the fall in the world cocoa price. This led to the proposed and introduction of the first 'Cocoa Buying Agreement,' aiming for a uniform price for all farmers. The agreement was initially rejected leading to a halt in both internal and external cocoa marketing until a truce signed in March 1938, amid reduced world price of 20% (Milburn, 1970). This rejection of the agreement was as a result of no consultation from the brokers and the cocoa farmers by the European firms (Milburn, 1970).

In response to the cocoa hold-up, a royal commission was tasked to investigate the cocoa economy across West Africa. The findings by the commission advocated for a public backed cocoa marketing activities (Graue, 1950, p. 259). Consequently, the West African Cocoa Control Board (WACCB) was established in 1940 and 1942, it was replaced by the broader West African Produce Control Board (WAPCB).

2.7.2 Cocoa Marketing Board (1947-1960)

It attributed fault to brokers, recognising valid concerns from farmers and European firms (Anin, 2003). Despite the report's suggestions, brokers did not adopt them, and but the protests ceased. The buyers' agreement officially led to the establishment of the Cocoa Marketing Board (CMB) in 1947, which had minimal impact on addressing the fundamental issues. The CMB administered cocoa prices was given monopsony power over cocoa bean (Anin, 2003, Brooks *et al.*, 2007; Kolavalli & Vignera, 2011).

The CMB was designated the British Ministry of Food as the exclusive seller of Ghanaian cocoa through the CMB channel. The profit went into reserve that were used for public expenditure by the colonial government (Brooks *et al.*, 2007). The prevailing cocoa-buying companies comprising expatriates were designated agents of the WAPCB and retained their purchasing responsibilities (Anin, 2003).

Cadbury's stance endorsed the notion of rehabilitating West African cocoa economies and acknowledged the role of marketing boards as fixtures in the colonial cocoa commodity chain (Beckman, 1976). In 1953, the establishment of the United Ghana Farmers' Cooperative Council (UGFCC) marked the inception of a farmers' organisation with political aims. Aligned with President Nkrumah's Convention People's Party (CPP), it served as the farmers' arm of the party, entrusted with exclusive authority over cooperative development. Over time, the Farmers' Council evolved into an essential force, wielding economic and political influence (Anin, 2003; Beckman, 1976, p. 11).

2.7.3 Ghana Cocoa Board (COCOBOD) (1960-1983)

In 1961, four years after gaining independence, the Farmers' Council leveraged the legacy of CMB from the colonial era to monopolise Ghana's cocoa trade, ending the direct involvement of foreign buyers. Simultaneously, the Cocoa Marketing Company (CMC) Ghana was established as a commission agent of COCOBOD, overseeing various aspects of cocoa marketing, including buyer registration, the appointment of local agents, and cocoa sales logistics (Amoah, 1998, pp. 78-104). The producer prices were set by technical staff in the COCOBOD for approval by the government, known as the CPRICE (Quarmine *et al.*, 2014). This marked a shift from liberal economic policies to a predominantly state-controlled cocoa sector independent of colonial ties.

State investment in processing capacity led to the establishment of two cocoa processing factories in 1963, both of which were owned by COCOBOD. In 1982, COCOBOD acquired a third factory, the former British West African Mills (WAM) in Takoradi (Ministry of Finance, 1999, 71-2). Despite a brief disruption between 1966 and 1977 due to political changes, state governance persisted, with COCOBOD subsidiaries such as the Produce Buying Company (PBC) assuming control of internal marketing from 1977 onwards. The main problem of the CPRICE was that it failed to compensate farmers when there was inflation, discouraging an increase in supply (Franco, 1981; Ofosu-Asare, 2011).

The 1980s brought economic and political challenges, prompting international intervention and the implementation of reforms in the cocoa sector through initiatives such as the Cocoa Rehabilitation Project (CRP) and the Agricultural Sector Adjustment Programme (ASAP) under the Economic Recovery Program (ERP) (Ministry of Finance, 1999; Fold, 2002). Within this period, cocoa prices were not adjusted annually. Real prices were low compared to the levels seen in the 1950s due to high inflation (World Bank, 1984).

Increased prices were driven by pressure from the World Bank and were aligned with the agreement made during negotiations of the Agricultural Reform and Credit Program (ARCP) to develop a more rational and informed pricing policy. The average producer price per tonne of cocoa increased to 12,000 cedis (4,365.98 USD) in 1981/82, which far exceeded the average FOB price of 5,000 cedis. However, this price increase in 1981/82, without a corresponding adjustment in the exchange rate, resulted in a negative yield in cocoa exports and raised concerns about the government's ability to sustain price levels beyond a certain point without realigning its national currency (World Bank, 1984).

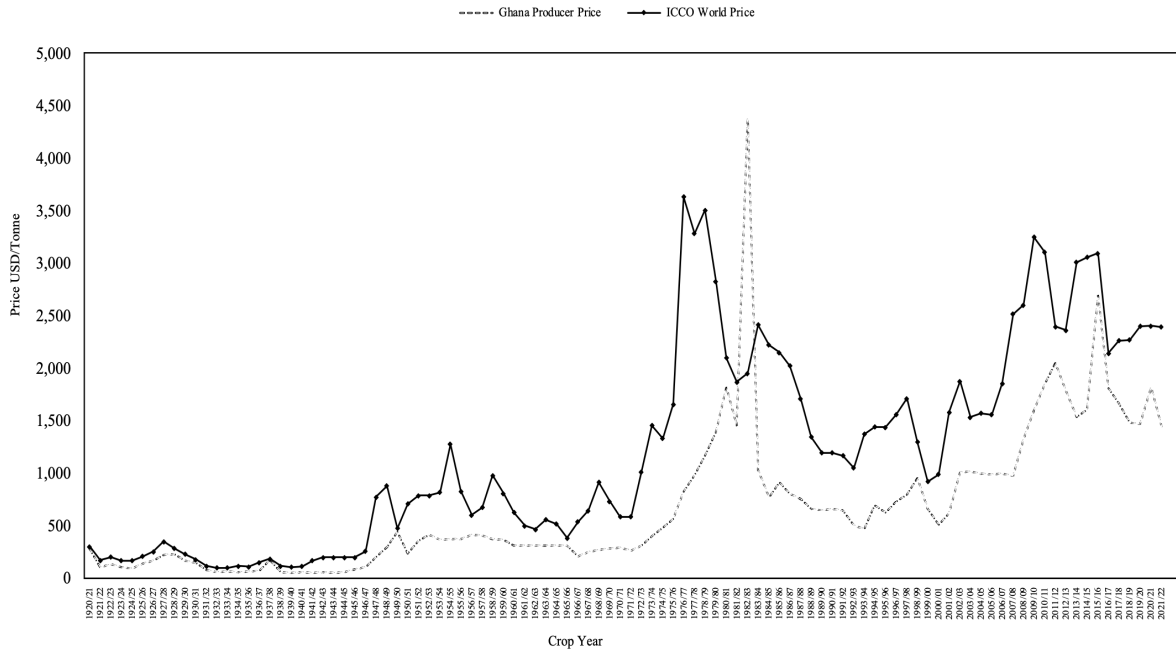


Figure 2.3. Ghana and World Cocoa Prices (1920-2022)

Source: Author's illustration based on data from ICCO, COCOBOD and Kotey *et al.* (1974)

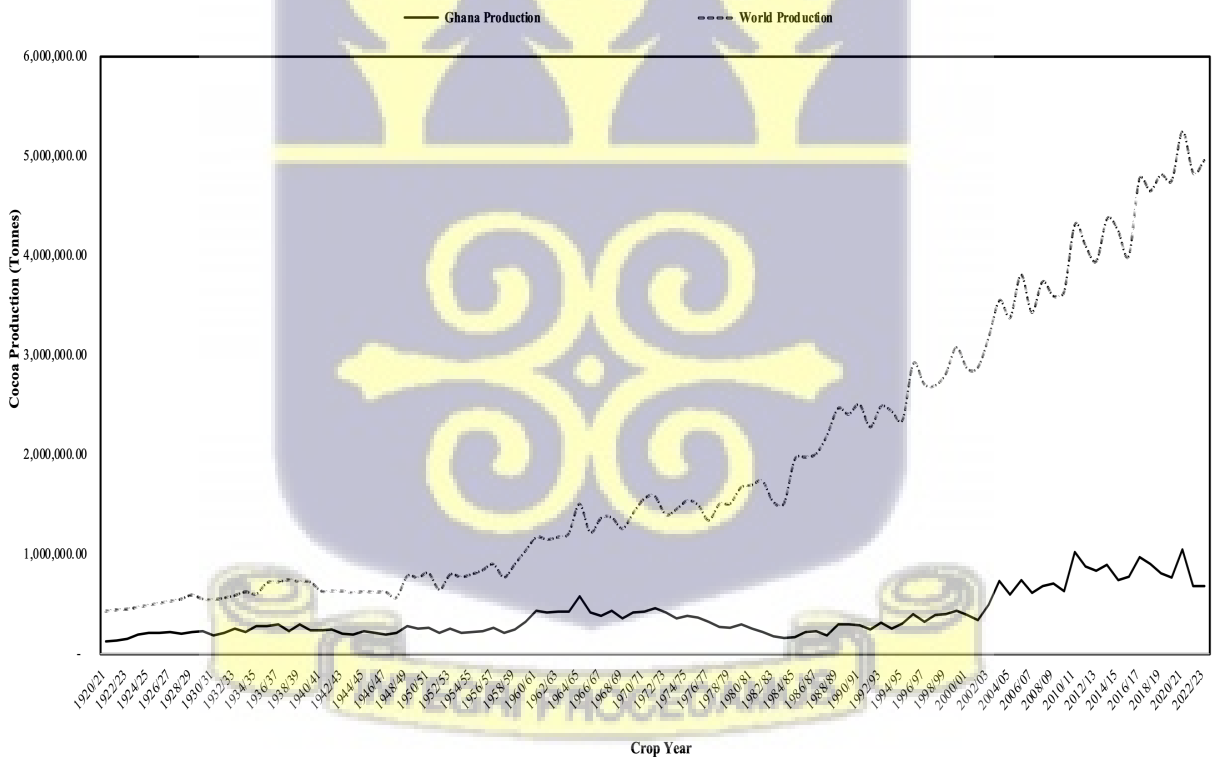


Figure 2.4. Ghana and World Cocoa Production (1920-2022)

Source: Author's illustration based on data from ICCO, COCOBOD and Kay (1972)

2.7.4 Multistakeholder Producer Price Review Committee (PPRC)

The ERP aimed to boost producer prices by streamlining inefficient marketing and pricing systems and enhancing the efficiency of cocoa-related activities (Akiyama et al, 2001). Ghana adopted a more gradual liberalisation approach, resisting some pressures from international donor organisations. Ghana opted for a phased reform introduction to avoid the pitfalls experienced by countries that abruptly liberalised, such as Nigeria. This included internal marketing liberalisation, privatisation of input distribution, extension service reforms, processing activity reorganisation, and a substantial reduction in COCOBOD staff.

In the early 1980s, COCOBOD employed approximately 120,000 people, which dwindled to 5,500 by 2006 (Maile, 2020). The CPRICE mechanism was revised due to its discouraging production (Koning, 1986). In 1984, the Producer Price Review Committee (PPRC) was introduced to oversee producer price determination. The average production cost mechanism (COP) was introduced by bringing stakeholders together to estimate costs using data collected by COCOBOD. They agreed to pay 20% of the profit margin to farmers. COCOBOD retained control over external marketing, ensuring consistent supplies of quality cocoa and receiving a premium on the world market through forward sales (Ministry of Finance, 1999; Laven, 2007a). The sector still receives a premium for its cocoa (see Figure 2.5 below shows higher country differential for Ghana.)

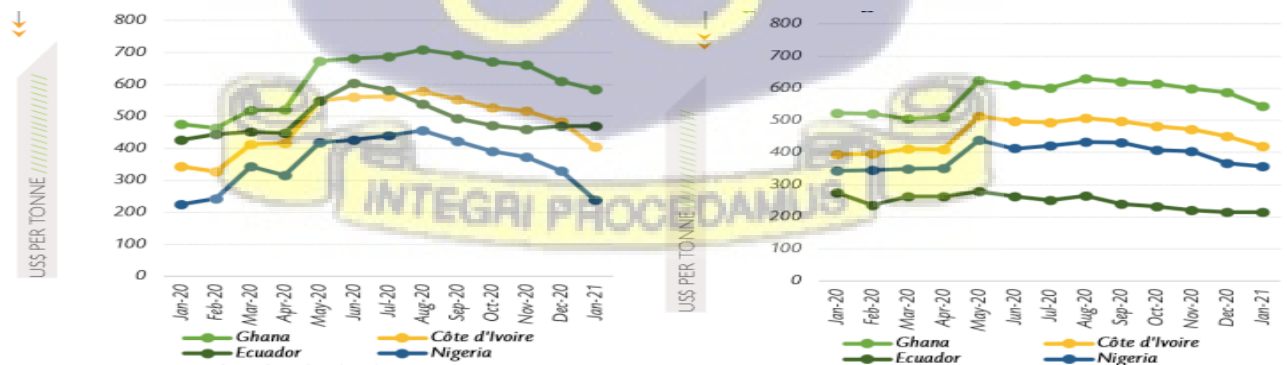


Figure 2.5. Origin Differential in Europe and the United States of America

Source: Commodity Risk Analysis

The liberalisation of internal marketing began in 1992 by introducing private licenced buying companies (LBCs) as competitors to the state-owned monopoly. Sixteen LBCs gained permission to buy cocoa between 1996 and 1997, with the PBC remaining the largest buyer. Alongside marketing reforms, institutional changes occurred. COCOBOD restructured its processing activities, forming a joint venture with a German processor in 1993 to expand its processing base. The extension component of its services division merged with that of the Ministry of Food and Agriculture in 1995.

This privatisation aimed to increase competition and efficiency in input supply (Ministry of Finance, 1999, 23-24). The Ghana Cocoa, Coffee and Sheanut Farmers Association (GCCSFA) took over input procurement responsibilities in 1995, anticipating improved availability and reduced input prices through enhanced competition. In 1998, cocoa farmers and private LBCs were unsatisfied with how the average production cost was calculated and asked for reform (Kolavalli & Vigneri, 2011). The PPRC introduced negotiations between the LBCs and the farmers on the previous price received. The negotiations were still based on the COP prices.

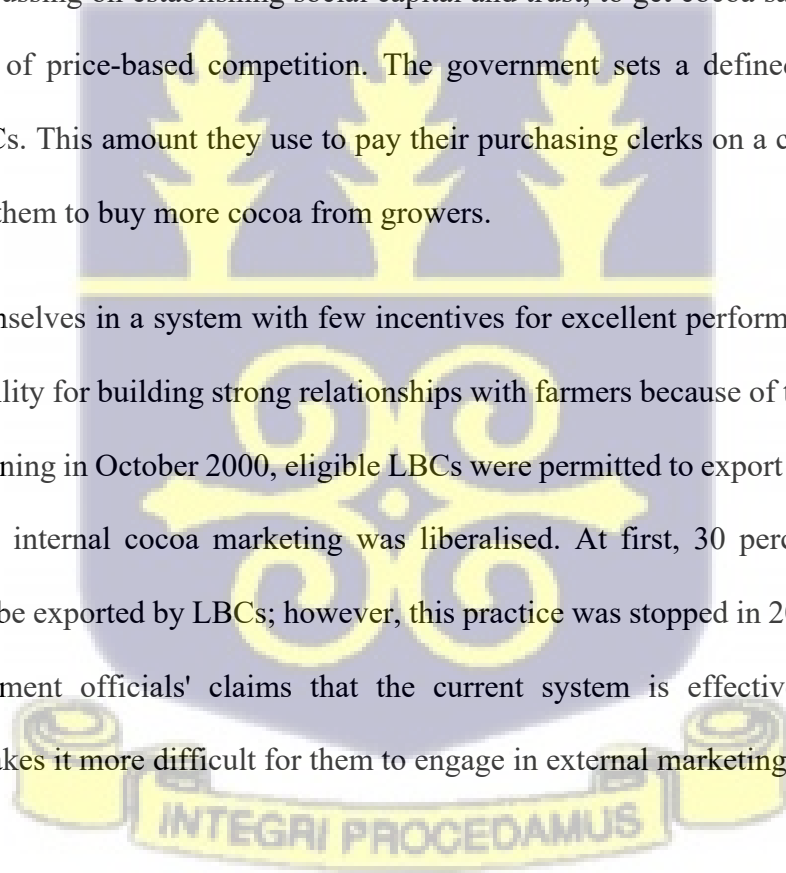
2.7.5 Net free on board (FOB) mechanism

In 2000, the government of Ghana decided to increase the share of world prices that farmers received. The PPRC introduced a new way of calculating producer prices based on a fixed 70% of the net FOB COCOBOD received through exports (Afari-Sefa *et al.*, 2010). Arriving at the net FOB price involves projecting the company's gross revenue and subtracting industry-related costs such as jute sacks, scholarship funds, fertiliser funds, and mass spraying. The net FOB pricing is that it deals with the actual cost of farmers rather than the latter.

Following the FOB reforms and the decreased participation of COCOBOD and its subsidiaries, the cocoa industry saw the emergence of new players and collaborations in the early 2000s, with the goal of bridging the gap created by the public sector's partial retreat. Even though its market share is decreasing, the PBC was the major buyer acquiring around 33% of cocoa in 2005–06. Notably, the PBC was partially privatised, and Cocobod is now the largest stakeholder in the company's shares, which are traded on the stock exchange.

The Kuapa Kokoo Union founded Ghana Sompka Kokoo, a new farmer-owned LBC, during this time, but no new foreign buyers were allowed to joined the market (Ton e., 2008). There was no price difference among LBCs because of internal marketing rivalry. LBCs used various approaches, focussing on establishing social capital and trust, to get cocoa sales from farmers in the absence of price-based competition. The government sets a defined annual buyers' margin for LBCs. This amount they use to pay their purchasing clerks on a commission basis and encourage them to buy more cocoa from growers.

LBCs find themselves in a system with few incentives for excellent performance and limited financial flexibility for building strong relationships with farmers because of the reforms' slow progress. Beginning in October 2000, eligible LBCs were permitted to export a portion of their purchases once internal cocoa marketing was liberalised. At first, 30 percent of domestic purchases may be exported by LBCs; however, this practice was stopped in 2007. Some LBCs dispute government officials' claims that the current system is effective, claiming that COCOBOD makes it more difficult for them to engage in external marketing.



2.7.6 The living income differential (LID)

The living income differential (LID) was introduced in 2019 by Cote d'Ivoire and Ghana as economies in the chocolate sector. The initial proposal was a floor price of USD 2600 per tonne of cocoa bean exports. This new policy aimed to increase farmers' farmgate prices by leveraging their support for the chocolate industry (FCC, 2019). The LID policy now entails a compulsory premium of USD 400 per tonne. A decreasing trend has followed for both the European (left) and U.S. markets (right) since August 2020. According to ICCO (2021), the introduction of LID payments has lowered the cocoa premium received by countries to reduce manufacturing costs (refer to Figure 2.5). However, Ghana still produces cocoa and receives a more significant premium than all other countries.

2.8 The impact of price reforms on producer prices

Price reforms significantly impact agricultural markets and the income of producers. According to Dastagiri and Vajrala (2018), political economy is important for farm support and for protecting producers and consumers against volatile prices. These decisions are mainly based on electoral gains. However, government interventions can dampen price volatility in the short run, and their effectiveness is often temporary (Pieters and Swinnen, 2016). Mitchell (2017) pointed out that producers can gain higher prices when they have access to market data, highlighting the importance of transparency and access to information.

In China, commodities with high self-sufficiency, such as wheat and corn, are less prone to speculative price bubbles than commodities with low self-sufficiency, such as soybeans (Li et al., 2017). They attributed this difference to government policies, market intelligence and the agricultural trade dynamics. Anderson (2016) argued that the disarray in the world food market over the decade was due to agricultural prices and past trade policies. Subsidies and trade

protections provided by wealthier countries reduce the financial incentive of developing countries.

Baffes and Gardner (2003) found that Ghanaian cocoa farmers did not experience a significant price increase under a broader cocoa reform between 1970 and 1995. Boysen *et al.* (2023), in their study on the effect of the living income differential on the welfare of cocoa farmers, stated that the effect ranges from zero to extensive. However, the remuneration is too dependent on chocolate manufacturers unless it is complemented by supply management. According to Abdulai and Reider (1995), there was a positive supply response to improve price. Quarmine *et al.* (2014) analysed the impact of price-related reforms and found that net FOB prices, which are institutionally determined, should factor in stabilising policies.

The current LID introduced to add a premium to the net FOB prices had low poverty and living income gain (van Vliet *et al.*, 2021; Waarts *et al.*, 2021). Laven (2007) and Vigneri (2007) found that reforms improved farmers' prices. Despite this ambiguity, studies need to systematically address the impact of specific reforms on the level and stability of prices paid to farmers, which this study seeks to fill.

Table 2.2 give the summary of all the producer price-related reforms discussed in the literature from 1920 to 2022. It highlights the main producer price policy objectives, the institutions that set-in producer prices and how the producer prices are determined.



Table 2.2. Producer price-related institutional changes in Ghana's cocoa sector, 1920–2022

Period	Price policy objective	Who set the price	How are price determined
1920-1946	Maximum government earning	Private trading firms and the colonial administration	Market/quality driven
1947-1951	Ensure fair and stable producer prices while generating revenue for the government	Cocoa Marketing Board (CMB)/Colonial Government	Administered prices
1952-1956	Stabilize prices for economic planning	Nkrumah as Prime Minister, with colonial government and Ministry of Finance	Administered prices, influenced by the Defence Act
1957-1965	Support national development and increase government revenue	Nkrumah's administration and CMB	Government-regulated prices and CPRICE mechanism: world price, farmers' expectations, and government revenue goals
1966-1983	Adapt to changing political landscape	Multiple military and civilian governments, with COCOBOD oversight	Prices adjusted Mechanism: according to political and economic conditions
1984-1997	Achieve positive real producer prices	Multistakeholder Producer Price Review Committee (PPRC)	Average cost of production (COP) Method: Calculating the average COP and determining prices to guarantee a 20% profit margin
1998-2000	Maintain positive real producer prices	Multistakeholder PPRC	Negotiation: Farmers bargain with the PPRC on prices depending on what they have previously been paid.
2001-2018	Maintain net FOB price of more than 70%	Multistakeholder PPRC	FOB Mechanism: Net COCOBOD revenue is subtracted from industry costs. The farmers receive a percentage of the remaining amount, net FOB.
2019-2022	Living Income Differential (LID) To increase the farmgate price of farmers	Multistakeholder PPRC	Same as above.

