Essays in Development Economics:
The Health and Economic Impact of the Farm-gate Cocoa Price Boom in Ghana

by

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A thesis submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Department of Economics

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Abstract

This thesis explores the impact of Ghana's farm-gate cocoa price shocks on welfare. It comprises of two essays.

The first essay examines the impact of a farm-gate cocoa price boom on child health, where the price boom directly affect household incomes and indirectly affect the investments in child health-promoting goods and activities. Ghana experienced an exogenous boom in farm-gate cocoa prices in the early 1990s. The agro-ecological properties of Ghana yield sharp comparisons across districts making the southern parts of Ghana, the only areas that receives sufficient amount of rain for cocoa production. I identify the effects of the cocoa price boom by comparing child health outcomes in cocoa producing districts to other non-cocoa producing districts during pre and post price boom periods. The evidence suggests that the cocoa price boom led to a differential increase in the probability of stunting and underweight in children living in cocoa districts relative to those in non-cocoa districts. Next, I explore the mechanisms through which a cocoa price increase affects child health and find that there is a differential increase in the probability of stunting and underweight for children in cocoa districts because the income effect derived from the price boom fails to exceed the substitution effect that results in declines in antenatal visits, breastfeeding and vaccinations against diseases.

The second essay investigates the impact of Ghana's farm-gate cocoa price increase between 1998/1999 and 2012/2013 on the welfare of residents living in cocoa areas of Ghana. Over the study period, real farm-gate cocoa prices in Ghana increased over 50%, raising questions on whether these gains had any meaningful impact on inequality and on policymakers' attempts to alleviate poverty among residents in cocoa areas. I identify the impacts of the cocoa price boom by comparing poverty and inequality in wage and consumption

of households in cocoa producing districts to those of non-cocoa districts during the price boom periods. The overall impact of the farm-gate cocoa price boom led to an increase in the differential change in wage and consumption of households by about 20% to 71% and 8% to 11% points, respectively. It also led to a differential decline in wage and consumption inequality by about 37% to 60% and 16% to 40% points respectively. Further, there was a 7% points decline in the poverty headcount ratio for households in cocoa districts compared to those in non-cocoa districts, and the cocoa price boom resulted in a decline in the intensity of poverty. I find that there was a differential decline in the poverty gap ratio by about 4% points for households in cocoa districts relative to those in non-cocoa districts. Finally, I find evidence to suggest that both landless and landowning households at the bottom half of the wage and consumption distribution benefited from the gains of the price boom compared to those at the top half. However, landowning households were the higher beneficiaries of the price boom compared to the landless households.

Preface

This thesis is an original work by Philip Jako Akude. No part of this thesis has been previously published.

Acknowledgements

First, I thank God Almighty for giving me the strength and knowledge to undertake this research. The Lord's grace enabled me to persevere through the entire duration of my Ph.D. program.

I want to express my sincere gratitude to my supervisor Dr. Beyza Ural-Marchand for her guidance and continuous support of my research. I could not have completed this research without her patience, motivation and constant feedback. I am also grateful to Dr. Ural-Marchand for the genuine concern she has always shown for my career and the well-being of my family.

I thank the rest of my thesis committee: Dr. Joseph Marchand and Dr. Pinar Gunes. Their feedback, encouragement and the hard questions they threw at me allowed me to view my research from perspectives that had never crossed my mind. I much appreciate the invaluable contributions each of you made to my research.

My sincere thanks also go to Dr. Christopher McCabe, who allowed me to join his research team as a research assistant. I gained valuable work experience from the McCabe Research Group. I also had the chance to work on other research projects, attend several conferences and engaged with other researchers from around the globe.

I am thankful to my external examiners, Dr. Daniel Rosenblum and Dr. Jeffrey Penney, for their kind review. Their insightful comments will not only allow me to enhance this research but also take it farther in the future.

I appreciate the Graduate Chair at the Economics Department, Dr. Heather Eckert, and the Graduate Program Advisor Christina Smith for all their support during the period of my research. To all the professors and office staff at the Economics Department who offered precious time to me during my studies, I say thank you. Also, to my course mates past and present, with whom I have bounced ideas, I say many thanks.