Source: Author based on the literature. Source: Author based on the literature

2.9 International trade theories dealing with agricultural commodities

This section reviews key international trade theories, from classical to structuralist, to provide a theoretical framework for analysing Ghana's cocoa sector. The focus is on how these theories explain patterns of specialization and trade, and how they justify or inform government policy interventions, particularly producer price reforms.

2.9.1 Theory of absolute advantage (Adam Smith)

Adam Smith, in *The Wealth of Nations* (1776), founded the classical theory of international trade on the principle of absolute advantage. He argued that trade arises from specialization, where a country should produce and export goods it can create more efficiently (at a lower absolute cost) than other nations, importing those where it is less efficient (Smith, 1776). Applied to Ghana's cocoa sector, the theory of absolute advantage explains its historical specialization. Ghana's specific soil, climate, and early-mover experience provided a natural absolute advantage in cocoa cultivation compared to other countries and other domestic crops (Austin, 2014). Producer price reforms that ensured stable and attractive farm-gate prices reinforced this advantage by incentivizing farmers to specialize in cocoa rather than alternative livelihoods, thereby boosting labour productivity and output across the cocoa belt (World Bank, 2018).

2.9.2 Theory of comparative advantage (David Ricardo)

David Ricardo (1817) advanced trade theory by demonstrating that mutual gains from trade are possible even if one country holds an absolute advantage in all goods. The critical determinant is comparative advantage: a country should specialize in producing goods for which it has the lowest opportunity cost. This theory provides a powerful lens for understanding farmer responses in Ghana's cocoa economy. Producer price policies directly alter the opportunity cost of cultivating cocoa. When policies made cocoa economically

attractive relative to food crops or other cash crops, farmers rationally allocated land and labour to cocoa specialization (Ricardo, 1817; Schumacher, 2012). Conversely, during periods of low or unstable cocoa prices, such as the 1970s, the opportunity cost of growing cocoa rose, leading farmers to shift resources into food production or informal activities, illustrating the practical relevance of comparative cost (Herbst, 1993).

2.9.3 Neoclassical formulations: Opportunity cost and supply response

Modern neoclassical economics has refined Ricardo's insight using formal tools such as production possibility frontiers (PPFs) and indifference curves (Haberler, 1930). This model illustrates how relative price shifts alter opportunity costs and influence production decisions along the PPF. In Ghana, reforms that guaranteed minimum producer prices through the Cocoa Marketing Board (CMB) effectively changed the relative price of cocoa, lowering its opportunity cost compared to alternative land uses. When reforms improved price certainty and returns, farmers reinvested in cocoa farms, expanding production. However, when official producer prices lagged behind rising input and labour costs, the effective opportunity cost of cocoa cultivation increased, causing a shift in land use away from cocoa (Vigneri & Santos, 2008). This framework centralizes opportunity cost in understanding the supply response of farmers to price policies.

2.9.4 Heckscher-Ohlin factor endowment theory

The Heckscher-Ohlin (H-O) model (Heckscher, 1919; Ohlin, 1933) posits that comparative advantage is derived from a country's factor endowments. Countries will export goods that intensively use their relatively abundant factors of production. Ghana's comparative advantage in cocoa exports stems from its abundance of agricultural land suitable for cocoa and unskilled labour. Producer price reforms interact with this endowment structure by influencing the returns to these factors. For example, during the 1980s structural adjustment programme,

higher cocoa producer prices increased the returns to land and labour dedicated to cocoa, thereby strengthening Ghana's export position by drawing more resources into the sector (World Bank, 2018). Furthermore, the H-O framework highlights the distributive consequences of such reforms, as benefits accrue differently to landowners, labourers, and marketing intermediaries, influencing rural income distribution.

2.9.5 The Prebisch-Singer hypothesis and structuralist critique

In contrast to the optimistic predictions of classical and neoclassical theories, the Prebisch-Singer hypothesis presents a structuralist critique. It argues that over the long run, the terms of trade for primary commodity exporters tend to decline, meaning the prices of their exports (like cocoa) fall relative to the prices of manufactured goods they import (Prebisch, 1950; Singer, 1950). This theory provides a critical justification for proactive government intervention in Ghana's cocoa sector. Faced with declining or volatile global cocoa prices, successive governments have used stabilization policies, guaranteed prices, and marketing board reforms to shield farmer incomes and protect national export earnings (IMF, 2007; FAO, 2018). A contemporary example is the introduction of the Living Income Differential (LID) in 2019 by Ghana and Côte d'Ivoire. This direct price premium reflects the structuralist concern that, without coordinated intervention, cocoa farmers would remain trapped by a systemic tendency towards declining terms of trade (Griffiths, 2022).

2.10 Review of prior studies and methods

2.10.1 Agricultural supply response: the Nerlove tradition

The classic partial-adjustment model (Nerlove, 1958) posits that producers adjust gradually toward a desired (capacity) output, with expectations formed over prices and other fundamentals. In log-linear form, the short-run elasticity is read from the differenced (error-

correction) equation, while the long-run elasticity aggregates dynamic effects via $\varepsilon^{LR} = \frac{a_2}{1-a_1}$,

where a_1 is the persistence in output and a_2 the price response.

For Ghana, Bateman (1972) pioneered a two-step scheme that decomposes observed output into a “normal/capacity” component and short-run deviations driven by prices and rainfall. Iterating between (i) capacity estimation and (ii) a short-run equation in log output (normal output, current cocoa price, rainfall) yields a convergent short-run price elasticity and highlights weather as a major transitory driver.

Subsequent studies retained this dual structure while enriching covariates. Stryker (1990) and Frimpong-Ansah (1992) regress actual output on lagged output, cocoa and competing-crop (maize) prices, and a constructed normal-output series (the latter using “undistorted” equilibrium prices in Frimpong-Ansah). In these models, short-run elasticities reflect variable-input adjustments (labour, chemicals), and long-run elasticities operate through planting/rehabilitation and thus capacity.

Abdulai and Rieder (1995) show key series are non-stationary and recast the Nerlove framework as an error-correction model, capturing (i) short-run reactions, (ii) a long-run cointegrating link between output and capacity/relative prices, and (iii) the speed of adjustment. Studies that allow for crop competition confirm substitution e.g., higher maize prices depress cocoa as well as strong persistence in output; rainfall explains intra-annual swings (e.g., Hattink et al., 1998).

Across this literature, cocoa supply is price-inelastic: short-run elasticities cluster around 0.2%, and long-run elasticities are higher but less than one. Many papers report elasticities without standard errors or confidence intervals, limiting inference. The policy implication is consistent: price incentives alone yield modest near-term gains; durable supply responses require capacity

measures (replanting, rehabilitation, disease control, improved seedlings, pruning, and extension) and attention to cross-crop price signals. Methodologically, ECM/ARDL specifications dominate static regressions by aligning with underlying adjustment dynamics and the time-series properties of the data. Our study addresses this issue by using ECM/ARDL for the analysis.



CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses the methods and procedures used to analyse the study objectives. The theoretical frameworks underlying the analysis used in the study are discussed first. This is followed by a discussion of the study's conceptual framework, methods used to analyse the specific objectives, definitions of variables used, data sources, research approach, and data used for the study and analysis.

3.2 Theoretical frameworks

3.2.1 The agricultural price fluctuation model

The theoretical framework underpinning the study is the agricultural price fluctuation model, which integrates two main perspectives: the cobweb (adaptive expectations) framework (Ezekiel, 1938; Nerlove, 1958) and the rational expectations approach (Muth, 1961). The cobweb mechanism generates endogenous cycles from adaptive forecasting. In contrast, rational expectations attribute volatility primarily to real shocks (such as weather, global demand, producer price policy, and trade policy) rather than systematic forecast errors.

Studies such as Chatrath et al. (2002) and Cashin et al. (2002) highlight that agricultural commodity prices typically display non-normal distributions, high autocorrelation, positive skewness, and high kurtosis. Price series are also characterized by asymmetric cycles with more frequent and deeper slumps than upturns, leading to persistent uncertainty in price behaviour.

Let P_t^w denote the world price, P_t^{FOB} the Ghanaian free-on-board (FOB) price, P_t^f the farm-gate price, and Y_t the marketed output in marketing season t . Let τ_t represent per-unit costs or levies.

(a) Administered price rule, price floors, and subsidies

Ghana's season-fixed producer price can be represented as a smoothed share-of-FOB rule, subject to a minimum floor price and adjusted by subsidies:

$$P_t^{f,*} = (1 - \lambda) P_{t-1}^f + \lambda(\alpha_t P_t^{\text{FOB}} - \tau_t), \quad 0 < \lambda \leq 1, \quad 0 < \alpha_t < 1 \quad (3.1)$$

$$P_t^f = \max\{ P_t^{f,*}, P_t^{\text{min}} \} \quad (3.2)$$

$$P_t^{\text{eff}} = (1 + s_t^a) P_t^f + s_t^u \quad (3.3)$$

where λ is the smoothing parameter, α_t the policy share of FOB, P_t^{min} the guaranteed floor price, and s_t^a and s_t^u are ad valorem and per-unit subsidies, respectively.

The short-run pass-through from FOB to the farm-gate price equals $\lambda\alpha_t$, while the long-run pass-through approaches α_t . When the floor price binds, short-run pass-through locally falls to zero, truncating negative shocks to producer prices.

3.2.2 Price transmission from world to domestic markets

The FOB price relates to the world price through a cost or basis-adjusted relationship:

$$\ln P_t^{\text{FOB}} = \mu_0 + \mu_1 \ln P_t^w + \ln FX_t + q_t - c_t + \epsilon_t, \quad (3.4)$$

Where q_t = quality/basis premium

An error-correction mechanism can represent the dynamic link between world and domestic prices:

$$\Delta \ln P_t^f = \phi (\ln P_{t-1}^f - c - \beta \ln P_{t-1}^w) + \sum_{i=0}^q \gamma_i \Delta \ln P_{t-i}^w + \delta' Z_t + \xi_t, \quad \phi < 0 \quad (3.5)$$

Where

$$\beta_t = \beta_1 \text{Integration}_t + \beta_2 \text{Policy}_t, \quad 0 < \beta_t \leq 1 \quad (3.6)$$

Defining price returns as

$$r_t^w \equiv \Delta \ln P_t^w, \quad r_t^{\text{FOB}} \equiv \Delta \ln P_t^{\text{FOB}}, \quad r_t^f \equiv \Delta \ln P_t^f \quad (3.7)$$

we expect $r_t^f \approx \lambda \alpha_t r_t^{FOB}$, implying that the amplitude of domestic price adjustments depends on the degree of policy smoothing and the share of FOB passed to producers.

Producer output decisions can then be expressed as

$$\ln Y_t = \psi_0 + \psi_1 E_{t-1}[\ln P_t^{eff}] + \psi_2 Gap_{t-1} + \psi_3' W_t + v_t, \psi_1 > 0 \quad (3.8)$$

where $Gap_{t-1} = \ln P_{t-1}^{CI} - \ln P_{t-1}^f$ captures the price gap between the producer price and the cost index, and W_t represents other controls such as input costs and weather conditions.

In the short run, equilibrium in the cocoa market can be expressed as

$$Q_t^s = a + b E_{t-1}[P_t^f] + u_t, b > 0 \quad (3.9)$$

$$Q_t^d = c - d P_t^f + v_t, d > 0 \quad (3.10)$$

$$Q_t^s = Q_t^d \Rightarrow P_t^f = \kappa + \theta E_{t-1}[P_t^f] + \varepsilon_t \quad (3.11)$$

where $\kappa = (a - c)/d$ and $\theta = b/d$.

The agricultural price fluctuation model, therefore, captures both expectation-driven and shock-driven volatility mechanisms. It further accounts for the role of policy interventions price-setting, minimum price guarantees, and subsidies in influencing the behaviour of producers and the degree of price transmission from world to domestic markets.

By integrating the rational and adaptive expectations hypotheses with the price transmission theory, this framework provides a coherent basis for examining how producer-price-related reforms have influenced Ghana's cocoa sector between 1920 and 2022. It reflects the observed stylised facts of the cocoa market periods of booms, busts, and stagnation while linking them to changes in market liberalisation, policy design, and global price shocks.

3.3 Conceptual Framework

The underlying conceptual framework presented in Figure 3.1 revolves around the interactions among key actors, including the type of government, either colonial or self-governance, and the international community, such as bilateral donors, international lending institutions, and nongovernmental agencies. These interactions significantly shaped the type of regulatory institution and the process of market price reforms. For example, colonial governments often prioritized the extraction of raw materials, while self-governing states may focus on national development goals. The outcomes of price reforms are contingent on the dynamics of this process.

The interplay of local and external interest groups emphasised the impact of macroeconomic and global economic trends on regulatory institutions. Regulatory institutions regulate private entry and serve as a buffer against macroeconomic shocks and producer risk. National political-economic considerations are influenced by perceptions of the state's role in providing public goods, particularly in managing export earnings risk and the social contract with urban and rural consumers. Regulatory institutions (Cocobod through the CMC) generate foreign earnings through exports, which are important for macroeconomic stability. For instance, a regulatory body might enforce trade agreements or quality standards that align with global expectations, ensuring that cocoa exports remain competitive. Moreover, these institutions are influenced by macroeconomic factors such as exchange rates, inflation, and foreign exchange policies. Regulatory institutions, in turn, provide new technology to boost output and are the only way to increase production to the rest of the world.

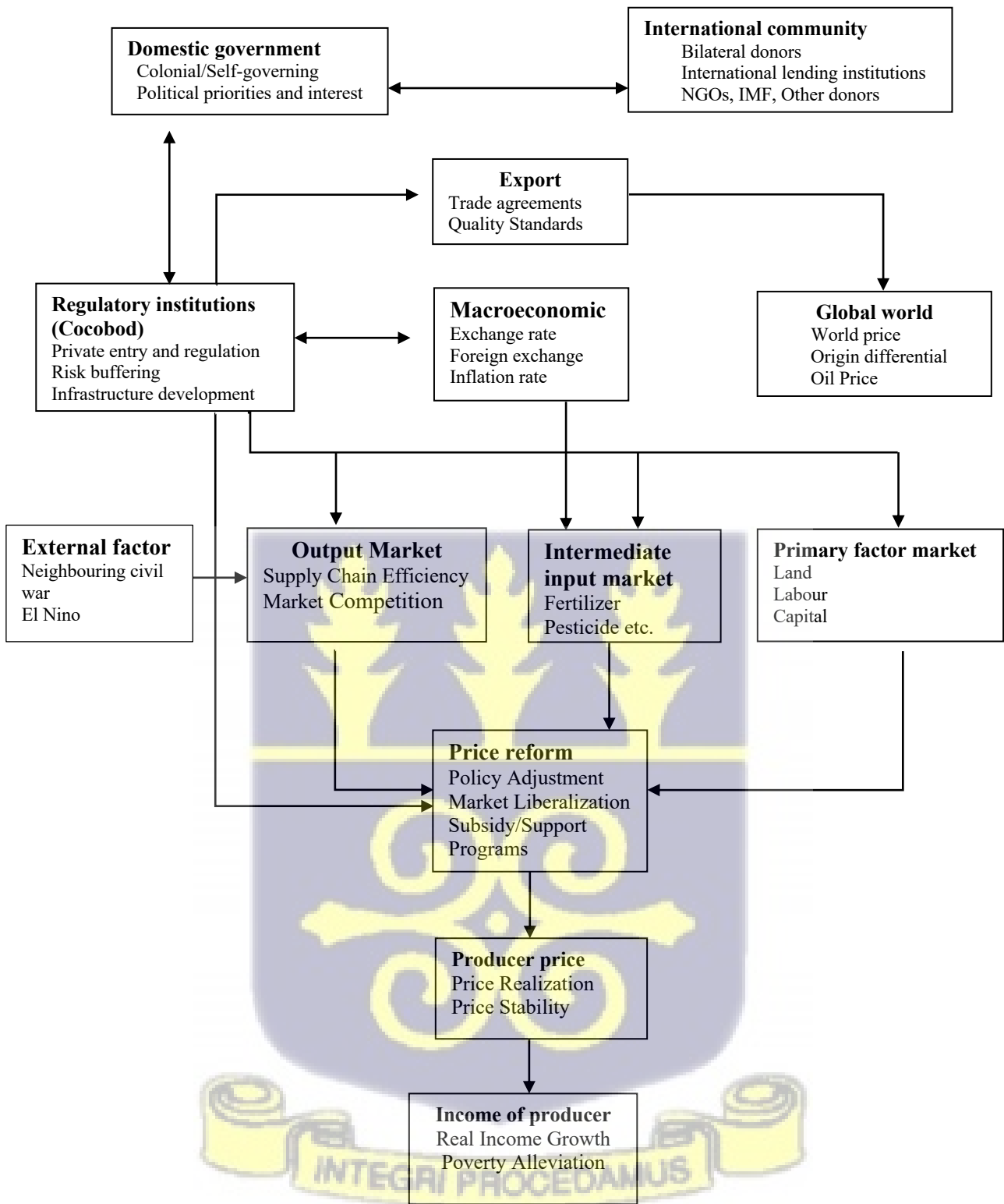


Figure 3.1. Conceptual Framework

Source: Author

Global economic trends, including fluctuations in world cocoa prices, origin differentials, and oil prices, have a direct impact on the domestic economy and regulatory institutions. For example, a rise in global oil prices might increase the cost of inputs like fertilizers and pesticides, thereby affecting the cost structure in the cocoa production process. Similarly, changes in world cocoa prices directly affect export revenues, which in turn influence the income levels of producers.

External factors, such as neighbouring civil wars, smuggling or climatic events like El Niño, can disrupt supply chains and market competition. For instance, a neighbouring country's civil war might result in the smuggling of cocoa to Ghana and a refugee problem, which would impact labour markets and the supply of cocoa generally. El Nino events might disrupt weather patterns, leading to crop failures and reduced output.

The output market, influenced by factors such as supply chain efficiency and market competition, interacts with the input market, where the availability and cost of fertilizers, pesticides, and labour are determined. Regulatory institutions may intervene in these markets by providing subsidies or support programs, thereby influencing market competition and the overall efficiency of the supply chain.

Price reforms are crucial for cocoa farmers' income growth, affecting producer prices and incomes. These reforms involve policy adjustments, market liberalization, and subsidies to at stabilizing prices and ensuring fair returns. However, price volatility can undermine income stability and make poverty alleviation efforts more challenging. The framework highlights the interconnectedness of factors like domestic governance, international influence, regulatory institutions, macroeconomic trends, global economic conditions, and external shocks in shaping these outcomes

3.4 Method of analysis

The methods used in the study are discussed in this section. First, a diagnostic check was performed to determine whether the models fit our series. The augmented Dickey-Fuller (ADF) unit root test by Dickey and Fuller (1979), the KPSS test proposed by Kwiatkowski *et al.* (1992), and Kapetanios (2005) tests were used to confirm the stationarity of the price series to avoid spurious regression. The Maki cointegration test (Maki, 2012) was used to test the long-run relationships between variables at the level in the presence of break. The Bayesian structural time series was used to estimate the causal impact assessment before and after a producer price reform. The Relative Price Index (RPI) for FOB price proportion received by farmers, adjusted absolute mean deviation (AMAD) for price volatility, and an Autoregressive Distributed Lag (ARDL) model for long-run effects on cocoa output.

3.4.1 Unit root tests

Before doing the analysis, the data series was tested for stationarity. The stationarity tests were used to examine whether the series exhibits no trend or change in mean and variance over time. Stationarity can manifest in two forms: weak or strong. Weak stationarity, also known as second-order stationarity, characterises a series whose first and second moments (mean and autocovariance) remain independent of time. On the other hand, strong stationarity is evident when the mean, autocovariance, variance, and all higher moments at any lag, such as k , persistently remain constant across time. The expected value of X_t does not vary with time; it is constant and given by λ_t . Mathematically, this condition is expressed as:

$$E(X_t) = \lambda_t \quad (3.12)$$

$$\text{Var}(X_{t1}) = \text{Var}(X_{t2}) = \text{Var}(X_{t3}) = \text{Var}(X_{t4}) = \sigma_0 \quad (3.13)$$

$$\text{Cov}(X_t, X_{t+k}) = \sigma_y(k) \quad (3.14)$$

A nonstationary series is a series that does not have a constant variance; hence, it changes over time. Therefore, Y_t is a nonstationary series whose mean λ_t is dependent on time t with a weak stationary error ϵ_t

$$Y_t = \lambda_t + \epsilon_t \quad (3.15)$$

$$\lambda_t = f(t) \quad (3.16)$$

Differencing was used to transform a nonstationary time series into stationary. The process of differencing the data set at level. When a time series becomes stationary after a single differencing, then the series is integrated of order one as $I(1)$ or ΔY . Conversely, if the nonstationary series attains stationarity after being differenced d times, it is designated as integrated of order d , denoted as $I(d)$ or $\Delta^d Y$. An initially stationary series is identified as being of order zero, represented by $I(0)$.

The objective of ensuring stationarity is to establish the stability of autoregressive parameters and the invertibility of moving average parameters within defined limits in an estimated time series model. As Hamilton (1994) highlighted, meeting the stationarity condition facilitates estimation and subsequent forecasting. A unit root test is performed to ascertain the presence or absence of stationarity. This test aids in determining whether the series exhibits a stochastic or deterministic trend. Various graphical and quantitative approaches have been developed for testing stationarity. The graphical method involves visually inspecting autocorrelation function (ACF) plots. A rapidly decaying ACF after a few lags indicates stationarity, while a slow and persistent decay suggests non stationarity. In this study, three quantitative methods, namely, the augmented Dickey-Fuller (ADF) test, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test and the Kapetanois test, were employed to test for the presence of a unit root. The existence of a unit root implies non stationarity, necessitating differencing to achieve stationarity.

3.4.1.1 Augmented Dickey-Fuller test

The Augmented Dickey-Fuller (ADF) test extends the Dickey-Fuller test to address any form of serial correlation present in a time series (Dickey & Fuller, 1979). Acquah (2012), Abdulai (2002), and De Jong *et al.* (1992) emphasise that the ADF test is the most comprehensive test for a unit root. This distinction arises because the ADF test remains unaffected by size distortions in the face of extreme autocorrelation, over parametrisations, and increased sampling frequency, all while dealing with autocorrelated errors. Therefore, the ADF test operates under the assumption that the series adheres to a random walk. This is achieved by considering the first-order autoregressive AR(1) process outlined below.

$$Y_t = \partial Y_{t-1} + \epsilon_t \quad (3.17)$$

where

- Y_t denotes the variables used for study
- Y_{t-1} lagged value of Y
- t denotes the time index
- ∂ denotes the coefficient of the model
- ϵ_t error term with an independent and identically distributed normal distribution with mean 0 and variance σ^2 [i.e., $N(0, \sigma^2)$]

A unit root is attained when ∂ equals one. Equation (3.6) transitions into a nonstationary random walk model without drift. The diagnostic procedure involves regressing the observed variable Y_t on its lagged value Y_{t-1} , potentially with an intercept with a time trend. After estimating ∂ , it is compared to one. Equation (3.6) is transformed into:

$$\Delta Y_t = (\partial - 1)Y_{t-1} + \epsilon_t = \phi Y_{t-1} + \epsilon_t \quad (3.18)$$

The difference operator, denoted by Δ , signifies the disparity between consecutive time points, expressed as $\Delta Y_t = Y_t - Y_{t-1}$, with $\varphi = \partial - 1$. Equation (3.7) facilitates testing the null hypothesis ($\varphi = 0$) against the alternative ($\varphi \neq 0$).

Nonrejection of the null hypothesis ($\varphi = 0$) suggests $\partial = 1$, affirming the presence of a unit root in the series. The decision to reject or uphold the null hypothesis is contingent upon the calculated test statistic and critical values of the augmented Dickey-Fuller (ADF) test. The ADF test, however, contends that issues arise from serial correlations in residuals, potentially biasing conclusions. To mitigate this concern, the autoregressive (AR) model incorporates sufficient lagged dependent variables, necessitating a reformulation of the model (Equation 3.7) as follows:

$$\Delta Y_t = \gamma + \rho_t + \varphi Y_{t-1} + \gamma_1 \Delta Y_{t-1} + \dots + \gamma_{p-1} \Delta Y_{t-p+1} + \epsilon_t \quad (3.19)$$

Here, γ denotes a constant, ρ signifies the estimated value on the time trend series, and $\gamma_1 \Delta Y_{t-1} + \dots + \gamma_{p-1} \Delta Y_{t-p+1}$ represents the summation of lagged values of the dependent variable ΔY_t , where p is the lag order of the autoregressive (AR) process. Introducing a constraint ($\rho=0$ and $\gamma = 0$) yields a random walk, while the constraint $\rho = 0$ corresponds to modelling a random walk with drift. Incorporating lags of order p in the model allows for higher-order AR processes in the augmented Dickey-Fuller (ADF) formulation. The ADF test assesses the parameter φ , and a φ value of 0 implies the presence of a unit root in the series, indicating non-stationarity.

The ADF statistic is given by

$$F = \frac{\hat{\varphi}}{SE(\varphi)} \quad (3.20)$$

where, $\hat{\varphi}$ denotes the least square estimate. $SE(\varphi)$ denotes the standard error estimate of φ . We reject the null hypothesis ($\hat{\varphi}=0$) when the Augmented Dickey-Fuller (ADF) test statistic exceeds the critical value.

3.4.1.2 Kwiatkowski-Philips-Schmidt-Shin (KPSS) test

The null hypothesis in the KPSS test asserts that a series exhibits stationarity around the mean or a linear trend, while the alternative posits non stationarity attributable to the presence of a unit root. The test model of the KPSS comprises three fundamental components: a random walk, a deterministic trend, and a stationary error term. An essential assumption is that the starting point is a data-generating process following the form:

$$Y_t = w_t + \varepsilon_t \quad (3.21)$$

where

w_t represents a random walk process defined by $w_t = w_{t-1} + \mu_t$, where ε_t is an error term, and μ_t signifies the error term in the random walk equation. It is posited that μ_t is i.i.d. The null and alternative hypotheses can be stated as follows:

$$H_0 : \sigma^2 = 0$$

$$H_0 : \sigma^2 > 0$$

If the null hypothesis fails to be rejected, then Y_t is made of a constant term and a stationary term, indicating the stationarity of Y_t .

Therefore, the KPSS test statistic is formulated as follows:

$$KPSS = \sum_{t=1}^N \frac{P_t^2}{\sigma_\infty^2} \quad (3.22)$$

Where,

N represents the number of observations, $P_t = \sum_{i=1}^t \varepsilon_i$, $i=1$ for $t=1, 2, \dots, T$, and ε_i denotes the estimated errors from the model Y_t . σ_∞^2 represents the estimator of the long-run variance of the error term, defined as: $\sigma_\infty^2 = w_t + \varepsilon_t$, $\sigma^2 = \lim_{N \rightarrow \infty} N^{-1} \text{Var}(\sum_{i=1}^t \varepsilon_i)$,

$$\sigma^2 = \lim_{N \rightarrow \infty} N^{-1} E[P_t^2]$$

Decision: Reject the null hypothesis H_0 if the calculated test statistic exceeds the critical value at the specified significance level.

3.4.1.3 Kapetanios unit root test with breaks

Kapetanios's (2005) unit root test in the presence of structural breaks is employed for assessing the stationarity of a series. The test is reliable and robust. The test can detect both intercept and/or trend stationarity while accommodating up to five data-dependent structural breaks, determined endogenously through the minimisation of squared residuals. The formula for the Kapetanios test is represented as:

$$y_t = \alpha_0 + \alpha_1 t + \partial y_{t-1} + \sum_{i=1}^k \vartheta_i \Delta y_{t-i} + \sum_{i=1}^m \gamma_i DU_{i,t} + \sum_{i=1}^m \kappa_i DT_{i,t} + \varepsilon \quad (3.23)$$

Where,

α_0 and $\alpha_1 t$ are the intercept and trend parameters, respectively.

∂ is the parameter of the autoregressive term of order one, AR (1).

$DU_{i,t}$ and $DT_{i,t}$ are break dummy variables for the intercept and time trend, respectively.

The null hypothesis is that there is a unit root or nonstationary with m structural breaks

$DU_{i,t}$ and $DT_{i,t}$ are defined based on structural break dates.

Kapetanios (2005) suggested that as the number of breaks m increases, the power of the test decreases.

3.4.2 Model selection criteria

To select the most suitable model to describe the time series data, a model selection criterion was used. Similar to De-Graft (2015) and Abunyuwah (2008), the information criterion (IC) test was used to assess the goodness of fit of different models applied to the data. The underlying principle of IC tests is identifying a model that best fits a dataset with minimal parameters, using maximum likelihood with a penalty for its complexity.

Information criteria, including the Akaike information criterion corrected (AICc), Akaike information criterion (AIC), and Bayesian information criterion (BIC), incorporate penalties that increase with the number of parameters. In this study, the Akaike information criterion (AIC) formulated by Akaike (1973) and the Bayesian information criterion (BIC) were employed to measure the goodness of fit to select the most appropriate model. The penalties in these criteria discourage overfitting, ensuring that an increased number of parameters does not disproportionately enhance goodness of fit. The optimal model has the lowest BIC or AIC values among a set of candidate models (Mitchell & McKenzie, 2003). The expressions for the BIC and AIC are generally as follows:

$$BIC = \log(\sigma_r^2) + K \log(n) \quad (3.24)$$

$$AIC = 2K - 2 \ln(L) \quad (3.25)$$

Where,

$\log(\sigma_r^2)$ is the natural log of the estimated error variance

K is the number of parameters in the model

$\log(n)$ is the natural log of the number of observations in the model

n is the number of observations in the dataset

$\ln(L)$ is the maximum likelihood function (L) the model maximises

The AIC penalises the number of parameters to prevent overfitting, while the BIC balances goodness of fit and model of fit. Therefore, for both, lower values indicate a better fit.

3.5 Impact of price-related reforms on farmers' producer prices

In causal impact analysis, covariates should be unaffected by the reforms being studied and have a clear relationship with the dependent variable. A strong relationship between the chosen covariates and the dependent variable improves the effectiveness of the CIA in determining the intervention's effects. Since the FOB reflects global market trends, rather than domestic

policies directly, it can be an external benchmark unaffected by the price reforms in Ghana. The FOB price was used as a covariate for forecasting producer pricing using Directed Acyclic Graph (DAG) and correlation analysis.

The relationship study found a positive relationship between the FOB price and the producer price at various reform periods. A higher FOB price often corresponds to an increase in producer price. This research used the Causal Impact package in R (Brodersen et al., 2015) for causal inference using a BSTS, with optional model parameters and values. The causal inference is implemented through counterfactual predictions. The model was fitted using 10,000 Markov Chain Monte Carlo (MCMC) samples for robust impact estimation. Data columns were standardised based on pre-intervention moments and a prior standard deviation of 0.01 was set for the Gaussian random walk of the local level, accounting for model sensitivity to intervention impact while accounting for data variability.

The CIA observation model is expressed as follows:

$$y_t = \alpha_t + \beta FOB_t + \epsilon_t \quad (3.26)$$

Where,

y_t is the annual producer price at time t, α_t is the state component (trend), α_t represent the state (trend), β is the coefficient of the FOB, $\epsilon_t \sim N(0, \sigma_\epsilon^2)$ is an observation error.

The state equation (α_t) is given as follows

$$\alpha_t = \alpha_{t-1} + \zeta_t \quad (3.27)$$

Causal impact evaluation

To assess the impact of the reform, I calculated the counterfactual value (\tilde{y}_t), a predicting a producer price as if no reform had occurred.

$$\Phi_t = y_t - \tilde{y}_t \quad (3.28)$$

By averaging Φ_t values across post-reform periods, we obtain the reform's cumulative impact on producer prices.

3.6 Proportion of free-on-board prices received by farmers

The real relative price index measures the change in producer prices compared to FOB prices over time, adjusting for inflation for comparability across different periods. The ratio directly measures the proportion of FOB price received by producers, indicating the effectiveness of price transmission from the global market to local producers. The study analysed the real relative price index over a period, focusing on major price reforms. It examined changes in the index to determine if reforms increased or decreased producers' share of the FOB price. Comparing the index before and after reforms allowed for a comparison of reforms' impact on producer welfare.

$$\text{Real relative price index}_t = \frac{\text{real producer price}_t}{\text{real FOB price}_t} \quad (3.29)$$

3.7 Measuring the Volatility of the Producer Cocoa Price Under Each Reform

To examine volatility, the adjusted mean absolute deviation (AMAD) was used to measure the annualised volatility of the cocoa price series within each reform period. This process involves two simple steps: calculating the sum of the absolute simple return on producer price series and then compute the average of the absolute returns over the periods. According to Ederington and Guan (2006), the adjusted mean absolute deviation is more robust to outliers and non-normal data.

$$MAD_t = \left(\frac{n}{n-1}\right) \sqrt{\frac{\pi}{2}} \frac{1}{n} \sum_{j=0}^{n-1} |R_{t-j}| \quad (3.30)$$

$R_t = \frac{p_{t-1}}{p_t} - 1$, represents the simple return price series at time t.

AMAD converges to $\frac{\sigma}{k}$ with $\sqrt{\frac{\pi}{2}}$ for normal distributions. $\sqrt{\frac{\pi}{2}}$ is a constant for the correction factor to approximate the standard deviation for a normal distribution. A small sample size correction factor of $\left(\frac{n}{n-1}\right)$ was used to correct for the bias in small samples (unbiased scaling), n is the size of the sample, x_i is the value in the sample, π is the sample mean, p_t is the price at t, p_{t-1} is the price at t-1.

3.8 Effect of producer price reforms on cocoa output

3.8.1 Maki cointegration

Before estimating the effect of factors and reform variables on cocoa output, Maki cointegration test was used to test for cointegration in the presence of structural breaks. Because the time series considered in this analysis is long, without accounting for structural breaks may not yield consistent results. The cointegration approaches with structural breaks involve various methods, including those proposed by Hatemi-J (2008) and Gregory and Hansen (1996). However, these methodologies have shown limited efficacy in accommodating fewer structural breaks compared to the Maki cointegration approach. The Hatemi-J (2008) can accommodate two, while Gregory and Hansen (1996) can determine one structural break in a model. In contrast to the computational simplicity of Maki cointegration and its capacity to account for up to five unknown structural breaks, the Maki approach stands out. Therefore, the study opted to use the Maki approach to examine the cointegration relationship between the cocoa output and its determinants.

The Maki cointegration with regime shift and trend is given by :

$$Y_t = \zeta + \sum_{i=1}^k \xi_i J_{it} + \pi t + \sum_{i=1}^k \pi_i (t \cdot J_{it}) + \sum_{j=1}^m o_j A_{jt} + \sum_{i=1}^k \sum_{j=1}^k o_{ij} (A_{jt} \cdot J_{it}) + \xi_t \quad (3.31)$$

Where: Y is the dependent variable (Cocoa Output); ζ : The constant term (intercept) before any break; J_{it} : Dummy variable(s) for the structural break(s)/regime(s). $J_{it} = 1$ for periods after break i , and 0 otherwise. ξ_i : The change in the intercept following a structural break i . The total intercept after the break i is $\zeta + \xi_i$; t : The deterministic time trend.

π : The coefficient of the deterministic trend before any break; π_i : The change in the trend's slope following structural break i . The total trend slope after break i is $\pi + \pi_i$; A_{jt} : The vector of m explanatory variables (Producer Price, Rainfall).

o_j : The slope coefficients of the explanatory variables A_{jt} before any break.

o_{ij} : The change in the slope coefficient of the variable A_j following structural break i . The total effect of A_j after break i is $o_j + o_{ij}$; ξ_t : The stochastic error term.

3.8.2 Autoregressive distributed lag (ARDL) model

Cointegration is a common technique to establish the long-term relationship between non-stationary market prices (Asche et al., 1999; Fernández-Polanco & Llorente, 2019). The establishment of cointegration does not automatically imply causality. An autoregressive distributed lag (ARDL) bound testing was used to determine the long-term and short-term cointegration between producer price reforms and cocoa output. Following Rahman and Kashem (2017) and Khan *et al.* (2020), we estimate an autoregressive distributed-lag (ARDL) model in error-correction form that accommodates I(0)/I(1) regressors and separates short- from long-run effects. Let $q_t = \ln(\text{Production})$, $p_t = \ln(\text{Real producer price})$, $r_t = \ln(\text{Rainfall})$, and τ_t a deterministic trend; d_t includes institutional and climate dummies (CMB, liberalization, Net-FOB, Nkrumah, El Niño). The long-run relation is

$$q_t = \alpha + \beta_p p_t + \beta_r r_t + \beta_\tau \tau_t + d_t' \eta + u_t \quad (3.32)$$

The conditional ECM is

$$\Delta q_t = \phi ECT_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta q_{t-i} + \sum_{j=0}^{q_p-1} \delta_j \Delta p_{t-j} + \sum_{k=0}^{q_r-1} \rho_k \Delta r_{t-k} + \kappa \Delta \tau_t + d_t' \theta + \varepsilon_t, \quad (3.33)$$

where $ECT_{t-1} = q_{t-1} - \hat{\alpha} - \hat{\beta}_p p_{t-1} - \hat{\beta}_r r_{t-1} - \hat{\beta}_\tau \tau_{t-1} - d_{t-1}' \hat{\eta}$.

Cointegration is assessed by the ARDL bounds test; if the F-statistic exceeds the upper bound, we recover $\hat{\beta}$ as long-run elasticities and $\phi < 0$ measures the speed of adjustment. Lag orders are chosen by Schwarz Bayesian Criterion, and standard residual/structure diagnostics (BG LM, RESET, JB, heteroskedasticity) are reported.

The optimal lags of the ARDL allow for the avoidance of the autocorrelation problem selected using the BIC.

3.9 Study design and data sources

Annual secondary time series data were used for this analysis because Ghana trade its cocoa beans through yearly forward sales and producer prices are mostly set for a whole crop year. The data on world cocoa production, Ghanaian cocoa production, producer prices and world prices were obtained from the COCOBOD and the International cocoa organisation (ICCO), with earlier years obtained from Kofi (1972). The consumer price index (CPI) data figures from 1960 to 2022 were sourced from the Ghana Statistical Service (GSS). For the earlier period, 1920–1959, historical producer price data were drawn from Kofi (1974), and the corresponding CPI series were obtained from Bateman (1972) published in a book edited by Kotey et al. (1972). These sources collectively provide a comprehensive view of the evolution of Ghana's cocoa sector over more than a century, encompassing both colonial and post-independence policy regimes.

This study used more than a century of secondary yearly data from 1920 to 2022 to investigate producer price-related institutional reforms in Ghana spanning from the colonial era (1920) to the current period of self-rule (2022). This research started in 1920 because it was the year in which Ghana claimed the title of the world's largest producer of cocoa, which was highly concentrated in the Eastern Region of Ghana (Ministry of Finance, 1999, p. 6). The rainfall data were obtained from World Bank, Climate Change Knowledge Portal (2024). The data were analysed using R, Gretl, Gauss and Microfit software.



Table 3.1 Description and source of data used in study

	Description	Period	Source and construction
Cocoa Production	Annual cocoa output (metric tonnes)	1920-2022	Kay (1972); COCOBOD, ICCO
Real Producer Price	Nominal price deflated by CPI (2013 constant prices)	1920-1959	Constructed from nominal price from Kofi (1974) and Accra Retail Price Index from Bateman (1972).
		1960-2022	Nominal price from ICCO (2023); CPI from Ghana Statistical Service. Series deflated and harmonized to 2013 base year.
Rainfall	Annual rainfall (millimeters)	1920-2022	World Bank Climate Change Knowledge Portal (World Bank, 2023).
CMB Era	Cocoa Marketing Board monopsony	1947-1956	
Nkrumah Era	Post-independence government period	1957-1965	
Net FOB Era	Period of specific export taxation policies	2001-2019	
LID Era	Period of cocoa sector liberalization	2019-2022	
El Niño Weather Shock	Years of strong El Niño events	1976, 1977, 1978, 1982, 1983, 1990, 1993, 1998, 2006, 2014	

Source: Author's illustration



CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This section presented the results of the study. The descriptive statistics of the variables used were discussed. Then, the stationarity of each data series was assessed to ensure the consistency of the statistical properties of each series over time, which is crucial for the validity and reliability of the time series models and forecasts. The findings were guided by specific objectives: the impact of price-related reforms on producer price, the percentage of the free-on-board prices paid to farmers under each reform, the volatility of producer price under each producer price reform period, and the effect of producer price-related reform on cocoa output are investigated. The discussion of all of the results concluded the section.

4.2 Descriptive statistics

Table 4.1 shows the descriptive statistics of the data used in the analysis. Table 4.1 shows the descriptive statistics of variables from 1920 to 2022. The variables were described in natural logarithm and at level. Looking at the climatic variables, the temperature recorded minimal variations around the mean of 27.36 degrees Celsius with a coefficient of variation of 0.44% on a logarithmic scale. Rainfall showed more variability with a CV of 2.31%. The high fluctuations in rainfall may indicate periods of drought and excessive rainfall which may affect cocoa yield. The average cocoa production observed over the decade was 382,636.80 tonnes. A record maximum of 1,047,385.00 tonnes was recorded in the 2020/21 crop season and the lowest production in 1983/84 of 126,247.00 tonnes in the 1920/23 crop season. The average world production of cocoa was 1,873,547.00 tonnes with a maximum of 5,244,560.00 tonnes recorded in the 2020/21 crop season. The price series was adjusted for inflation with the Ghanaian consumer price index (CPI) with a base year of 2013. The average real producer price was 2,917.04 GHS/Tonne, the highest was 7731.16 GHS/Tonne recorded in the 1982/83

crop season with the lowest of 328.82 GHS/Tonne recorded in 1943/1944. The average real free on board (FOB) price received was 8,668.93 GHS/Tonne below the real-world price of 9,335.86 GHS/Tonne. The proportion of years of shocks between 1920 and 2022 for weather shock, political instability, Oil price shock, Weather Shock, Cote d'Ivoire war shock was 11.7%, 7.8%, 4.9% and 5.8%. The proportion of reform era of the total sample being studied for the colonial era (26.21%), CMB era (4.85%), Pre-republic era (4.85%), Nkrumah era (8.74%), Downturn era (17.48%), COP era (13.59%), Negotiation era (2.91%), Net FOB reform era (28.6%) and LID era (3.88%).