To my manager at Alberta Health, Fred Ackah, your kind consideration and support, made it possible for me to complete my research. A special thanks go to the Research Department at the Ghana Cocoa Board for providing me with the cocoa production data. I also thank participants at the 51st Annual Conference of the Canadian Economic Association Meeting in Antigonish, who provided me with feedback on Chapter 1 of this thesis.

I am grateful to my siblings, relatives and friends for their encouragement. And to my mother, Comfort Sakyi, who continues to provide me with moral and spiritual support throughout my life. I am also thankful to my late father, George Newton Akude, who laid the educational platform for me. And to my late grandfather Boaz Geoffrey Anku who was always keen to know what I was doing and how my research was proceeding.

Finally, but by no means least, I want to say a special thank you to my daughter and wife Dzifah and Akosua. Both of you have always believed in me and supported me all along the way throughout my Ph.D. studies. Thank you for giving me a reason to keep going and never give up.

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Chapter 1

Introduction

Cocoa is Ghana's most important cash crop, and for over three decades, it has been the country's highest agriculture foreign exchange earner. Despite a large amount of revenue cocoa adds to the Ghanaian economy, available reports indicate that malnutrition and poverty are prevalent in the areas that produce this cash crop. The liberalization of Ghana's cocoa sector has allowed farm-gate cocoa prices to increase by more than 300% (in nominal terms) since 1990. Essentially, any boom in the farm-gate cocoa price should improve the welfare of individuals and households that live in the areas of Ghana that grow cocoa.

Ghana presents a compelling case to explore how a farm-gate price increase impacts welfare for three reasons. First, over 800,000 of Ghananian households depend on cocoa for a large share of their income. Second, Ghana's cocoa sector is made up of smallholder farmers so any increases in farm-gate prices have a direct effect on the incomes of the households that produce this cash crop. Third, the nature of Ghana's agro-ecological landscape means that cocoa can only grow in parts of the country that receive an annual rainfall of 1500mm or more, and this presents an excellent opportunity to use a natural experiment to explore my research questions. This thesis consists of two essays, and each essay provides insights on how a boom in farm-gate cocoa prices impact welfare.

In Chapter 2 of this thesis titled "Price Shocks and Child Health Outcomes: The Case of The Ghana Cocoa Price Boom." I investigate the impact of the Ghana farm-gate cocoa price increases on child health. I provide answers to the following questions: First, how does a farm-gate cocoa price increase in Ghana affect Child health? Second, what are the mechanisms through which a farm-gate cocoa price increase affects child health? A farm-gate cocoa price shock affects child health through the interaction of an income and substitution effect. An increase in farm-gate cocoa prices will result in a positive shock to incomes, which will subsequently lead to an increase in household incomes. This is the income effect of the price shock. Also, a boom in farm-gate cocoa prices will increase labour demand in the areas that produce cocoa. Following the increase in labour demand, households will increase the time spent at work and consequently reduce the time used in performing child intensive activities, including child care. This is the substitution effect. If the income effect exceeds the substitution effect, child health improves. However, if the substitution effect exceeds the income effect, then child health deteriorates.

I use four waves (1993, 1998, 2003, 2008) of detailed child-level data obtained from the Ghana Demographic Health Survey (DHS) to address my research questions. I find that during a cocoa price increase, the incidence of stunting and underweight increases because the cost to child health due to the substitution effect exceeds the gains derived through the income effect.