Table 4.1. Descriptive statistics of variables

Variable	Mean	Standard deviation	CV (%)	Minimum	Maximum
Rainfall (mm)	103.23	11.12	10.78	69.75	149.33
Ln Rainfall (mm)	4.63	0.11	2.31	4.24	5.01
Ghana production (Tonne)	382636.80	222798.90	58.23	126247.00	1047385.00
Ln Ghana production (Tonne)	12.72	0.51	4.01	11.75	13.86
World production (Tonne)	1873547.00	1367369.00	72.98	430000.00	5244560.00
Ln World production (Tonne)	14.17	0.75	5.28	12.97	15.47
Real world price (GHS/Tonne)	9335.86	7822.07	83.79	519.37	43214.75
Ln Real world price (GHS/Tonne)	8.83	0.82	9.25	6.25	10.67
Real FOB price (GHS/Tonne)	8873.53	6862.47	77.34	608.76	38673.98
Ln Real FOB prices (GHS/Tonne)	8.85	0.69	7.83	6.41	10.56
Real producer price (GHS/Tonne)	2917.04	1530.08	52.45	328.82	7731.16
Ln Real producer price (GHS/Tonne)	7.85	0.53	6.77	5.80	8.95
Reform and weather Shocks Dummy (%)					
Weather shock	11.65				
Producer Reform (%)					
Colonial era	26.21				
CMB era	4.85				
Pre-Republic era	4.85				
Nkrumah era	8.74				
Downturn era	17.48				
COP era	13.59				
Negotiation era	2.91				
Net FOB era	17.48				
LID era	3.88				
Number of Observations	103				

Source: Author Note: CV = coefficient of variation

4.3 Tests of stationarity

4.3.1 Unit root test without structural break

Table 4.2 summarizes the stationarity results without breaks using the KPSS test and the ADF test from 1920 to 2022. The variables were assessed in level and at first difference under both the intercept and trend specifications. A strong stationarity was detected at the level for both intercept and intercept and trend for rainfall for both KPSS and ADF test. The prices series (world price, FOB price and producer price) recorded were stationary at level. The Ghana production and real producer price were non-stationary at level. All variables were stationary after the first difference. The null hypothesis of the ADF test of non-stationarity was rejected. Similarly, the results of the KPSS test failed to reject the null hypothesis of stationarity around either a deterministic trend or a constant. The stationarity of the log difference implied that the growth rate of the price series and production variables are cointegrated at order one. This revealed a tendency for these series to have a long-term relationship due to similar stochastic processes.

4.3.2 Unit root test in the presence of break

The result of the stationarity test with breaks using the Kapetanios test for variables from 1920 to 2022 are presented in Table 4.3 for variables from 1920 to 2022. The test statistics are reported for stationarity under various conditions, including intercept, trend, intercept and trend, and at first difference. The break dates identified up to three years were reported for each variable. Considering that the price series were influenced by several policy reforms in the sector, the Kapetanios test was used to reveal structural breaks in the series. Here, there was no consideration for the truncated data because they were too short to reveal significant breaks. The cocoa production and producer prices were stationary after the first difference. The periods of structural breaks observed were in the year 1947, 1964, and 1981 for the cocoa production while for the producer price, the break point were in year 1944, 1964 and 1981 and 1964.

Table 4.2. Results of the stationarity test

Variable (Ln)	ADF				KPSS			
	Level		First difference		Level		First difference	
	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend
Rainfall	-6.045***	-6.309***	-12.242***	-12.178***	0.465**	0.124*	0.05	0.039
Real producer price	-2.122	-2.726	-7.448***	-7.381***	1.033***	0.327***	0.048	0.051
Real FOB price	-3.002**	-4.199***	-8.346***	-8.309***	1.130***	0.219***	0.065	0.048
Real world price	-2.736*	-3.355*	-8.295***	-8.258***	1.136***	0.244***	0.051	0.048
Ghana production	-1.562	-2.227	-8.826***	-8.782***	1.333***	0.206**	0.071	0.07

Source: Author's computation Note: ***, **, * coefficients at 1%,5%,10% significance levels

Table 4.3. Stationarity with structural breaks

Variable (Ln)	Model	Test Statistic	1% CV	5% CV	10% CV	Break Years
Rainfall	Drift (C)	-12.28***	-6.99	-6.53	-6.27	1936, 1969, 1989
	Trend(T)	-6.57***	-6.29	-5.73	-5.43	1946, 1963, 1993
	C & T	-7.49***	-7.40	-7.01	-6.69	1950, 1969, 1994
	1st Diff	-8.81***	-6.99	-6.53	-6.27	1946, 1963, 1983
Real producer price	Drift (C)	-5.23	-6.99	-6.53	-6.27	1937, 1955, 1974
	Trend(T)	-4.19	-6.29	-5.73	-5.43	1952, 1980, 2005
	C & T	-4.11	-7.40	-7.01	-6.69	1950, 1981, 2005
	1st Diff	-11.07***	-6.99	-6.53	-6.27	1944, 1964, 1981
Real FOB price	Drift (C)	-7.31***	-6.99	-6.53	-6.27	1937, 1958, 1978
	Trend(T)	-5.82**	-6.29	-5.73	-5.43	1947, 1964, 1981
	C & T	-7.42***	-7.40	-7.01	-6.69	1958, 1978, 1995
	1st Diff	-8.05***	-6.99	-6.53	-6.27	1940, 1965, 1982
Real world price	Drift (C)	-5.80	-6.99	-6.53	-6.27	1937, 1959, 1978
	Trend(T)	-4.32	-6.29	-5.73	-5.43	1951, 1968, 1985
	C & T	-5.80	-7.40	-7.01	-6.69	1959, 1978, 2005
	1st Diff	-6.67**	-6.99	-6.53	-6.27	1942, 1964, 1981
Ghana production	Drift (C)	-3.17	-6.99	-6.53	-6.27	1957, 1984, 2001
	Trend(T)	-4.42	-6.29	-5.73	-5.43	1944, 1961, 1983
	C & T	-6.02	-7.40	-7.01	-6.69	1958, 1975, 2001
	1st Diff	-10.72***	-6.99	-6.53	-6.27	1947, 1984, 2001

Source: Author's computation Note: ***, **, * coefficients at 1%,5%,10% significance levels

4.4 Impact of price-related reforms on producer prices

4.4.1 Causal impact analysis on producer price related reform

The results of the causal impact analysis on the effect of producer price-related reforms on the cocoa producer prices are reported in Table 4.5 below. The diagram showing showing the effect of the reform is presented in Figure 4.1.

4.4.1.1 Cocoa Marketing Board

The impact of introducing the Cocoa Marketing Board (CMB) has a significant negative effect on producer price received during the colonial era. The CMB period had an average posterior predicted effect inference of 9.7. Without the introduction of reforms, there would have been an expectation of an average of 9.2. By subtracting the prediction from the observed responds yield a causal effect of -0.5. The cumulative effect after the intervention was 46.1, lower than the predicted of 48.4 if there were no CMB reforms. The result showed in absolute terms a decrease of 4.7% on average producer price after the CMB reform was introduced.

4.4.1.2 Pre-Republic reform

The pre-republic reform in 1957, when Nkrumah became the prime minister did not affect the producer price of cocoa. The predicted producer price average effect was about 9.2 lower than the actual effects of 9.1. Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on the response variable of 0.1. Summing up all the producer prices received (cumulative effect) after the reform period was at 45.3. The cumulative counterfactual estimated was 45.8. In relative terms, the response variable showed a decrease of 1% which was not statistically significant at the 5% confidence interval.

4.4.1.3 Nkrumah reform

After Ghana became a republic in 1957, Nkrumah introduced reforms with the objective to support national development. As shown graphically below (Figure 4.1), there was a gradual reduction in the producer price received by farmers. The Nkrumah period had an average posterior or counterfactual predicted effect inference of 8.6. Without the introduction of reforms, there would have been an expectation of an average of 8.0. Subtracting the prediction from the observed responses yields a causal effect of -0.6. The cumulative effect after the intervention was 72.0, lower than the predicted 73.2 if there were no reforms. The result showed in relative terms a decrease of 7.4% on average producer price after the national support policy or reform was introduced.

4.4.1.4 Downturn reform

The Downturn reform was introduced in 1966 based on changing world price of cocoa in an era of political instability in Ghana. As reported in Table 4.1 below, the introduction of the reform significantly decreases the producer price received. By carefully examining the plot of the causal impact of the intervention, it can be observed that there was a consistent decrease in the producer price between 1960 and the 1970s. After the introduction of the downturn reform, the average value of producer price was 7.4. By contrast, without the downturn reform, there would have been a producer price of 7.8. In relative terms, the response showed a decrease of 5.5% in producer price. This revealed a reduction effect on the producer price of farmers.

4.4.1.5 COP reform

The COP reform, also known as the average cost of production reform, introduced in 1984 to pay 20% profit margin to farmers. The causal impact analysis revealed a decrease in the producer price received by cocoa farmers. The counterfactual predicted was 7.5 which was lower than the average value of producer price without the introduction of the reform of 7.6.

The relative increase in price after the intervention was 1.7% which was slightly significant at 10%.

4.4.1.6 Negotiation reforms

The negotiation reform was introduced in 1998 to improve the producer price received by farmers. The causal impact analysis revealed a positive relative effect of 4.6% increase as compared to the COP reform. After the introduction of the negotiation reform, the average value of the producer price was 7.5. Comparing it to one without the reform, the average prediction was 7.6. The effect of the negotiation reform on increasing the producer price was significant at 4.6%.

4.4.1.7 Net Free On-Board (FOB) price reform

The net FOB price reform which promised a net 70% of FOB price to farmers revealed a relative increase of 7.2% increase as compared to the negotiations in the 1990s. The average producer price is 8.2, and an expected average of 7.6 in the absence of the net FOB reform. The response value had an overall cumulative producer price of 146.9 compared to 137.0 if there were no policy reform. This means there was a positive effect of the reform on improving the income of farmers as compared to the negotiation reform.

4.4.1.8 Living Income Differential (LID) reform

The counterfactual estimate for the introduction of the LID was 7.9. The actual producer price observed after the reform was introduced was 8.0. By summing up the individual data points during the post-intervention period, the response variable observed was 28.61. Without the intervention of the reform, the cumulative response would have been 29.8. The relative response was an increase of 0.66% as compared to net FOB price. The LID reform had no effect on the producer price.

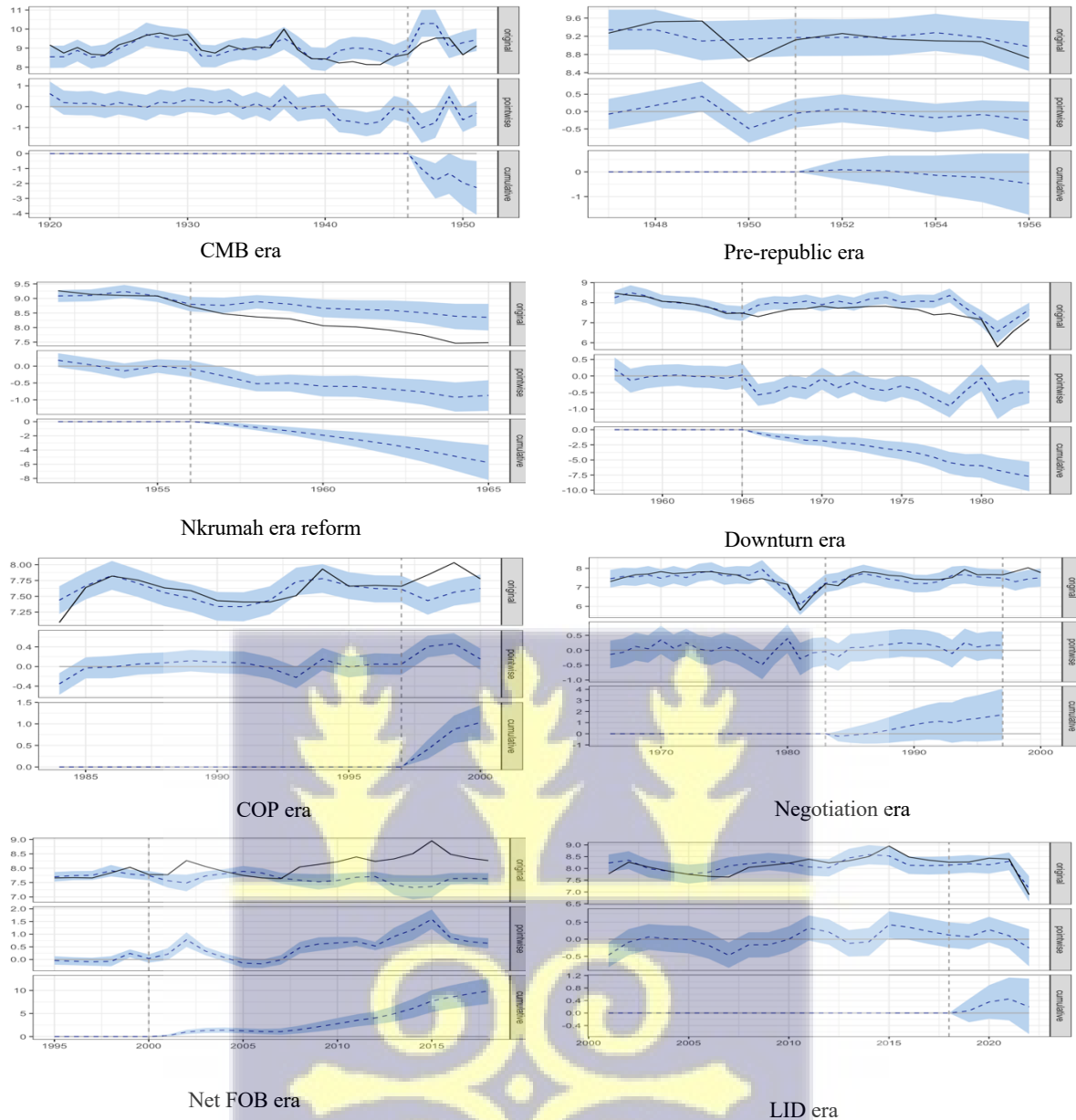


Figure 4.1 Causal impact analysis of producer price related reforms on producer price
 Source: Author's illustration based

Table 4.5. Causal impact of producer price-related reforms on the producer price

Price Related Reform	Actual effect		Predicted (s.d.)		Absolute effect		Relative effect (%)		Significance (p-value)
	Avg.	Cum.	Avg.	Cum.	Avg.	Cum.	Avg.	Cum.	
CMB Reform	9.2	46.1	9.7 (0.18)	48.4	-0.45	-2.22	-4.7	-4.7	0.0064***
Pre-Republican Reform	9.1	45.3	9.2 (0.13)	45.8	-0.05	-0.095	-1.0	-1.0	0.222
Nkrumah Reform	8.0	72.0	8.6 (0.14)	-5.76	-1.20	-11.0	-7.4	-7.4	0.000***
Downturn reform	7.4	133.3	7.8 (0.07)	141.1	-0.43	-7.72	-5.5	-5.5	0.000***
COP Reform	7.6	106.2	7.5 (0.08)	104.5	0.12	1.71	1.7	1.7	0.070*
Negotiations Reform	7.9	23.6	7.5 (0.07)	22.6	0.34	1.03	4.6	4.6	0.000***
Net FOB Reform	8.2	146.9	7.6 (0.08)	137.0	0.55	9.89	7.2	7.2	0.000***
LID Reform	8.0	32.0	7.9 (0.11)	31.8	0.05	0.20	0.66	0.66	0.323

Source: Author's computation Note: ***, **, * coefficients at 1%, 5%, 10% significance levels

4.5 Proportion of Free-on-Board prices received by farmers

Table 4.6 captures the proportion of producer prices received by farmers concerning the free-on-board prices. It captures the evolution of cocoa prices regarding significant price reform periods in Ghana's economic history. The focus is on the Relative Price Index (RPI) during historical phases spanning from 1920 to 2022. The colonial and free market era captured 65.23% reflecting moderate market conditions under colonial governance. This period, however recorded the minimum RPI of 26.49%. After the introduction of the cocoa marketing board, the RPI dropped to 49.01% between 1947 and 1951. It marked an era of state intervention in cocoa pricing and export. In the pre-republic reform when Nkrumah was the prime minister, a slight recovery brought the RPI to 50.20%, suggesting a marginal improvement but a sustained centralised control.

The Nkrumah era saw a rebound of RPI to 64.59% with a minimum of 39.55% and a maximum of 81.63%. This period marked a fall in global cocoa prices, but Nkrumah's leadership likely benefited from increased government focus on cocoa export as a driver of development. The downturn era (1966–1983) marked economic and political instability; the RPI plummeted to 66.21% in Ghana, mainly because of crop years 1981/82 and 1982/83. This was an era when the average producer price per tonne of cocoa increased to 12,000 cedis (4,365.98 USD) per tonne in 1981/1982 from 4000 cedis (USD), which far exceeded the average FOB price of 5,000 cedis due to pressure on by international communities such as the world bank to improve the producer price of farmers (World Bank, 1984). It reflects a period of economic challenges during the coup and mismanagement.

The average cost of production (COP) reform saw a further decline in RPI to 49.92%. Policies under the cocoa. The rehabilitation project during the COP sought to stabilise production and price performance remained subdued. The highest real producer price received by farmers

occurred during the Negotiation period at 82.08% of the FOB price. It reflects a gain from negotiated terms with international stakeholders and liberalisation efforts. The RPI during the net fob reform in 2001 remained stable at 65.81% with a minimum of 45.05, reflecting a steady export pricing system based on FOB prices.. The living income differential (LID) showed a positive impact of the share of producer farmers receive of 72.71% in Cedis. The LID however in the 2022/2023 period was lower of 56.33% RPI.

In real terms, using 2013 values, inflation alone would suggest that prices would lose value, as purchasing power tends to decrease. The real price of cocoa for all reform periods decreased due to high inflation when compared to nominal values (Figure 4.4). The figure illustrates no real increase in the prices of cocoa over the decade.

Table 4.6. Producer price to FOB relative index

Descriptives	Colonial era	CMB era	Pre republic	Nkrumah era	Downturn era	COP era	Negotiation era	Net FOB	LID
Mean	65.23	49.01	50.19	64.59	66.21	49.92	82.08	65.81	72.71
SD	21.31	29.41	15.63	13.55	60.76	7.94	15.46	13.55	12.58
CV(%)	32.67	60.00	31.13	20.97	91.77	15.90	18.84	20.60	17.30
Minimum	26.49	27.51	29.96	39.55	28.30	33.39	71.77	45.05	56.33
Maximum	109.17	99.90	72.94	81.63	233.60	60.16	99.85	92.39	83.15
Observations	27.00	5.00	5.00	9.00	18.00	14.00	3.00	18.00	4.00

Source: Author

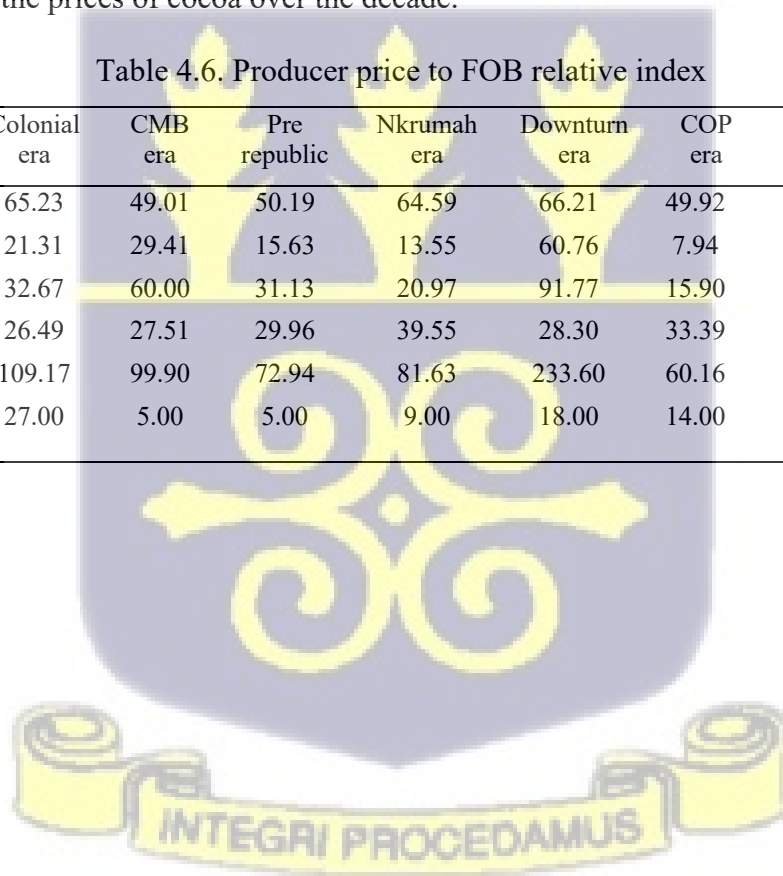
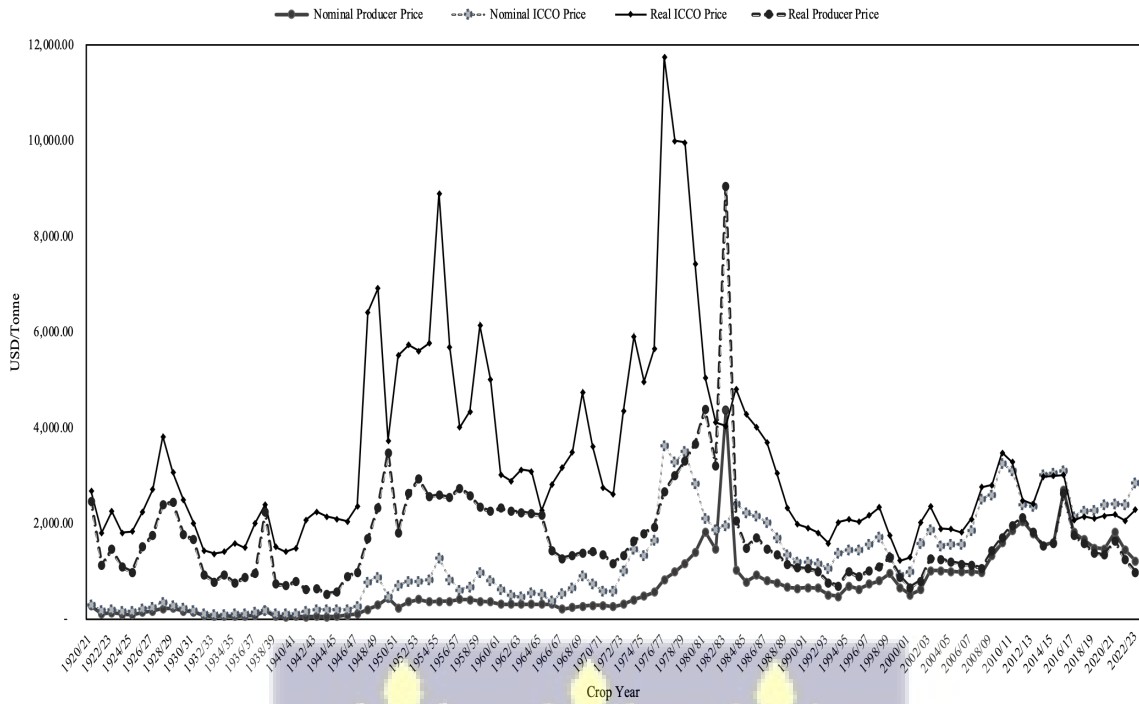
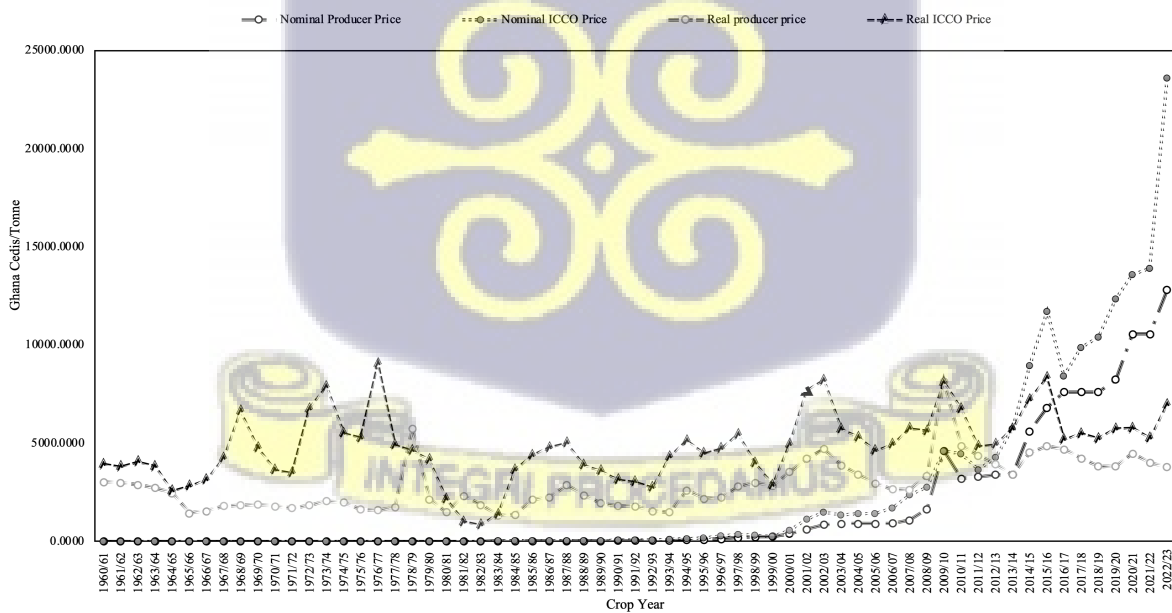


Figure 4.4. Nominal and real cocoa prices (100=2013) in USD per tonne



Source: Author

Figure 4.5. Nominal and real cocoa prices (100=2013) in Ghana cedis per tonne



Source: Author

4.6 Producer price volatility under each reform

Table 4.7 illustrates the price volatility in Ghana's cocoa sector across distinct reform eras based on the adjusted mean absolute deviation. The patterns of volatility in producer prices, FOB (Free on Board) prices, and world cocoa prices help to understand the role of institutional reforms in shaping market outcomes. The colonial era and free market showed the highest volatility of 40.44% reflecting the absence of institutional intervention. The prices respond to traders' double-dealing, supply, and global dynamics with minimal domestic stabilization. The CMB experienced increased volatility due to rigid pricing mechanisms, which failed to mitigate the shocks from global price fluctuations. The volatility in producer prices increased to 75.84% in FOB prices. This shows that the volatility in the world price has been transmitted into the producer price.

During the pre-republic era and the Nkrumah reform era, producer price volatility declined to 8.56%, reflecting the attempt to stabilise prices through state control. However, the system collapsed during the Downturn era, with volatility surging to 34.84%. It highlights the failure to centralise systems when fiscal and macroeconomic instability rises. The COP periods experienced liberalisation reforms such as the Cocoa Rehabilitation Program, which reduced volatility significantly to 28.04% in Ghana Cedis. Also, during this period, the volatility in the world prices also reduced.

The Net FOB framework further stabilized prices by aligning domestic pricing with global markets (8.46% world price volatility). These eras highlight the importance of aligning institutional design with market-based incentives. The LID showed a mixed pattern, with volatility of 16.49%.

Table 4.7 Volatility of producer, FOB price and world prices

Price-related Reform	Period	Producer Price	FOB Price	World
		Volatility (%) Ghana Cedis	Volatility (%) Ghana Cedis	Volatility (%) Ghana Cedis
Colonial and free market	1920-1946	40.44	29.74	27.53
CMB	1947-1951	75.84	51.80	49.80
Pre-Republican era	1952-1956	8.56	45.86	43.60
Nkrumah era	1957-1965	12.79	21.91	22.90
Downturn era	1966–1983	34.84	43.74	46.41
COP era	1984–1997	28.04	20.56	20.50
Negotiation era	1998–2000	8.85	63.94	61.84
Net FOB era	2001–2018	18.79	23.31	23.33
LID	2019- 2022	16.49	23.84	8.46

Source: Author

4.7 Discussion of results

The study found four breakpoint points in the producer price series, in 1944, 1964, and 1981. Each of the break mark a profound institutional and macroeconomic transition. The 1944 break coincided with the colonial establishment of the West African Cocoa Control Board during World War II, which centralized marketing and fixed producer prices below world levels to ensure export stability, thereby reducing farmers' income share (Meredith, 1988). Prior to that in the 1937/38 crop year, the increase in producer price was a result of approximately 98% of European cocoa companies deciding to set new cocoa prices due to cocoa holdup by Ghanaian farmers' good prices, but this price gradually decreased (Austin, 1988; Howard, 1976).

The 1964 break reflected a combination of domestic policy extraction under Nkrumah's stated industrialization and external shocks from the global cocoa price collapse between 1962 and 1965 (Benneh & Anaman, 2022). Economic shocks during this period were linked to Cold War political tensions and Ghana's leading role in the Pan-African movement, with world cocoa prices reaching a historic low of \$ 211 per ton in July 1965 (Benneh & Anaman, 2022). Producer prices fell sharply as the government retained export surpluses through the CMB in 1951 to contribute to economic development (Lambert, 2019; Kolavalli & Vigneri, 2011). In 1956/57, farmers put pressure on the government, as producer prices remained the same, while export taxes increased despite declining world cocoa prices. This was also a period of independence for Ghana and periods after Ghana's second election. This led to a reduction in government revenue from 60 percent in 1954 to 13 percent in 1956–57 crop years (Kollavali & Vigneri, 2011).

The final break in 1981 represented the near collapse of Ghana's cocoa sector amid a macroeconomic crisis, with producer price increases offset by exchange rate misalignment, inflation, and a sharp decline in cocoa's share of export revenue from 46% to 23% (Kolavalli & Vigneri, 2011). These breaks collectively depict the evolution of Ghana's cocoa economy from colonial control through post-independence fiscal extraction to the pre-reform crisis era, highlighting how shifts in global markets, governance regimes, and exchange rate policies shaped long-term producer incentives and the structural dynamics of the sector.

For cocoa production, the structural breaks were found at 1947, 1984, and 2001. In the 1940s, there was an outbreak of pests and diseases (especially the swollen shoot virus) which reduced production in the western region (Amanor, 2010; Kolavalli & Vigneri, 2011). This pushed increased cocoa production into the Brong Ahafo region (Amanor, 2010), before expanding

into the eastern region (Kolavalli & Vigneri, 2011). The year 1947 was also the year in which the Cocoa Marketing Board (CMB) was introduced, which gave it a monopsony over cocoa purchase (Kolavalli & Vigneri, 2011). The second break corresponds to the introduction of the cost of production. The third break in 2001 was possibly due to an increase in production due to record-high world prices offered by Cocobod (Afari-Sefa *et al.*, 2010; Kolavalli & Vigneri, 2011) and the rapid expansion of cocoa lands for production and more frequent application of fertilizer (Vigneri & Santos, 2008). Some of the growth in this period can also be attributed to the smuggling of cocoa from Côte d'Ivoire into Ghana. According to Brooks *et al.* (2007), about 120,000 to 150,000 tons of cocoa were smuggled 2003/2004 season.

From the causal impact analysis, the establishment of the Cocoa Marketing Board (CMB) in 1947, though aimed at stabilizing prices, hurt producer prices, with an average decline of 4.7%. This suggests that state control shifted benefits away from farmers toward stabilization and administrative costs. Similarly, during the Nkrumah and Downturn reform eras, producer prices declined by 7.4% and 5.5%, respectively, showing that heavy state involvement and political instability constrained the share of export prices reaching farmers (Amanor, 2010; Kolavalli & Vigneri, 2011; Lambert, 2019).

In contrast, reforms that leaned toward market allocating more income to farmers yielded more favorable outcomes. The Negotiation reform of 1998 and Net FOB price reform in 2001 both recorded positive causal effects on producer prices, with increases of 4.6% and 7.2%, respectively. These reforms introduced greater transparency in price setting and linked farm-gate prices more directly to world prices, improving farmer welfare.

The Living Income Differential (LID) reform, designed to guarantee better incomes for farmers, showed only a marginal increase (0.66%) in producer prices. This implies that while

the LID policy had symbolic importance, its short-term transmission to actual farm-gate prices was weak, possibly due to exchange rate depreciation, inflation, and the pass-through structure of the pricing system. During the colonial and early free market era (1920–1946), the average proportion of FOB received by farmers (RPI) stood at 65.23%, with a minimum of 26.49%. Significant fluctuation, seen in the minimum RPI, emphasizes the volatility and exploitation typical of colonial trade systems, where producer prices were largely determined by British trading firms and not by market conditions favorable to local farmers.

The establishment of the Cocoa Marketing Board (CMB) in 1947 marked a major structural change, introducing state intervention in price setting and export management. The average RPI declined to 49.01% between 1947 and 1951, suggesting that the introduction of the CMB shifted more revenue share toward the state for stabilization and development objectives. This decline aligns with the findings of Milburn (1970), Southall (1978) and Alence (2001) who noted that marketing boards across West Africa had influence in the new institution.

Under Nkrumah's pre-republic and early post-independence reforms, the RPI rose slightly to 50.20%, and later to 64.59% during the Nkrumah era (1957–1966). This recovery indicates that while state control persisted, efforts were made to improve farmers' welfare through higher producer prices. This period coincided with declining global cocoa prices (Benneh & Anaman, 2022) and Nkrumah's development-oriented policies relied heavily on cocoa revenues, potentially constraining how much benefit could be transferred to producers (Lambert, 2019). The relatively high maximum RPI of 81.63% during this era reflects short-term price improvements, possibly due to favorable international conditions or government subsidy measures.

The downturn era (1966–1983) was marked by severe economic and political instability, leading to an RPI of 66.21%. Although the nominal producer price increased significantly in 1981/82, the high inflation and macroeconomic mismanagement eroded real returns to farmers. The World Bank (1984) reports confirm that the government's decision to raise producer prices during this time was externally influenced, reflecting conditionality pressures to enhance farmer incentives amidst a collapsing economy.

The Cost of Production (COP) reform period recorded a further decline in RPI to 49.92%, while the Cocoa Rehabilitation Project aimed to revitalize output and restore farmer confidence, the pricing mechanism remained constrained by structural inefficiencies and fiscal pressures (Petithuguenin, 1995). In contrast, the Negotiation Era marked a turning point, achieving the highest RPI of 82.08%. This remarkable improvement signals gains from policy improvement, enhanced engagement with international buyers, and market-based price determination. Farmers received a fairer share of the export price, which reflects improved efficiency in marketing and negotiation processes. Similarly, under the Net FOB reform introduced in 2001 onwards, the RPI remained relatively stable at 65.81%, suggesting sustained policy consistency and moderate benefits to farmers.

The introduction of the Living Income Differential (LID) in 2019 initially improved the RPI to 72.71%, implying that the policy succeeded in enhancing farmers' share of export earnings. Nonetheless, by 2022/2023, the RPI declined to 56.33%, indicating that the real value of producer prices diminished, likely due to inflationary pressures of 54.1% in December (GSS, 2022).

The volatility experienced during the colonial era, the highest volatility of 40.44%, reflecting the absence of institutional mechanisms to cushion farmers against international price shocks. Prices were largely driven by trader speculation, supply fluctuations, and external market

forces. During the colonial period, there was high price volatility due to the oligopsony of European traders entrenched in fixing prices under a free market (Alence, 2001; Staritz *et al.*, 2022). As a result, several cocoa holdups resulted (Austin, 1988; Howard, 1976). This instability exposed producers to high income uncertainty and demonstrates the vulnerabilities of an unregulated market system.

With the introduction of the Cocoa Marketing Board (CMB), volatility in producer and FOB prices increased further to 75.84%. The findings suggest that rigid pricing and export control mechanisms could not effectively absorb global shocks. By contrast, during the Pre-Republic and Nkrumah eras, volatility declined sharply to 8.56%, indicating that price stabilization policies were effective in buffering farmers from external price swings. However, this stability was short-lived; during the Downturn era (1966–1983), volatility surged to 34.84%, mirroring the broader macroeconomic and political instability that characterized Ghana's economy during that period.

The Cost of Production (COP) and Net FOB reforms marked a shift toward market-based pricing systems, resulting in much lower volatility levels 28.04% and 8.46%, respectively. These results demonstrate that partial liberalization, when well-aligned with global pricing mechanisms, enhances domestic price stability. The LID period, however, showed a mixed volatility pattern (16.49%), suggesting that while the policy aimed to raise farmer income, it did not substantially reduce exposure to price fluctuations, possibly due to continued regulation or the high inflation recorded in 2022 (GSS, 2022). Reforms under LID highlight the trade-off between price stabilization and achieving equitable income distribution for producers. These findings align with broader economic theory: institutions that align incentives and reduce market distortions are critical to mitigating volatility. However, excessive reliance on state control or poorly calibrated reforms can amplify risks.

CHAPTER FIVE

RESULTS AND DISCUSSION OF SUPPLY RESPONSE OF PRODUCER PRICE-RELATED REFORMS ON COCOA SECTOR OF GHANA FROM 1920 TO 2022

5.1 Introduction

This chapter is dedicated to the discussion of the results of the supply response to producer price reforms in the cocoa sector of Ghana from 1920 to 2022. The next section discusses the evolution of producer prices and production across reform periods over the century. This was followed by the unit root test of variables. The last section discusses and links cocoa output to producer price-related reforms through cointegration equations.

5.2 The evolution of producer prices and production across reform periods

The summary of the production and producer prices across different reforms from 1920 to 2022 is reported in Table 5.1. The average cocoa production rose across all the reform eras. The average production during the colonial era was 219,812 tonnes to 789,375 tonnes under the LID reform period, an approximate increase of about 259%. The Net FOB reform saw the highest average of 743,725 tonnes, followed by negotiation of 408,131 tonnes, the Nkrumah era recorded 382,612 tonnes, the Downturn era (329,919), the CMB era (241,530), and the Pre-republic era of 233,338 tonnes. The dispersion of the output is lowest during Negotiation (6.19%), indicating highly stable production within that short period, and relatively low under the Pre-republic (9.42%) and CMB (12.88%) eras. Variability is highest under Nkrumah (28.32%), followed by the pre-republic era (26.76%) and COP (25.06%). Overall output ranged from a minimum of 126,247 tonnes (Colonial) to a maximum of 1,047,385 tonnes recorded in the 2020/21 crop season during the LID era, highlighting substantial expansion in the recent regime.

The average real producer prices are highest at the pre-republic era of GHS 5,966/tonne and CMB era (GHS 5,693.91), with the LID period close behind at GHS 4,463 (n=18). Prices are

much lower on average during the Downturn era (GHS 1,888), COP era (GHS 2,009) and the Colonial (GHS 2,085), with moderate recovery in Net FOB (GHS 3,708) and LID (GHS 4,463; about GHS 655 above Net FOB). The lowest mean occurs under COP. Price variability is the highest in the colonial era with a CV of 39.52%, followed by the Downturn era (34.68%) and the CMB (38.82%), indicating substantial dispersion in those periods. Price stability is strongest under the Prime Minister (CV = 7.02%) and LID (8.01%) regimes, with Negotiation also relatively stable (8.53%). Across all eras, producer prices range from a minimum of GHS 869.56/tonne (Downturn era) to a maximum of GHS 22,131.78/tonne recorded in the colonial era.

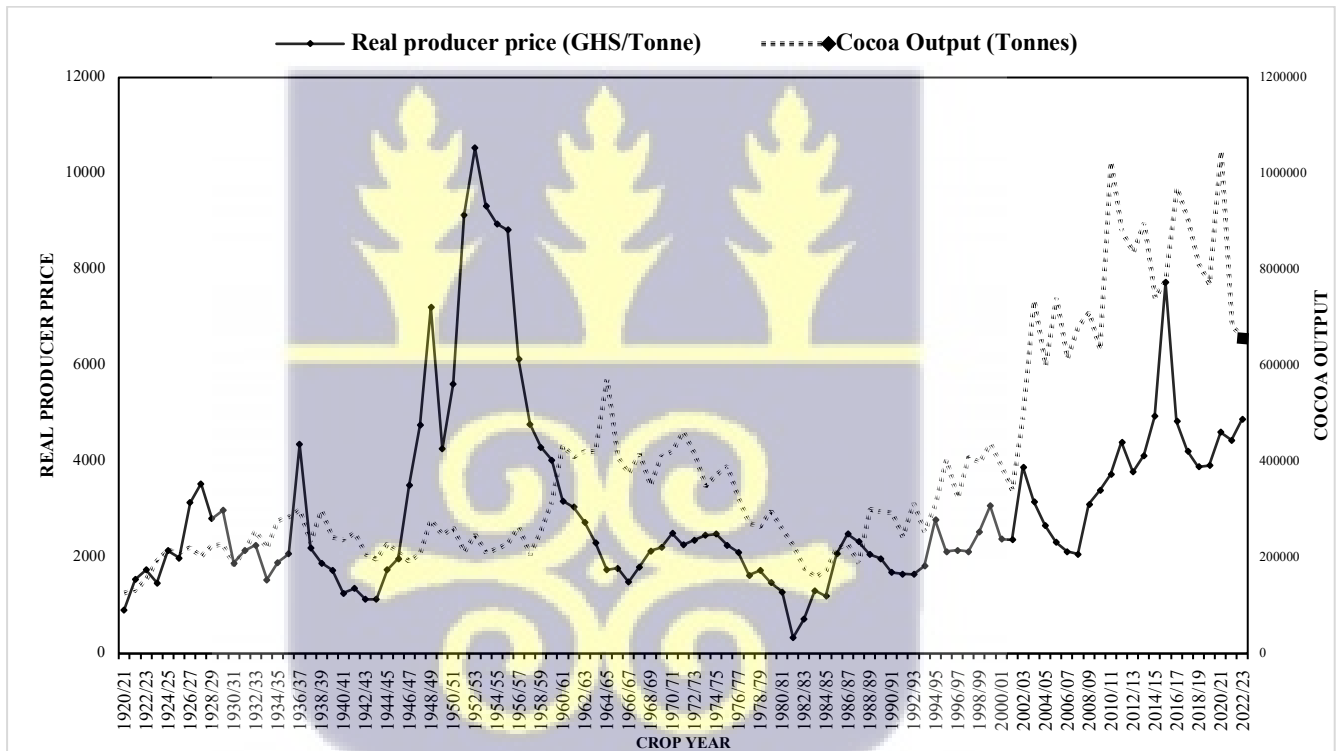


Figure 5.1: Real producer price and cocoa output from 1920 to 2022

Note: Author's illustration based on data from ICCO, Kofi (1942) and Bateman (1972)

Table 5.1. Descriptive statistics of producer price and production price by reform era

Statistic	Mean	SD	CV(%)	Minimum	Maximum	Observations
Ghana production (Tonne)						
Colonial era	219,811.56	43,103.17	19.60915	126,247.00	300,000.00	27
CMB era	241,530.20	31,110.05	12.8804	207,559.00	278,372.00	5
Pre-republic era	233,337.60	21,991.46	9.424738	209,882.00	263,695.00	5
Nkrumah era	382,611.56	108,357.63	28.32053	206,448.00	571,271.00	9
Downturn era	329,919.06	88,271.65	26.755547	158,886.00	462,460.00	18
COP era	282,239.46	70,728.42	25.059721	172,514.00	409,382.13	14
Negotiation era	408,130.92	25,265.52	6.190544	389,771.50	436,945.94	3
Net FOB era	743,724.94	170,101.63	22.87158	340,563.00	1,024,553.31	18
LID era	789,374.56	178,816.53	22.652939	656,139.88	1,047,384.94	4
Producer price (GHS/Tonne)						
Colonial era	2,085.77	824.384213	39.524198	910.587328	4,356.74	27
CMB era	5,693.91	1,235.17	21.69276	4,260.65	7,212.13	5
Pre-republic era	5,966.25	218.660446	3.664959	5,673.09	6,189.03	5
Nkrumah era	3,456.55	1,416.75	40.98756	1,479.51	5,480.29	9
Downturn era	1,887.96	654.92202	34.68939	328.82252	2,567.13	18
COP era	2,009.72	396.756388	19.741848	1,194.60	2,784.83	14
Negotiation era	2,666.66	365.014342	13.688066	2,385.33	3,079.13	3
Net FOB era	3,708.62	1,344.50	36.25323	2,069.84	7,731.16	18
LID era	4,463.76	406.691525	9.110962	3,916.84	4,882.00	4

Source: Author Note: CV = coefficient of variation, SD = Standard Deviation



5.3 Unit root test of variables

To ensure the appropriateness of the econometric specification, unit root tests were conducted on all variables using the Augmented Dickey–Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) procedures. The results, summarized in Table 5.2, indicate that all variables rainfall, real producer price, and Ghana’s cocoa production, are non-stationary in levels but become stationary after first differencing, implying integration of order one, $I(1)$. Specifically, the ADF statistics for rainfall reject the null of a unit root at the 1% significance level in both level and differenced forms, while the KPSS test confirms stationarity at first difference. In contrast, the real producer price and production series fail to reject the null of a unit root at level under the ADF test but achieve strong stationarity upon differencing, consistent with the KPSS results. These findings suggest that while climatic conditions have shown moderate persistence, price and output variables display pronounced stochastic trends over the long term.