In chapter 3, titled "Distributional Impact of a Cocoa Price Boom: Evidence from Ghana." I examine the extent to which a farm-gate price increase affects the welfare of households across the distribution. In this chapter, I explore three questions: First, where are the gains from a farm-gate cocoa price increase concentrated across the wage and consumption distributions of households? Second, does a cocoa price increase drive inequality in household wages and consumption? Third, what is the impact of a cocoa price increase on poverty? I make the following hypothesis: 1) During a farm-gate cocoa price increase, wages and per capita consumption across the distribution will rise. 2) The impact of a farm-gate cocoa price increase will have an ambiguous effect on wage and consumption inequality. This is because if the price increase causes wages and consumption of households at the lower half of the distribution to increase faster than those at the top half, then inequality will decline. If the wages and consumption of households at the top half of the distribution increase faster than those at the lower half, then inequality will increase. If the wages and consumption of households at the upper and lower end of the distribution increase at the same rate, inequality will remain unchanged. 3) A farm-gate price increase will lead to a decline in the poverty headcount because some households below the poverty line will be marginally lifted out of poverty due to the positive income shock associated with the price boom.

I use three waves of data (1998/1999, 2005/2006 and 2012/2013) from the Ghana Living Standards Survey(GLSS) to address my research questions. My results reveal that a farm-gate cocoa price increase generally results in a differential increase in wage and per capita consumption of households across the distribution. Also, during the price increase period, there is a differential decline in wage and consumption inequality as well as poverty.

Both essays make important contributions to existing studies. First, I document how increasing farm-gate cocoa prices affect the welfare of residents living in areas that produce cocoa, and provides the channels through which this shock affects welfare. Second, I produce a unique dataset to address the research questions; specifically, I combine administrative data from the Ghana Cocoa Board with other survey data. Third, I use a novel approach to identify individuals and households who will be most impacted by Ghana's farm-gate price boom.

The findings in this research have implications on policy. It gives decision-makers an indication of when healthcare resources are needed most, to combat child malnutrition in cocoa areas. It shows how farm-gate prices can be used as a policy tool to minimize poverty and wage and consumption inequality in areas of Ghana that produce cocoa.

The outline of this thesis is as follows: In Chapter 1, I present an overview of the thesis in the introduction. Next, I investigate the impact of the Ghana farm-gate cocoa price increases on child health in Chapter 2. Chapter 3 examines the distributional impact of the farm-gate cocoa price boom on household wages and consumption in Ghana. I conclude the thesis in Chapter 4.

Chapter 2

Price Shocks and Child Health Outcomes: The Case of the Cocoa Price Boom in Ghana

2.1 Introduction

A large body of research has examined the impact of shocks on child health, and the consensus is that during a shock, the direction of child health depends on the interaction of the income and substitution effects generated as a result of the shock (Dehejia and Lleras-Muney, 2004; Ferreira and Schady, 2009). Child health improves whenever the income effect dominates and deteriorates whenever the substitution effect dominates. Some studies have shown that the resulting impact of exogenous shocks on child health tends to be country-specific (Ferreira and Schady, 2009). For lower-income countries, a positive shock often leads to positive child health outcomes, while adverse shocks negatively affect child health (Hoddinott and Kinsey, 2001; Jensen, 2000). For higher-income countries, the evidence generally suggests that positive shocks worsen child health and vice versa (Ruhm, 2000a; Ruhm, 2003). There is no clear evidence on how shocks impact child health in middle-income countries, including Ghana (Maluccio, 2005; Miller and Urdinola, 2010). The farm-gate cocoa price boom that occurred in Ghana between 1993 and 2008 presents an excellent experiment to assess how shocks affect child health in a middle-income country, and this helps me to fill a gap in the literature.

A cocoa price boom will affect child health through the interaction of an income and a substitution effect. During a cocoa price boom, households living in cocoa areas will likely experience a positive shock to their wages, all else equal, and this allows them to increase their investment in normal goods including goods that promote child health(examples include nutritious diets and childcare activities)[1]. At the same time, rising earnings and incomes caused by the price boom increases the opportunity cost of leisure[2], and as a consequence household are likely to demand less leisure [3]. Whenever the income effect is greater than the substitution effect, child health improves, and child health deteriorates when the substitution effect is greater than the income effect.

In this paper, I examine the impact of Ghana's farm-gate cocoa price increase between 1993 and 2008 on child health, and investigate the channels through which this price increase impacts the health of children living in cocoa areas of Ghana.[4] I measure the impact of a cocoa price boom as the differential change in anthropometric measurements of children in cocoa-producing areas and those in non-cocoa producing areas before and after the price boom. I focus on child health for two reasons. First, children are the most vulnerable group in society whose health is easily affected by external factors. Second, improvements in the health and nutrition of pre-school children have long term consequences on their attained height when they become young adults (Alderman et al., 2006; Hoddinott and Kinsey, 2001). Ghana presents a compelling case for two reasons. First, unlike other countries where giant corporations control the cocoa sector, Ghana's cocoa sector is mostly dominated by smallholder farmers who mostly rely on family members and in some cases, individuals within the community for the supply of labour (Anyidoho et al., 2012; Abenyega and Gockowski, 2003; Austin, 1996; Sutton, 1983). Second, over 800,000 of Ghanaian households (approx. 20%) depend on the cocoa sector for employment (Anim-Kwapong and Frimpong, 2004; ICCO, 2006) and about two-thirds of their total household income (Kolavalli and Vigneri,

[1]This is the income effect.

[2]Leisure is the time spent by parents in performing child health-promoting activities.

[3]This is the substitution effect

[4]Farm-gate price is the producer price of cocoa paid to cocoa farmer, excluding any transport or delivery charge.

2011).

This study contributes to existing studies in a variety of ways. First, the paper documents that stunting and underweight among children under five increase during a farm-gate cocoa price boom in Ghana. This motivates me to investigate the mechanisms through which a price shock can affect child health. To this end, I combine data from the Demographic Health Survey (DHS), Ghana Living Standard Survey (GLSS) and cocoa production data from the Ghana Cocoa Board to produce a unique dataset used for my study. By doing so, I document that price shocks lead to deterioration in the long run due to lower incidence of vaccination, and fewer antenatal visits. This paper investigates a case not covered in previous studies; it adds to the existing literature by identifying the channels through which a farm-gate cocoa price boom in Ghana impacts child health using a natural experiment. The Ghanaian case has a nontrivial advantage of providing sharp comparisons across regions as the agro-ecological properties lead to cocoa production exclusively in the southern areas. These differences across the regions, along with detailed information on cocoa production, maternal health, child health, as well as labour market outcomes, allow me to carefully study the income and substitution effects of price shocks on child health in areas of Ghana that produce cocoa.

Overall, the results show that the farm-gate cocoa price boom that occurred between 1993 and 2008 resulted in an increase in stunting and underweight among children living in cocoa areas of Ghana compared to those in non-cocoa areas. During the boom period, the differential change in the probability of being stunted increased by 39% for all children in cocoa areas compared to the non-cocoa areas. Also, I observed higher cases of stunting in all other groups of children living in cocoa districts compared to those in non-cocoa areas. During the same period, the differential change in the probability of being underweight also increased by 11% in children residing in cocoa districts relative to non-cocoa areas. Also, the probability of being underweight increased among all other groups of children investigated in this study except boys under 24 months. I provide evidence to show that the substitution effect caused by the price boom dominated the income effect resulting in a decline in maternal behaviours such as breastfeeding and antenatal services.

2.2 Background

Cocoa plays an integral role in the economic development of Ghana. In 2013, Ghana's cocoa sector contributed 8% of total GDP and 61% of foreign export earnings from the agriculture sector (Ghana Statistical Service, 2013), and it continues to add about 21% to global cocoa production (ICCO, 2003; ICCO, 2004; Leiter and Harding, 2004).

Cocoa production depends primarily on the pattern of rainfall. However, the distribution of monthly rains throughout the year is more critical for cocoa production than the annual total (Vigneri, 2008; Wood and Lass, 2008). In Ghana, there are seven major agro-ecological zones; Wet Evergreen, Rain Forest, Deciduous Forest, Transitional Zones, Coastal Savannah, Guinea Savannah and Sudan Savannah (See Figure 4.1). The southern half of Ghana comprises Wet Evergreen, Rain Forest, Deciduous Forest, Transitional Zones and Coastal Savannah. This area is the most suitable for cocoa growth. The northern half of the country is not ideal for cocoa growth due to the pattern of rainfall exhibited in this region. The perfect amount of annual rain under which the cocoa crop grows is about 1500mm-2000mm (Schroth et al., 2016; Carr and Lockwood, 2011). The average yearly rainfall in the southern half is generally between 1400 mm-2000 mm (Figure 4.2), which is ideal for cocoa growth, while the average annual rainfall in the northern half is about 800mm-1200mm (Oppong-Anane, 2006).