Given the century-long dataset and the possibility of regime shifts, the analysis further applied unit root tests with structural breaks by Kapetanios (2015) to account for policy and environmental shocks (Table 5.3). The break-adjusted results corroborate the earlier findings: all variables become stationary after first differencing, even when accounting for up to three endogenous structural breaks. The identified break years align with major historical episodes, including the 1930s cocoa hold-ups, post-independence market restructuring (1950s–1960s), and the economic recovery and liberalization periods (1980s–2000s) (k. Overall, the results confirm that the variables are integrated of order one, justifying the use of the Autoregressive Distributed Lag (ARDL) framework, which accommodates a mix of $I(0)$ and $I(1)$ regressors and allows for robust long- and short-run estimation in the presence of structural breaks.

Table 5.2. Stationarity test for variables

Variable (Ln)	ADF				KPSS			
	Level		First difference		Level		First difference	
	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend
Rainfall	-6.045***	-6.309***	-12.242***	-12.178***	0.465**	0.124*	0.05	0.039
Real producer price	-2.122	-2.726	-7.448***	-7.381***	1.033***	0.327***	0.048	0.051
Ghana production	-1.562	-2.227	-8.826***	-8.782***	1.333***	0.206**	0.071	0.07

Source: Author's computation Note: ***, **, * coefficients at 1%,5%,10% significance levels

Table 5.3. Stationarity with structural breaks for variables

Variable (Ln)	Model	Test Statistic	1% CV	5% CV	10% CV	Break Years
Rainfall (mm)	Drift (C)	-12.28***	-6.99	-6.53	-6.27	1936, 1969, 1989
	Trend(T)	-6.57***	-6.29	-5.73	-5.43	1946, 1963, 1993
	C &T	-7.49***	-7.40	-7.01	-6.69	1950, 1969, 1994
	1st Diff	-8.81***	-6.99	-6.53	-6.27	1946, 1963, 1983
Real producer price (GHS/Tonne)	Drift (C)	-5.23	-6.99	-6.53	-6.27	1937, 1955, 1974
	Trend(T)	-4.19	-6.29	-5.73	-5.43	1952, 1980, 2005
	C &T	-4.11	-7.40	-7.01	-6.69	1950, 1981, 2005
	1st Diff	-11.07***	-6.99	-6.53	-6.27	1944, 1964, 1981
Ghana production (Tonne)	Drift (C)	-3.17	-6.99	-6.53	-6.27	1957, 1984, 2001
	Trend(T)	-4.42	-6.29	-5.73	-5.43	1944, 1961, 1983
	C &T	-6.02	-7.40	-7.01	-6.69	1958, 1975, 2001
	1st Diff	-10.72***	-6.99	-6.53	-6.27	1947, 1984, 2001

Source: Author's computation Note: ***, **, * coefficients at 1%,5%,10% significance levels

5.4 Cointegration analysis of the supply response of producer price-related reforms

5.4.1 Maki cointegration

Table 5.4 presents the results from the Maki cointegration test in the presence of breaks. It presents the results of the regime shift with trend analysis for the cocoa price model. The test statistic was -8.401, which is below the 5% critical value of -7.145 as well as the 5% critical value of -7.673. This implies that the following years saw notable regime shifts and structural time changes in 1947, 1977, and 2002. These disruptions most likely represent significant structural changes through policies. Notably, in 1947, the first regulatory body for the cocoa sector was institutionalised. The year 1977 saw a period of severe drought and a date marking the year in which Côte d'Ivoire bypassed Ghana to become the leading exporter of cocoa beans

in the world (Benneh & Anaman, 2022). The year 2002 marked a year after the introduction of the net-FOB reform, which assured at least 70% of the net FOB price to farmers.

This method was used as a robustness check for the ARDL model. Guided by these breaks, the study accounted for policy/shock indicators into the ARDL specification for the full 1920–2022 sample, entering them as level/trend shifts so that both the long-run relation and the short-run ECM are estimated conditional on the observed regimes. The long-run ARDL and short-run models were then reported and interpreted

Table 5.4 Cointegration in the presence of break

Relation	Model	Test statistics	CV 1%	CV 5%	Break years
ln(Production) ~ ln(Producer price), ln(Rain)	Regime shift and trend	-8.401***	-7.673	-7.145	1947, 1977, 2002

Source: Author’s computation Note: ***, **, * coefficients at 1%,5%,10% significance levels

5.4.2 ARDL bound test for cointegration

The empirical results of the ARDL bond test of price-related reforms are reported in Table 4.9 and Table 5.5. The effect of producer price reforms on cocoa output was analysed using the ARDL model specification. Maki cointegration test was carried out to test for cointegration in the variables in the presence of a break. The bond test was used to establish that there was cointegration between the variables using optimal lags obtained through the Bayesian Information Criterion (BIC), then estimating the long- and short-term effect models. The F-statistics for all the models with prices exceed the 95% upper bound.

Table 5.5. Cointegration and bound test for ARDL model

Test statistic	Value	Significance level	95% Lower Bound critical value	95% Upper Bound critical value
F-statistic	8.3443***	5%	7.2596	8.2609
W-statistic	25.0328***	5%	21.7787	24.7826

Source: Author’s computation Note: ***, **, * coefficients at 1%,5%,10% significance levels

5.4.3 The Long-run supply response of producer price-related reforms

Table 5.6 presents the long run cointegrating relationship, indicating the permanent effect of the regressors on cocoa output once all dynamic adjustments have taken place. The producer price had a positive response to the long-run cocoa production. This confirms a fundamental determinant of cocoa supply. The supply response was inelastic at 0.26% to a 1% rise in producer price. Climatic factor, rainfall is a highly significant and positive factor in the long run, with an elasticity above 2.0. This highlights the rain-fed nature of Ghanaian cocoa cultivation and its vulnerability to climatic shifts. The magnitude implies that production is highly sensitive to changes in precipitation patterns. Technological progress captured by the trend variable was positive. The positive and significant trend coefficient is 0.018. This is because of long-term effects of technological improvements, better planting materials, and agricultural extension services over the centuries.

The Nkrumah era is associated with a significant positive boost to long-run production, likely reflecting state-led investments and expansion efforts. The La Côte d'Ivoire civil war has a strong positive long-run effect. This is a classic "cross-border" effect, where instability in the world's largest producer likely created market opportunities and higher prices for Ghanaian farmers, incentivizing long-term production expansion (refer to Table A1 in the appendix). The El Niño weather phenomenon has a significant negative long-run impact in the full sample, confirming that extreme weather events can cause lasting damage to cocoa orchards.

Table 5.6 Long run (cointegrating relation; dependent variable: ln Production)

Variable	Coefficient	Standard Deviation	T-Ratio	P-Value
lnReal producer price	0.259*	0.141	1.844	0.069
lnRainfall	2.238**	0.957	2.339	0.022
Trend	0.018**	0.005	3.339	0.000
CMB era	-0.254	0.211	-1.202	0.233
LID	-0.464	0.504	-0.912	0.360
Net-FOB era	0.356	0.263	1.356	0.179
Nkrumah era	0.473**	0.223	2.121	0.037
El Niño	-0.524**	0.265	-1.981	0.051
Constant	-5.040*	7.034	-0.717	0.476

Note: ***, **, * denote significance at 1%, 5%, 10%.

5.4.4 Short-run supply response of producer price-related reforms

Table 6 captures the immediate-year effects and the process of adjustment towards the long-run equilibrium. The negative and significant $ECM(t-1)$ indicates convergence to a long-run equilibrium; with -0.276 , about 27.6% of any disequilibrium is corrected each year (half-life approximately 2.14 years). This coefficient measures the speed at which production corrects any disequilibrium from the previous year. This is a reasonably rapid adjustment for a perennial crop. The only significant producer price-related reform era that was significant was the Nkrumah era. This may be because of the investment of the Nkrumah government in large-scale state-run farms, inspired and aided by the Soviet Union (Lambert, 2019).

The coefficients of the two lagged production growth were negative and significant. This indicates a complex dynamic pattern, potentially reflecting cobweb-type behaviour or corrective adjustments after a production surge, where high output in one year is followed by a period of consolidation or recovery. The rainfall variable, unlike in the long run, is statistically insignificant. This may be because its immediate effect is captured by other dynamic factors, or because the impact of rainfall is cumulative and only fully realized over time. The short-run model effectively captures transient shocks. The El Niño event causes an immediate drop in production.

The diagnostic tests are reported in Table 5.7. The Breusch-Godfrey test shows no evidence of serial correlation, confirming the ARDL model's key assumptions. Ramsey's RESET test reveals no misspecification. The Shapiro-Wilk normality test shows normal distribution, while the Breusch-Pagan test shows homoscedastic residuals. The overall model fit is highly significant, the multiple R-squared and adjusted R-squared values indicate strong explanatory power of 92.1% and 91.0% providing the best fit respectively.

Table 5.7 ARDL error-correction (short run) Ghana, 1920–2022. Dependent variable: $\Delta \ln$ Production)

Variable	Coefficient	Standard deviation	T-Ratio	P-Value
$\Delta \ln \text{ Production}_{t-1}$	-0.334***	0.098	-3.418	0.001
$\Delta \ln \text{ Production}_{t-2}$	-0.225**	0.095	-2.3722	0.020
$\Delta \ln \text{ Real Producer Price}_t$	0.072**	0.036	2.0107	0.047
$\Delta \ln \text{ Rainfall}_t$	0.092	0.170	0.540	0.590
ΔTrend	0.005***	0.001	3.615	0.001
CMB era	-0.070	0.059	-1.189	0.238
LID	-0.128	0.124	-1.029	0.307
Net-FOB era	0.098	0.081	1.209	0.230
Nkrumah era	0.131**	0.058	2.254	0.027
El Niño	-0.145**	0.059	-2.456	0.016
ECT_{t-1}	-0.276***	0.068	-4.04	0.000

Notes: ***, **, * denote significance at 1%, 5%, 10%.

Table 5.8 Model fit and residual diagnostics

Metric	Model
R^2 / Adjusted R^2	0.921 / 0.910
SER	0.148
F-stat (df), p	82.489 (12,85), <0.001
RSS	1.8576
LogL / AIC / SBC	55.262 / 42.262 / 25.460
Durbin–Watson (DW)	2.107
Test	
Serial correlation (BG)	$\chi^2(1) = 1.259$ [0.262]
Functional form (RESET, \hat{y}^2)	$\chi^2(1) = 2.547$ [0.110]
Normality (JB)	$\chi^2(2) = 0.214$ [0.899]
Heteroskedasticity (ARCH/White)	$\chi^2(1) = 0.957$ [0.328]

Notes: SBC = Schwarz (Bayesian) selection. DW is shown for reference; primary serial-correlation inference is from BG LM. All diagnostics pass at 5%, no evidence of serial correlation, misspecification, non-normality, or heteroscedasticity. With $DW \approx 2.11$, residual autocorrelation is unlikely.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Introduction

This chapter presents the summary, conclusion, and recommendations of the study.

6.2 Summary of the research and major findings

The study analysed the impact of producer price-related reforms on the cocoa sector of Ghana. The main objective of the study was to assess the impact of producer price-related reforms on the cocoa sector of Ghana. The specific objectives are to examine the impact of producer price-related reforms on farmers' producer prices, to examine the proportion of the free-on-board price paid to farmers under each reform, the volatility of producer prices under each reform, and the effect of producer price-related reforms on cocoa output using annual data from 1920 to 2022. The study assessed the producer price-related reforms introduced during the Colonial and free market era (1920-1946), the Cocoa Marketing Board (CMB) (1947-1951), Pre-Republic era (1952-1956), Nkrumah era (1957-1965), Downturn era (1966-1983), average production cost (COP) era (1984-1997), Negotiation era (1998-2000), Net FOB era (2001-2018) and the LID era (2019-2022). R, Gauss, Gretl, and Microfit software were used in the data analysis.

The study used the causal impact analysis based on the Bayesian structural time series to assess the impact of producer price reforms on cocoa producer prices. The relative price index (RPI) was used to assess the proportion of free-on-board (FOB) prices received by farmers, the adjusted absolute mean deviation (AMAD) was used to assess the volatility of producer prices under each reform, and the Autoregressive Distributive lag model (ARDL) model used to examine the effect of producer price on cocoa output in Ghana.

Over the 103 years, the average cocoa production was 382,636.80 tonnes, with a maximum of 1,047,385.00 tonnes recorded in the 2020/21 crop season. The lowest of 126,247.00 tonnes

was recorded in the 1983/84 crop year. The average world production of cocoa was 1,873,547.00 tonnes with a maximum of 5,244,560.00 tonnes recorded in the 2020/21 crop season. The average real producer price was 2,917.04 GHS/Tonne, the highest was 7,731.16 GHS/Tonne, with the lowest of 328.82 GHS/Tonne. The average real free on board (FOB) price received was 6862.27 GHS/Tonne, below the real-world price of 7,822.07 GHS/Tonne. All variables are assessed for stationarity to ensure the consistency of the statistical properties of each series over time, which is crucial for the validity and reliability of the time series models. Stationarity test and cointegration test with a break were also used to account for the structural break that may occur in the long series being studied.

The key findings from the study are:

1. Market-oriented reforms such as the negotiation reform and the net FOB reforms produced positive causal effects on producer prices of 4.6% and 7.2% respectively. Indicating that government-oriented reforms such as the CMB era and the Nkrumah era, led to a decline of producer prices ranging from 4.7% to 7.4%.
2. The recent Living Income Differential (LID) policy recorded only 0.66% increase in producer prices, highlighting limited effectiveness despite pre-poor objectives.
3. Reform such the colonial Cocoa Marketing Board and subsequent government controls generally lowered the proportion of FOB received by farmers (RPI), showing that centralised pricing limited farmers' gains from export earnings.
4. The Negotiation and Net FOB reform periods recorded the highest RPI levels (around 82%), reflecting better price transmission to farmers through liberalised and negotiated pricing mechanisms.
5. The declining trend and stationary real value of producer prices over time indicate that most reforms failed to sustain farmers' purchasing power and real income growth.
6. The colonial and CMB periods recorded the highest volatility (over 40–70%), showing that both the absence of regulation and overly rigid state controls failed to stabilize prices.

7. The Net FOB and COP reforms significantly reduced volatility (to 8.46% and 28.04%), demonstrating that aligning domestic prices with global market mechanisms improves stability more effectively than direct state intervention.
8. The study revealed that the long-run supply response of cocoa production to producer price changes is positive but inelastic, with an elasticity of 0.26%. This indicates that while producer price remains an important determinant of cocoa output, farmers' responsiveness to price incentives is limited due to the perennial nature of the crop.
9. The short-run dynamics revealed from the century series indicate that about 27.6% of disequilibrium is corrected annually, or it takes 2.1 years, indicating a moderate speed of adjustment of cocoa supply toward its long-run equilibrium.
10. Rainfall emerged as a major long-run driver of cocoa production, with a strong and significant elasticity of 2.24. This underscores the rain-fed dependence of Ghana's cocoa sector and its high vulnerability to climatic fluctuations.
11. Technological progress, proxied by the trend variable, was found to have a positive and significant effect on long-run cocoa output. This reflects the cumulative impact of improved farming technologies, superior planting materials, and extension services over time.
12. Among the reform periods, the Nkrumah era had a significant positive influence on both long- and short-run production, reflecting the impact of state-led investments and large-scale production initiatives during that period.
13. External shocks and climatic events had a significant negative effect long run effect affirming that adverse effects of extreme weather events affect cocoa yields on the short run and long run of cocoa production.

6.3 Conclusion

The evolution of Ghana's cocoa sector over the past century illustrates the profound interaction between economic incentives, institutional design, and state capacity. Producer price reforms, though often justified as mechanisms to protect farmers or stabilize markets, were deeply embedded in the broader political economy of Ghana's development trajectory. The results of this study reveal that reforms anchored in market participation and negotiation, such as the Net FOB and Negotiation eras, generated more efficient price transmission and higher returns for producers. In contrast, reforms dominated by centralized state control, particularly during the CMB and Nkrumah periods, suppressed producer incentives and weakened the link between global prices and farmer welfare. The limited impact of the recent Living Income Differential (LID) stresses the enduring tension between redistributive policy goals and structural constraints in global commodity markets. While the LID aimed to secure a fairer income for cocoa farmers, its modest effects point to the persistent asymmetry of power between producing and consuming nations, as well as the institutional rigidities of Ghana's marketing system.

Price volatility patterns reveal that neither unfettered markets nor excessive state control ensured stability. Rather, periods that balanced state oversight with market signals, such as the COP and Net FOB eras achieved more resilient outcomes. This finding reinforces the broader principle that well-designed institutions, not merely state intervention or liberalization per se, determine the success of policy reform.

The inelastic supply response to producer price changes, coupled with the strong role of rainfall and technological progress, highlights the dual dependency of Ghana's cocoa economy on natural endowments and on the institutional capacity to adapt. The historical evidence demonstrates that technological diffusion, long-term investment, and consistent policy frameworks matter more for productivity than short-term price adjustments. Moreover,

external shocks and climatic variability had significant negative effects. Ghana's cocoa story is one of institutional evolution: a gradual, uneven process of learning, adaptation, and reform, reflecting the broader challenge of aligning state structures with the incentives that drive innovation and growth.

6.4 Recommendations

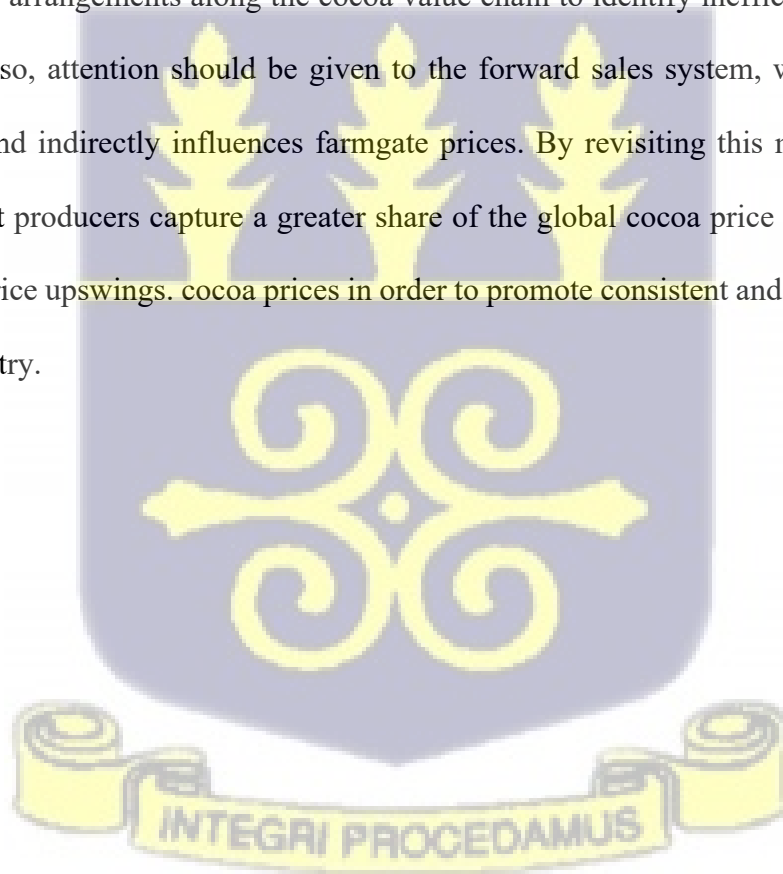
First of all, the study established that reforms such as the LID have not significantly improved the prices received by farmers. Therefore, the Ghana Cocoa Board (COCOBOD), in collaboration with the Ministry of Finance (MoF) and the Bank of Ghana, should transition from politically determined pricing to a transparent, rules-based pricing mechanism. Establishing a semi-autonomous Cocoa Pricing Authority with representation from farmer cooperatives, exporters, and independent economists would enhance credibility, transparency, and fairness in the annual price-setting process.

Secondly, the long-run model indicates that rainfall (2.238; $p = 0.022$) and trend factors (0.018; $p = 0.000$) significantly affect production, while El Niño shocks (-0.524) have a negative impact. The Ministry of Food and Agriculture (MoFA) and COCOBOD's Research Department should invest in climate-smart technologies, including irrigation, pest-resistant hybrids, and improved agronomic practices. At the same time, the Forestry Commission and Environmental Protection Agency (EPA) should strengthen efforts to curb illegal mining and deforestation, protecting productive land for sustainable cocoa cultivation.

Thirdly, Weather shocks significantly reduce cocoa output, The government needs to monitor the occurrences of the El Nino weather phenomenon by resourcing the Ghana Meteorological Agency to improve its prediction of the phenomenon to enhance the country's preparedness for this phenomenon and other weather-related shocks.

Fourth, this study established that negotiation reform produced the highest relative price index, and the lowest volatility, the COCOBOD governments should think about implementing a LID that is high enough to guarantee that most cocoa farmers earn a living income. Additionally, the flow of money and decision-making within COCOBOD must be more transparent and include farmers who are not politically undermined.

To conclude, the limited long-run elasticity of cocoa supply (0.26) partly reflects the absence of real growth in producer prices over time. COCOBOD should enhance the role of producer organizations, cooperatives, and civil society in price determination and promoting local value addition and processing. National regulators should undertake a comprehensive review of existing pricing arrangements along the cocoa value chain to identify inefficiencies and areas of rent loss. Also, attention should be given to the forward sales system, which determines export prices and indirectly influences farmgate prices. By revisiting this mechanism could help ensure that producers capture a greater share of the global cocoa price and benefit more directly from price upswings. cocoa prices in order to promote consistent and steady growth of the cocoa industry.



References

- Abdulai, A. (2002). Using threshold cointegration to estimate asymmetric price transmission in the Swiss pork market. *Journal of Applied Economics*, 34, 679-687.
- Abdulai, A. and Reider, P. (1995). The impact of agricultural policy on cocoa supply in Ghana: error-correction estimation. *Journal of African Economies*, 4, 315 –335.
- Aboa, A. (2022). Cocoa buyers back Ivory Coast and Ghana's cocoa premium schemes. *Reuters*. Retrieved from <https://www.reuters.com/world/africa/cocoa-buyers-subsidise-ivory-coast-ghanas-cocoa-premium-2022-07-09/>
- Abunyuwah, I. (2008). *Market integration analysis and time series econometrics: Conceptual insights from Markov-switching models* (Doctoral dissertation, Faculty of Agricultural Sciences), Georg-August University of Göttingen, Germany.
- Acquaah, B. (1999). *Cocoa Development in West Africa (The Early Period with particular reference to Ghana)*. Ghana Universities Press, Accra, Ghana.
- Acquah, H. D. G., Micah, J. A., & Owusu, R. (2012). Price transmission in domestic agricultural markets: Evidence from selected cassava markets in Ghana. *Journal of Sustainable Development in Africa*, 14(5), 218-228.
- Adombila, M. A. (2024, September 17). Exclusive: Ghana lost 160,000 tons of cocoa to smuggling in 2023/24 season, Cocobod official says. *Reuters*. Retrieved from <https://www.reuters.com/world/africa/ghana-lost-160000-tons-cocoa-smuggling-202324-season-cocobod-official-says-2024-09-16/>
- Afari-Sefa, V., Gockowski, J., Agyeman, N. F., & Dziwornu, A. K. (2010). Economic cost-benefit analysis of certified sustainable cocoa production in Ghana. In *3rd conference of African Association of Agricultural Economists and the Global Food and Financial Crisis*, Cape Town, South Africa.
- Afele, J. T., Agbenyega, O., Barnes, V. R., Amisah, S., Acheampong, E., Owusu, V., ... & Danquah, E. (2024). Understanding and addressing climate change impacts on cocoa farming in Ghana. *Environmental Challenges*, 14, 100823.
- Ahoba, M. (2021). *Policy Reforms in Côte d'Ivoire: The Case of the Rubber, Cocoa and Oil Palm Sub-sectors* (Doctoral Dissertation, Institut National Polytechnique). Université Catholique de Louvain, Belgium.
- Ajeigbe, K. B., Ganda, F., & Enowkenwa, R. O. (2023). Impact of sustainable tax revenue and expenditure on the achievement of sustainable development goals in some selected African countries. *Environment, Development and Sustainability*, 1-25.
- Akaike, H. (1973). Information theory and an extension of the maximum likelihood principle. In B. N. Petrov & F. Csaki (Eds.), *Proceedings of the Second International Symposium on Information Theory* (pp. 267–281). Akademiai Kiado, Budapest, Hungary.
- Akiyama, T., Baffes, J., Larson, D. F., & Varangis, P. (2003). Commodity market reform in Africa: Some recent experience. *Economic Systems*, 27(1), 83-115.

- Akiyama, T., Baffes, J., Larson, D., & Varangis, P. (2001). Market reforms: lessons from country and commodity experiences. In Akiyama, A., Baffes, J., Larson, D. and Varangis, P., (eds), *Commodity Market Reforms: Lessons of Two Decades* (pp 5-34). World Bank, Washington D.C., United States.
- Akrofi-Atitianti, F., Ifejika Speranza, C., Bockel, L., & Asare, R. (2018). Assessing climate smart agriculture and its determinants of practice in Ghana: A case of the cocoa production system. *Land*, 7(1), 30.
- Alence, R. (1990). The 1937-1938 Gold Coast cocoa crisis: The political economy of commercial stalemate. *African Economic History*, (19), 77-104.
- Alence, R. (2001). Colonial government, social conflict and state involvement in Africa's open economies: the origins of the Ghana Cocoa Marketing Board, 1939-46. *The Journal of African History*, 42(3), 397-416.
- Allman, J. (1994). Making mothers: Missionaries, medical officers, and women's work in colonial Asante, 1924-1945. *History Workshop Journal*, 38(1), 23-47.
- Amoah, J. E. K. (1998). *Marketing of Ghana Cocoa 1885-1992*. Cocoa Outline Series 2: Jermre Enterprise Ltd, Accra, Ghana.
- Amuda, Y. J., & Alabdulrahman, S. (2024). Cocoa, palm tree, and cassava plantations among smallholder farmers: Toward policy and technological efficiencies for sustainable socio-economic development in southern Nigeria. *Sustainability*, 16(2), 477.
- Anaman, K. A. & Bukari, G. A. (2021). Voter turnouts in presidential elections in Ghana: a political economy analysis using district-level data. *Research in World Economy*, 8(1), 13-31.
- Anaman, K.A. (1988). *African farm management: Principles and applications with examples*. Ghana Universities Press.
- Anderson, K. (2016). Antipodean agricultural and resource economics at 60: national and global price- and trade-distorting policies. *Australian Journal of Agricultural and Resource Economics*, 60(4), 614-628.
- Anin, T. E. (2003). *An Economic Blueprint for Ghana*. Woeli Publication Services, Accra, Ghana.
- Asare, R. (2016). *The Relationships between On-farm Shade Trees and Cocoa Yields in Ghana*. Department of Geosciences and Natural Resource Management, University of Copenhagen, Copenhagen.
- Asfaw, H. A. (2014). Trade policy and economic growth in Sub-Saharan Africa: A panel data approach. *American Journal of Trade and Policy*, 1(3), 95-102.
- Austin, G. (1988). Capitalists and chiefs in the cocoa hold-ups in South Asante, 1927-1938. *The International Journal of African Historical Studies*, 21(1), 63-95.

- Austin, G. (1996). Mode of production or mode of cultivation: Explaining the failure of European cocoa planters in competition with African farmers in colonial Ghana. In *Cocoa Pioneer Fronts since 1800: The Role of Smallholders, Planters and Merchants* (pp. 154-175). Palgrave Macmillan, London, United Kingdom.
- Baffes, J. and Gardner, B., 2003. The transmission of world commodity prices to domestic markets under policy reforms in developing countries. *Policy Reforms*, 6 (3), 159–180.
- Bateman, M. J. (1972). An Econometric Analysis of Ghanaian Cocoa Supply. In *The Economics of Cocoa Production and Marketing* (pp. 287-306). Institute of Statistical, Social and Economic Research (ISSER), University of Ghana.
- Beckett, S. T. (2019). *The Science of Chocolate*. Royal Society of Chemistry, London, United Kingdom.
- Beckman, B. (1976). *Organising the Farmers; Cocoa Politics and National Development in Ghana*. Scandinavian Institute of African Studies, Stockholm.
- Bello-Bravo, J., Lutomia, A. N., Medendorp, J. W., & Pittendrigh, B. R. (2022). Chocolate industry sustainable sourcing practices. *Trends in Sustainable Chocolate Production*, 259-290.
- Benneh, E. Y., & Anaman, K. A. (2022). Economic shocks and the growth of the Ghanaian cocoa industry from 1975 to 2019. *Ghana Journal of Development Studies*, 19(2), 57-82.
- Berlan, A. (2012). Good chocolate? An examination of ethical consumption in cocoa. *Ethical Consumption: Social Value and Economic Practice*, 43-59.
- Bond, T. J. (2011). The origins of tea, coffee and cocoa as beverages. *Teas, cocoa and coffee: plant secondary metabolites and health*, 1-24.
- Bourret, F. M. (1949). *The Gold Coast: A Survey of the Gold Coast and British Togoland, 1919-1946*: Stanford University Press, Stanford, United States.
- Boysen, O., Ferrari, E., Nechifor, V., & Tillie, P. (2023). Earn a living? What the Côte d'Ivoire–Ghana cocoa living income differential might deliver on its promise. *Food Policy*, 114, 102389.
- Brodersen, K. H., Gallusser, F., Koehler, J., Remy, N., & Scott, S. L. (2015). Inferring causal impact using Bayesian structural time-series models. *The Annals of Applied Statistics*, 9(1), 247–274.
- Brooks, J., Croppenstedt, A. & Aggrey-Fynn, E. (2007). *Distortions to Agricultural Incentives in Ghana, Agricultural Distortions Working Paper 47*. World Bank, Washington D.C., United States.
- Brooks, J., Croppenstedt, A., & Aggrey-Fynn, E. (2007). *Distortions to agricultural incentives in Ghana*. Working Paper 47, World Bank, Washington, DC.

- Buliř, A. (2002). Can price incentive to smuggle explain the contraction of the cocoa supply in Ghana?. *Journal of African Economies*, 11(3), 413-439.
- Cadby, J., Araki, T., & Villacis, A. H. (2021). Breaking the mold: Craft chocolate makers prioritise quality, ethical and direct sourcing, and environmental welfare. *Journal of Agriculture and Food Research*, 4, 100122.
- Çagli, E. Ç., & Mandaci, P. E. (2013). The long-run relationship between the spot and futures markets under multiple regime-shifts: Evidence from Turkish derivatives exchange. *Expert Systems with Applications*, 40(11), 4206–4212.
- Cashin, P., McDermott, C. J., & Scott, A. (2002). Booms and slumps in world commodity prices. *Journal of Development Economics*, 69(1), 277-296.
- Castro-Nunez, A., Charry, A., Castro-Llanos, F., Sylvester, J., & Bax, V. (2020). Reducing deforestation through value chain interventions in countries emerging from conflict: The case of the Colombian cocoa sector. *Applied Geography*, 123, 102280.
- Chatrath, A., Adrangi, B., & Dhanda, K. K. (2002). Are commodity prices chaotic? *Agricultural Economics*, 27(2), 123-137.
- Chauveau, J. P. (1997). Cocoa as innovation: African initiatives, local contexts and agro-ecological conditions in the history of cocoa cultivation in West African forest lands (c. 1850-c. 1950). *Paideuma*, 121-142.
- Cheng, I. H., & Xiong, W. (2014). Financialization of commodity markets. *Annual Review of Financial Economics*, 6(1), 419-441.
- Chrystal, P. (2021). *Rowntree's: The Early History*. Pen & Sword History. United Kingdom.
- Cidell, J. L., & Alberts, H. C. (2006). Constructing quality: The multinational histories of chocolate. *Geoforum*, 37(6), 999-1007.
- Clarence-Smith, W. G. (2000). *Cocoa and Chocolate, 1765-1914*. Routledge, London, United Kingdom.
- Colombo, M. L., Pinorini-Godly, M. T., & Conti, A. (2012). Botany and pharmacognosy of the cacao tree. *Chocolate and Health*, 41-62.
- Dand, R. (2011). *The International Cocoa Trade*. Woodhead Publishing, Cambridge, United Kingdom.
- Danquah, F. K. (2003). Sustaining a West African cocoa economy: Agricultural science and the swollen shoot contagion in Ghana, 1936-1965. *African Economic History*, (31), 43-74.
- Dastagiri, M. B., & Vajrjala, A. S. (2018). The political economy of global agriculture: Effects on agriculture, farmers, consumers and economic growth. *European Scientific Journal*, 14(4), 193-222.

- De-Graft Acquah, H., & De-Graft Acquah, J. (2015). An application of the error correction model in analyzing the long run equilibrium between Ghana's exports and imports. *Applied Studies in Agribusiness and Commerce*, 9(3), 57-62.
- DeJong, D. N., Nankervis, J. C., Savin, N. E., & Whiteman, C. H. (1992). The power problems of unit root test in time series with autoregressive errors. *Journal of Econometrics*, 53(1-3), 323-343.
- Department of Cooperatives (1990). *History of Ghana Co-operatives 1928-1985*. Department of Cooperatives, Accra, Ghana.
- Dicky, D. and W.A. Fuller, (1979), Distribution of the estimates for autoregressive time series with a unit root, *Journal of the American Statistical Association*, 74, 427-431.
- Ederington, L. H., & Guan, W. (2006). Measuring historical volatility. *Journal of Applied Finance*, 16(1).
- El Makhloufi, A., Mota, M. M., van Damme, D., & Langenberg, V. (2018). *Towards a Sustainable Agro-logistics in Developing Countries: the Case of Cocoa's Supply Chain in San Pedro Region/Cote d'Ivoire*. University of Applied Sciences (AUAS), Urban Technology, Amsterdam, Netherlands.
- Federation of Cocoa Commerce (FCC) (2019). *Implementation of Living Income Differential by Côte d'Ivoire and Ghana*. The Federation of Cocoa Commerce, London, United Kingdom.
- Fernández-Murga, L., Tarín, J. J., García-Perez, M. A., & Cano, A. (2011). The impact of chocolate on cardiovascular health. *Maturitas*, 69(4), 312-321.
- Fold, N. (2002). Lead firms and competition in 'Bi-polar' commodity chains: Grinders and branders in the global cocoa-chocolate industry. *Journal of Agrarian Change*, 2(2), 228-247.
- Fold, N., & Neilson, J. (2016). Sustaining supplies in smallholder-dominated value chains. In M. P. Squicciarini & J. Swinnen (Eds.), *The economics of chocolate* (pp. 195-212). Oxford University Press, Oxford, United Kingdom.
- Food and Agriculture Organisation (FAO) (2020). *Comparative Study on the Distribution of Value in European Chocolate Chains Research Report – Advance Copy*. Food and Agriculture Organisation of the United Nations (FAO) and Bureau d'Analyse Societale pour une Information Citoyenne (BASIC), Rome and Paris, Available at: https://lebasic.com/wp-content/uploads/2020/07/BASICDEVCO-FAO_Cocoa-Value-Chain-Research-report_Advance-Copy_June-2020.pdf.
- Food and Agriculture Organization of the United Nations (FAO) (2021). *FAOSTAT database*. Retrieved April 14, 2024, from <https://www.fao.org/faostat/en/>
- Foster, N., & Cordell, L. S. (Eds.). (1992). *Chillies to Chocolate: Food the Americas Gave the World*. University of Arizona Press, Arizona.

- Fountain, A., & Hütz-Adams, F. (2018). *Cocoa barometer 2018* (Report). VOICE Network, Ede, Netherlands.
- Fowler, M. S., & Coutel, F. (2017). Cocoa beans: From tree to factory. In S. T. Beckett, M. S. Fowler, & G. R. Ziegler (Eds.), *Beckett's industrial chocolate manufacture and use* (5th ed., pp. 9-49). Wiley Blackwell, Hoboken.
- Franco, G. R. (1981). The optimal producer price of cocoa in Ghana. *Journal of Development Economics*, 8(1), 77-92.
- Frankel, J. (1974). *Cocoa in Ghana: The Cocoa Farmers, Cocoa Marketing Board, and Elasticity of Supply*. Massachusetts Institute of Technology, Department of Economics, Cambridge, United States.
- Frydenborg, K. (2015). *Chocolate: Sweet Science and Dark Secrets of the World's Favorite Treat*. Houghton Mifflin Harcourt, United States.
- GCB Bank PLC. (2023). *Cocoa Industry in Ghana 2023*. GCB Bank. Retrieved from gcbbank.com.gh/downloads/research/sector-industry-reports/356-cocoa-industry-in-ghana-2023/file
- Ghana Cocoa Board (COCOBOD) (2000). *Ghana Cocoa Board Handbook*, COCOBOD, Accra, Ghana.
- Ghana Statistical Service (GSS) (2018). *Provisional 2017 Annual Gross Domestic Product*. GSS, Accra, Ghana (April).
- Ghana Statistical Service (GSS) (2020). *Census of Agriculture, 2017/2018 Report*. GSS, Accra, Ghana.
- Ghana Statistical Service (GSS). (2022). *Statistical bulletin: Consumer Price Index (CPI), December 2022*. Accra, Ghana: Ghana Statistical Service.
- Gibson, J. (2007). *Consistently inconsistent: Addressing income volatility among cocoa producers in Ghana and Côte d'Ivoire* (Report). International Institute for Sustainable Development (IISD), Winnipeg, Canada.
- Gilbert, C. (2016). The dynamics of the world cocoa price, In Squicciarini, M. P., & Swinnen, J. (Eds.), *Economics of Chocolate* (pp. 307-338). Oxford University Press. Oxford, United Kingdom.
- Gilbert, C. L. (1996). International Commodity Agreements: An obituary notice. *World Development*, 24(1), 1-19.
- Gilbert, C. L. (2009). Cocoa market liberalization in retrospect. *Review of Business and Economics*, 54(3), 294-312.
- Gilbert, C. L. (2024). Cocoa: Origin Differentials and the Living Income Differential. *The European Journal of Development Research*, 1-26.

- Gilbert, C. L., & Pfuderer, S. (2014). The financialization of food commodity markets. *Handbook on Food: Demand, Supply, Sustainability and Security*, 122-48.
- Gockowski, J., & Sonwa, D. (2011). Cocoa intensification scenarios and their predicted impact on CO₂ emissions, biodiversity conservation, and rural livelihoods in the Guinea rain forest of West Africa. *Environmental management*, 48(2), 307-321.
- Graue, E. (1950). Is cocoa being valorised?. *The Review of Economics and Statistics*, 32(3), 258-263.
- Gregory, A. W., & Hansen, B. E. (1996). Residual-based tests for cointegration in models with regime shifts. *Journal of Econometrics*, 70(1), 99-126.
- Gries, T., Kraft, M., & Meierrieks, D. (2009). Linkages between financial deepening, trade openness, and economic development: causality evidence from Sub-Saharan Africa. *World Development*, 37(12), 1849-1860.
- Grivetti, L. E., & Shapiro, H. Y. (2011). *Chocolate: History, Culture, and Heritage*. John Wiley & Sons, New Jersey, United States.
- Grossman-Greene, S., & Bayer, C. (2009). *A Brief History of Cocoa in Ghana and Côte d'Ivoire*. Payson Center for International Development, Tulane, United States.
- Grumiller, J., Grohs, H., Raza, W., Staritz, C., & Tröster, B. (2018). Upgrading in global value chains: The Ivorian and Ghanaian cocoa processing sectors. *ÖFSE Policy Note*, (24), 1-6.
- Gürsoy, B., & Heperkan, Z. D. (2020). Chocolate production, nutrients and health benefits. *International Journal of Food Engineering Research*, 6(2), 121-134.
- Gyan, J. K., & Bajan, B. (2022). Market analysis on cocoa beans export: The case of Ghana and Cote d'Ivoire in West Africa. *Journal of Agribusiness and Rural Development*, 66(4), 375-384.
- Haberler, G. (1930). The theory of comparative costs and its evaluation for the justification of free trade. *World Economic Archive*, 349-370.
- Hamilton, J. D., & Susmel, R. (1994). Autoregressive conditional heteroskedasticity and changes in regime. *Journal of econometrics*, 64(1-2), 307-333.
- Hancock, B. L., & Fowler, M. S. (1994). Cocoa bean production and transport. In *Industrial chocolate manufacture and use* (pp. 8-24). Springer, Boston, United States.
- Harwich, N. (2020). *Cocoa and Chocolate Trade Routes*. ReVista, Cambridge, United States.
- Hatemi-j, A. (2008). Tests for cointegration with two unknown regime shifts with an application to financial market integration. *Empirical Economics*, 35(3), 497-505.
- Hattink, W., Heerink, N., & Thijssen, G. (1998). Supply response of cocoa in Ghana: A farm-level profit function analysis. *Journal of African Economies*, 7(3), 424-444.

- Herbst, J. I. (1993). *The Politics of Reform in Ghana, 1982-1991*. University of California Press, California.
- Higgs, C. (2012). *Chocolate Islands: Cocoa, Slavery, and Colonial Africa*. Ohio University Press, Ohio.
- Hill, P. (1997). *The Migrant Cocoa Farmers of Southern Ghana: A Study in Rural Capitalism*. LIT Verlag Münster, Germany.
- Howard, R. (1976). Differential class participation in an African protest movement: The Ghana cocoa boycott of 1937–38. *Canadian Journal of African Studies*, 10(3), 469-480.
- Hütz-Adams, F. (2018). *Preisgestaltung in der Wertschöpfungskette Kakao*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Eschborn, Germany.
- Hütz-Adams, F., & Schneeweiß, A. (2018). *Pricing in the cocoa value chain - causes and effects* (Report). Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Eschborn, Germany.
- Hütz-Adams, F., Feldt, H., & Mürlebach, M. (2016). *Study on the establishment of a Cocoa Sustainability Fund*. SÜDWIND eV-Institut für Ökonomie und Ökumene, Bonn, Germany.
- Ingram, V., Van Rijn, F., Waarts, Y., & Gilhuis, H. (2018). The impacts of cocoa sustainability initiatives in West Africa. *Sustainability*, 10(11), 4249.
- International Cocoa Organization (ICCO) (2021). *Cocoa market report January 2021*. assessed on 13 Nov. 2021.
- International Cocoa Organization (ICCO) (2022). *The International Cocoa Council adopted the Amended International Cocoa Agreement of 2010*. Retrieved on 7 May 2023, from <https://www.icco.org/the-international-cocoa-council-adopts-the-amended-international-cocoa-agreement-2010/>
- International Cocoa Organization (ICCO) (2022b). *Quarterly Bulletin of Cocoa Statistics, vol. XLVII, No. 1, Cocoa year 2021/22*. ICCO, Abidjan, Cote d'Ivoire.
- International Cocoa Organization (ICCO) (2024). *Cocoa market report, April 2024*. International Cocoa Organization. <https://www.icco.org/wp-content/uploads/Cocoa-Market-Report-April-2024.pdf>
- Jagoret, P., Michel-Dounias, I., Snoeck, D., Ngnogué, H. T., & Malézieux, E. (2012). Afforestation of savannah with cocoa agroforestry systems: a small-farmer innovation in central Cameroon. *Agroforestry Systems*, 86, 493-504.
- Janvry, A. D., & Sadoulet, E. (2010). Agriculture for development in sub-Saharan Africa: An update. *African Journal of Agricultural and Resource Economics*, 5(1), 194-204.

- Kalischek, N., Lang, N., Renier, C., Daudt, R. C., Addoah, T., Thompson, W., ... & Wegner, J. D. (2023). Cocoa plantations are associated with deforestation in Côte d'Ivoire and Ghana. *Nature Food*, 4(5), 384-393.
- Kapetanios, G. (2005). Unit-root testing against the alternative hypothesis of up to m structural breaks. *Journal of Time Series Analysis*, 26(1), 123-133.
- Kaplinsky, R. (2004, May). Competitions policy and the global coffee and cocoa value chains. In *United Nations Conference for Trade and Development (UNCTAD)* (Vol. 31). Institute of Development Studies, Sussex, United Kingdom.
- Kay, J. A. (1972). Social discount rates. *Journal of Public Economics*, 1(3-4), 359-378.
- Keho, Y. (2017). The impact of trade openness on economic growth: The case of Cote d'Ivoire. *Cogent Economics & Finance*, 5(1), 1332820.
- Khan, Z., Hussain, M., Shahbaz, M., Yang, S., & Jiao, Z. (2020). Natural resource abundance, technological innovation, and human capital nexus with financial development: a case study of China. *Resources Policy*, 65, 101585.
- Kofi, T. A. (1976). MNC Control of Distributive Channels: A Study of Cocoa Marketing. *Stanford Journal of International Studies*, 11, 70.
- Kofi, T. A. (1972). Vertical Price Relationship in the International Cocoa Market and Implications for Ghana's Marketing Policies. In *The Economics of Cocoa Production and Marketing* (pp. 307-326). Institute of Statistical, Social and Economic Research (ISSER), University of Ghana.
- Kolavalli, S., & Vigneri, M. (2011). Cocoa in Ghana: Shaping the success of an economy. In P. Chuhan-Pole & M. Angwafo (Eds.), *Yes, Africa Can: Success Stories from a Dynamic Continent* (pp. 201–217). The World Bank, Geneva, Switzerland.
- Koning, N. B. J., & Jongeneel, R. A. (2006). *Food sovereignty and export crops: Could ECOWAS create an OPEC for sustainable cocoa?* Paper presented at Regional Forum on Food Sovereignty, University of Wageningen, Netherlands.
- Koning, P. (1986). *The state and rural class formation in Ghana: a comparative analysis*. KPI, London, United Kingdom.
- Kotey, R. A., Okali, C., & Rourke, B. E. (Eds.). (1974). *Economics of Cocoa Production and Marketing*. University of Ghana, Accra, Ghana.
- Kozicka, M., Tacconi, F., Horna, D., Gotor, E. (2018). *Forecasting Cocoa Yields for 2050*. Bioversity International, Rome, Italy.
- KPMG. (2013). *Improving smallholder livelihoods: Effectiveness of certification in coffee, cocoa and cotton* (Study commissioned by SUSTAINEO). KPMG Advisory N.V, Netherlands.

- Krauss, J. E., & Barrientos, S. (2021). Fairtrade and beyond: Shifting dynamics in cocoa sustainability production networks. *Geoforum*, 120, 186-197.
- Kroeger, A., Bakhtary, H., Haupt, F., & Streck, C. (2017). *Eliminating Deforestation from the Cocoa Supply Chain*. World Bank, Washington D.C., United States.
- Kwiatkowski, D., Phillips, P. C., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of Econometrics*, 54(1-3), 159-178.
- Läderach, P., Martinez-Valle, A., Schroth, G., & Castro, N. (2013). Predicting the future climatic suitability for cocoa farming of the world's leading producer countries, Ghana and Côte d'Ivoire. *Climatic change*, 119(3), 841-854.
- Lambert, K. (2019). 'It's All Work and Happiness on the Farms': Agricultural Development Between the Blocs in Nkrumah's Ghana. *The Journal of African History*, 60(1), 25-44.
- Laven, A. (2007). *Marketing Reforms in Ghana's Cocoa Sector: Partial Reforms, Partial Benefits?* Overseas Development Institute, London, United Kingdom. Retrieved from <http://www.odi.org.uk/resources/download/420.pdf>.
- Laven, A., & Boomsma, M. (2012). *Incentives for Sustainable Cocoa Production in Ghana*. Royal Tropical Institute, Amsterdam, Netherlands, 49.
- Laven, A., 2007. *Marketing Reforms in Ghana's Cocoa Sector: Partial Reforms, Partial Benefits?* (Background Note). Overseas Development Institute, London, United Kingdom.
- Lekane, G. M., & Asuelime, L. (2017). One country, three colonial legacies: the politics of colonialism, capitalism and development in the pre and post-colonial Cameroon. *Journal of Contemporary History*. 42(1), 134 -153.
- Lentz, D. L. (1991). Maya diets of the rich and poor: Paleoethnobotanical evidence from Copan. *Latin American Antiquity*, 2(3), 269-287.
- Li, J., Li, C. G., & Chavas, J. P. (2017). Food price bubbles and government intervention: is China different? *Canadian Journal of Agricultural Economics-Revue Canadienne D Agroéconomies*, 65(1), 135-157.
- Li, Z. (2018). *Interaction of Cocoa Powder with Intestinal Microbiota* (Doctoral Dissertation). Louisiana State University, Louisiana.
- Ludlow, H. (2012). Ghana, cocoa, colonialism and globalisation: Introducing historiography. *Yesterday and Today*, (8), 01-21.
- Lundstedt, H., & Pärssinen, S. (2009). *Cocoa is Ghana, Ghana is Cocoa: Evaluating Reforms of the Ghanaian Cocoa Sector* (Master's thesis, University of Lund). Lund University Publications, Lund, Sweden. Retrieved March 20, 2024, from <https://lup.lub.lu.se/luur/download?func=downloadFile&recordId=1511300&fileId=1647134>

- Maile, F. (2020). *Cooperation or confrontation? Public and private governance and smallholders' incomes in the cocoa sector in Ghana and in Côte d'Ivoire* (Master Thesis). University of Vienna, Vienna, Austria.
- Maki, D. (2012). Tests for cointegration allowing for an unknown number of breaks. *Economic Modelling*, 29(5), 2011-2015.
- Meredith, D. (1988). The Colonial Office, British business interests and the reform of cocoa marketing in West Africa, 1937–1945. *The Journal of African History*, 29(2), 285-300.
- Mhlanga, D. (2021). Artificial intelligence in the industry 4.0, and its impact on poverty, innovation, infrastructure development, and the sustainable development goals: Lessons from emerging economies?. *Sustainability*, 13(11), 5788.
- Miescher, S. F. (2022). *A Dam for Africa: Akosombo Stories from Ghana*. Indiana University Press, Indiana, United States.
- Milburn, J. (1970). The 1938 gold coast cocoa crisis: British business and the colonial office. *African Historical Studies*, 3(1), 57-74.
- Ministry of Finance (1999). *Ghana Cocoa Sector Development Strategy*. Ministry of Finance, Accra, Ghana.
- Mitchell, H., & McKenzie, M. D. (2003). GARCH model selection criteria. *Quantitative Finance*, 3(4), 262.
- Mitchell, T. (2017). Is knowledge power? Information and switching costs in agricultural markets. *American Journal of Agricultural Economics*, 99(5), 1307-1326.
- Moss, S., & Badenoch, A. (2009). *Chocolate: A Global History*. Reaktion Books, London, United Kingdom.
- Muojama, O. G. (2016). The first world war and the cocoa industry in Ghana: A study of the hazards of economic dependency. *Global Journal of Human Social Science Research*, 16, 33-41.
- Muojama, O. G. (2018). The international commodity restrictions and the West Africa cocoa industry during the great depression, *International Journal of Humanities and Social Sciences*, 8(12), 1929-1933.
- Musila, J. W., & Yiheyis, Z. (2015). The impact of trade openness on growth: The case of Kenya. *Journal of Policy Modeling*, 37(2), 342-354.
- Nijmeijer, A., Lauri, P. E., Harmand, J. M., Freschet, G. T., Nieboukaho, J. D. E., Fogang, P. K., ... & Saj, S. (2019). Long-term dynamics of cocoa agroforestry systems established on lands previously occupied by savannah or forests. *Agriculture, Ecosystems & Environment*, 275, 100-111.
- Nissanke, M. (2011). Commodity markets and excess volatility: Sources and strategies to reduce adverse development impacts. In *Promoting Beneficial Global Financial and*

Commodity Market Synergies, Common Fund for Commodities (CFC), Brussels, Belgium.

- Odiije, M. E. (2016). Diminishing returns and agricultural involution in Côte d'Ivoire's cocoa sector. *Review of African Political Economy*, 43(149), 504-517.
- Odiije, M. E. (2018). Sustainability winners and losers in business-biased cocoa sustainability programmes in West Africa. *International Journal of Agricultural Sustainability*, 16(2), 214-227.
- Odoom, D., Mensah, E. O., Dick-Sagoe, C., Lee, K. Y., Opoku, E., & Obeng-Baah, J. (2024). Examining the level of public awareness on the Sustainable Development Goals in Africa: An empirical evidence from Ghana. *Environment, Development and Sustainability*, 26(3), 6221-6238.
- Oduro, F. T., & Omane-Adjepong, M. (2012). Estimating the impact of the cocoa hi-tech and mass spraying programmes on cocoa production in Ghana: An application of intervention analysis. *International Journal of Applied Science and Technology*, 2(8), 71-79.
- Ofori-Abebrese, J., Pickson, R. B., & Ofori-Abebrese, G. (2017). Commodity prices, exchange rate and economic growth in West Africa: Case study of Cote d'Ivoire and Ghana. *Journal of Development and Agricultural Economics*, 9(9), 269-277.
- Ofosu-Asare, K. (2011). *Trade Liberalisation, Globalisation and the Cocoa Industry in Ghana: The case of the smallholder cocoa farmers* (Doctoral dissertation, University of Westminster).
- Ongolo, S., Kouassi, S. K., Chérif, S., & Giessen, L. (2018). The tragedy of forestland sustainability in postcolonial Africa: Land development, Cocoa, and politics in Côte d'Ivoire. *Sustainability*, 10(12), 1-17.
- Oomes, N., Tieben, B., Laven, A., Ammerlaan, T., Appelman, R., Biesenbeek, C., & Buunk, E. (2016). *Market Concentration and Price Formation in the Global Cocoa Value Chain*. SEO Economisch Onderzoek, Netherlands.
- Oreamuno, A., & Croppenstedt, A. (2023). *Bottlenecks, stresses, and risks in the cocoa supply chain in Ghana: Recommendations to increase its resilience (FAO Commodity and Trade Policy Research Working Paper No. 58)*. Food and Agriculture Organization of the United Nations, Rome, Italy.
- Owusu, O., & Tsamenyi, E. (2017). A Quantitative Assessment of the National Cocoa Disease and Pest Control (CODAPEC) Programme in Ghana. *Journal of Economics and Sustainable Development*, 8(14), 277-285.
- Oyekale, A. S. (2020). Dataset on cocoa production and climate change adaptation strategies in Ahafo Ano North District, Ghana. *Data in Brief*, 29, 105275.

- Perez, M., Lopez-Yerena, A., & Vallverdú-Queralt, A. (2021). Traceability, authenticity and sustainability of cocoa and chocolate products: A challenge for the chocolate industry. *Critical Reviews in Food Science and Nutrition*, 62(2), 475-489.
- Petithuguenin, P. (1995). Regeneration of cocoa cropping systems: the Ivorian and Togolese experience. *Cocoa cycles: the economics of cocoa supply*. Woodhead Publishers, London, 89-106.
- Phillips, P.C.B. and P. Perron, (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335–346.
- Pieters, H., & Swinnen, J. (2016). Trading-off volatility and distortions? food policy during price spikes. *Food Policy*, 61, 27-39.
- Poelmans, E., & Swinnen, J. (2016). A brief economic history of chocolate. In Squicciarini, M. P., & Swinnen, J. (Eds.), *The Economics of Chocolate* (pp. 11-45). Oxford University Press, Oxford. United Kingdom.
- Poelmans, E., & Swinnen, J. (2019). *A Brief Economic History of Chocolate*. Centre for Institutions and Economic Performance, Leuven, Belgium.
- Purcell, T. F. (2018). 'Hot chocolate': financialized global value chains and cocoa production in Ecuador. *The Journal of Peasant Studies*, 45(5-6), 904-926.
- Quarmin, W., Haagsma, R., van Huis, A., Sakyi-Dawson, O., Obeng-Ofori, D., & Asante, F. A. (2014). Did the price-related reforms in Ghana's cocoa sector favour farmers?. *International Journal of Agricultural Sustainability*, 12(3), 248-262.
- Rahman, M. M., & Kashem, M. A. (2017). Carbon emissions, energy consumption and industrial growth in Bangladesh: Empirical evidence from ARDL cointegration and Granger causality analysis. *Energy Policy*, 110, 600–608.
- Robins, J. E. (2012). Slave cocoa and red rubber: ED morel and the problem of ethical consumption. *Comparative Studies in Society and History*, 54(3), 592-611.
- Rosenblum, M. (2006). *Chocolate: A Bittersweet Saga of Dark and Light*. Macmillan, New York, United States.
- Ross, C. (2014). The plantation paradigm: colonial agronomy, African farmers, and the global cocoa boom, 1870s–1940s. *Journal of Global History*, 9(1), 49-71.
- Rousseau, D. (2016). Microstructural imaging of chocolate confectionery. *Imaging Technologies and Data Processing for Food Engineers*, 311-333.
- Ruf, F. O. (2011). The myth of complex cocoa agroforests: the case of Ghana. *Human Ecology*, 39, 373-388.
- Ruf, F., Schroth, G., & Doffangui, K. (2015). Climate change, cocoa migrations and deforestation in West Africa: What does the past tell us about the future?. *Sustainability Science*, 10, 101-111.

- Ryan, Ó. (2012). *Chocolate Nations: Living and Dying for Cocoa in West Africa*. Bloomsbury Publishing, London, United Kingdom.
- Sadhu, S., Kysia, K., Onyango, L., Zinnes, C., Lord, S., Monnard, A., & Arellano, I. R. (2020, October). *NORC final report: Assessing progress in reducing child labor in cocoa production in cocoa growing areas of Côte d'Ivoire and Ghana*. NORC at the University of Chicago. Retrieved July 23, 2023, from https://www.norc.org/PDFs/Cocoa%20Report/NORC%202020%20Cocoa%20Report_English.pdf
- Saj, S., Jagoret, P., Etoa, L. E., Fonkeng, E. E., Tarla, J. N., Nieboukaho, J. D. E., & Sakouma, K. M. (2017). Lessons learned from the long-term analysis of cacao yield and stand structure in central Cameroonian agroforestry systems. *Agricultural Systems*, 156, 95-104.
- Salisu, A. A., Adediran, I. A., Oloko, T. O., & Ohemeng, W. (2020). The heterogeneous behaviour of the inflation hedging property of cocoa. *The North American Journal of Economics and Finance*, 51, 101093.
- Schroth, G., Läderach, P., Martinez-Valle, A. I., Bunn, C., & Jassogne, L. (2016). Vulnerability to climate change of cocoa in West Africa: Patterns, opportunities and limits to adaptation. *Science of the Total Environment*, 556, 231-241.
- Schumacher, R. (2012). *Free Trade and Absolute and Comparative Advantage: A Critical Comparison of Two Major Theories of International Trade* (Vol. 16). Universitätsverlag Potsdam, Germany.
- Sostizzo, T. (2017). Sustainable and Future Oriented Cocoa Production in Ghana: Analysis of the Initiatives of two Swiss Chocolate Manufacturers. *African Technology Development Forum Journal*, 9(1), 20-31.
- Southall, R. J. (1978). Farmers, traders and brokers in the Gold Coast cocoa economy. *Canadian Journal of African Studies/La Revue Canadienne des Études Africaines*, 12(2), 185-211.
- Staritz, C., Tröster, B., Grumiller, J., & Maile, F. (2022). Price-setting power in global value chains: The cases of price stabilisation in the cocoa sectors in Côte d'Ivoire and Ghana. *The European Journal of Development Research*, 35(4), 840-868.
- Suh, N. N., & Molua, E. L. (2022). Suh, N. N., & Molua, E. L. (2022). Cocoa production under climate variability and farm management challenges: Some farmers' perspective. *Journal of Agriculture and Food Research*, 8, 100282.
- Swales, S. E. (1999). *Dynamics of Land Use and Agricultural Practices on the Uplands and Adjacent Flood Plain in the Lower Amazon*. University of Florida, Florida.
- The Case of the Smallholder Cocoa Farmers* (Doctoral dissertation, University of Westminster).

- Thorlakson, T. (2018). A move beyond sustainability certification: The evolution of the chocolate industry's sustainable sourcing practices. *Business Strategy and the Environment*, 27(8), 1653-1665.
- Toffano, S. (2021). *Global Goods and International Trade: Two Eras of Globalisation Compared*. Università Ca' Foscari Venezia, Venezia, Italy.
- Ton, G., Hagelaars, G., Laven, A., & Vellema, S. (2008). *Chain Governance, Sector Policies and Economic Sustainability in Cocoa: A Comparative Analysis of Ghana, Côte d'Ivoire, and Ecuador*. Markets, Chains and Sustainable Development Strategy & Policy Paper (No. 120), University of Wageningen, Netherlands.
- Tothmihaly, A. (2018). How low is the price elasticity in the global cocoa market?. *African Journal of Agricultural and Resource Economics*, 13(3), 209-223.
- Tröster, B., Staritz, C., Grumiller, J., & Maile, F. (2019). *Commodity Dependence, Global Commodity Chains, Price Volatility and Financialisation: Price-Setting and Stabilisation in the Cocoa Sectors in Côte d'Ivoire and Ghana*. ÖFSE Working Paper (No. 62), Austrian Foundation for Development Research. Vienna, Austria.
- Van Huellen, S. (2015). *Excess Volatility or Volatile Fundamentals?: The Impact of Financial Speculation on Commodity Markets and Implications for Cocoa Farmers in Ghana* (Doctoral Dissertation, SOAS University of London).
- van Vliet, J. A., Slingerland, M. A., Waarts, Y. R., & Giller, K. E. (2021). A living income for cocoa producers in Côte d'Ivoire and Ghana?. *Frontiers in Sustainable Food Systems*, 5, 732831.
- Varangis, P. and Schreiber, G. (2001). Cocoa market reforms in West Africa. In Akiyama, A., Baffes, J., Larson, D. and Varangis, P., (eds), *Commodity Market Reforms: Lessons of Two Decades*(pp 35-82). World Bank, Washington D.C., United States.
- Vellema, S., Laven, A., Ton, G., & Muilerman, S. (2016). Policy Reform and Supply Chain Governance. In Squicciarini, M. P., & Swinnen, J. (Eds.), *The Economics of Chocolate* (p. 228). Oxford University Press, Oxford. United Kingdom.
- Vellema, S., P. Zuurbier and F. Joosten. (2007). *Viable Value Chains and Pro-poor Development* (Paper presentation). International Conference on Global Initiative on Commodities, Brasilia, Brazil.
- Vigneri M., and P. Santos (2008). *What Does Liberalization without Price Competition Achieve? The Case of Cocoa Marketing in Rural Ghana*. IFPRI-GSSP Background Paper 14. International Food Policy Research Institute, Washington, DC.
- Vigneri, M., & Kolavalli, S. (2018). *Growth Through Pricing Policy: The case of cocoa in Ghana*. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.
- Vigneri, M., 2007. Drivers of cocoa production growth in Ghana. ODI Project Briefing. Overseas Development Institute, London, United Kingdom.

- Vlastou, I. (2010). Forcing Africa to open up to trade: Is it worth it? *The Journal of Developing Areas*, 25–39.
- Voorra, V., Bermúdez, S., & Larrea, C. (2019). *Global Market Report: Cocoa (Sustainable Commodities Marketplace Series)*. International Institute for Sustainable Development (IISD), Winnipeg, Canada.
- Waarts, Y. R., Janssen, V., Aryeetey, R., Onduru, D., Heriyanto, D., Aprillya, S. T., ... & Ingram, V. J. (2021). Multiple pathways towards achieving a living income for different types of smallholder tree-crop commodity farmers. *Food Security*, 13(6), 1467-1496.
- Waldburger, T., Monney, P., Anken, T., Cockburn, M., Etienne, A., Lecoeur, J., ... & Jöhr, H. (2019). *Growing Cocoa in Semi-arid Climate—A Scalable Use Case for Digital Agriculture*. Agroscope Science (No. 86), Tänikon, Ettenhausen, Switzerland.
- Witschey, W. R. T., & Brown, C. T. (2012). *Historical Dictionary of Mesoamerica*. Scarecrow Press, Maryland, United States.
- World Bank. (1984, May 24). *Project completion report: Ghana Ashanti Region Cocoa Project (Loan 1181-GH)*. World Bank Group Archives. Folder ID 1066972, ISAD(G) Reference Code WB IBRD/IDA OPE-06. Washington, D.C., United States.
- World Bank. (2024). *Climate Change Knowledge Portal*. Retrieved April 14, 2024, from <https://climateknowledgeportal.worldbank.org/>
- World Cocoa Foundation. (2022). *African Cocoa Initiative Phase II (ACI II): End of project report*. Retrieved from <https://www.worldcocoafoundation.org/wp-content/uploads/2018/08/FINAL-WCF-ACI-II-Final-Report.pdf>
- Yaro, J. A., Teye, J. K., & Wiggins, S. (2021). *Land and Labour Relations on Cocoa Farms in Sefwi, Ghana: Continuity and Change* (APRA Working Paper 73). Future Agricultures Consortium.