Long-term cocoa price trends are affected by the following factors: changes in supply and demand, ratios between stocks and grindings, corporate acquisitions and disinvestment in the cocoa trade and/or processing industry. Short-term cocoa price trends, on the other hand, are affected by: weather conditions, disease and pest infestation, availability or the lack of pesticides and fertilizers, producers withholding stocks in anticipation of higher prices, political instability and speculative trading on the futures markets (Fairtrade Foundation, 2011).[5]

[5] Volume of grindings, which is the industry term for processing cocoa beans into cocoa liquor, cocoa butter and cocoa powder, is equivalent to demand. Thus, a falling stocks-to-grindings ratio leads to higher prices and vice versa. Favourable weather conditions lead to abundant supplies and increase global stock, which suppresses prices. Disease and pest infestation, and in some cases drought in top producing countries causes a shortage of cocoa beans, and this leads to an increase in global prices.

Before the Second World War, cocoa beans in Ghana were purchased from local farmers by only a handful of unregulated firms. These firms colluded and offered lower purchase prices for the cocoa beans. The cocoa farmers became discontent and decided to withhold cocoa beans from the market until their grievances were addressed. The Cocoa Marketing Board (CMB) was formed as a temporary control board to ensure that farmers received reasonable prices for the sale of their cocoa beans. The CMB became the sole agent responsible for setting the purchase price of cocoa in Ghana, and this represented a shift from an unregulated system of cocoa marketing to one where farmers were required to sell all their produce to a statutory board with a price-setting authority. The new system required farmers to sell their entire cocoa stock at a fixed price to the CMB, after which licensed buyers would buy from the Board. To minimize economic losses, CMB set low producer prices, and surplus earnings from cocoa sales were used to offset losses incurred on unsold inventory.[6]

In the early 1990s, Ghana began a partial liberalization of its cocoa sector. The institution that manages the local production and export of Ghana's cocoa has undergone several transformations to ensure that Ghana remains competitive in the global supply of cocoa beans. The policy change provided that several factors, including world cocoa prices, free-on-board price, exchange rate, and the projected crop size, determined producer cocoa price in Ghana (Kolavalli and Vigneri, 2011). Following the liberalization, several quasi-exporting firms, both local and foreign-owned trading companies, emerged in all cocoa growing areas of southern Ghana (Vigneri and Santos, 2007), increasing private sector participation and creating more competition for the purchase of cocoa beans. The competitive market created resulted in farmers receiving fair prices for the sale of their cocoa beans. Farmers responded to this incentive by significantly increasing cocoa production, and revenues from cocoa exports in Ghana increased from $500 million in the year 2002 to approximately $1,200 million in the year 2006 (Essegbey et al., 2009). The government of Ghana, through the Cocoa Board, continues to set the farm-gate price paid to farmers everywhere in the cocoa belt.

The fluctuations in the post-1998 years correlated closely with world prices. One of the significant influences underlying the rise in world cocoa prices between 1998 and 2008 was

[6] See Alence (2002) for detailed discussion.

an increase in global demand for cocoa, as it expanded by about 17% between 2001/2002 and 2005/2006 cocoa years, and in response to this, cocoa production hit an all-time high of 3.6 million metric tons in 2005/6 ICCO (2007).[7] As the supply did not only meet the high demand, cumulative production deficits have also been an essential factor in cocoa prices. The average international cocoa prices as measured by the ICCO daily price increased by 19% in 2006/2007 and 36% in 2007/2008 compared to the previous cocoa years, primarily due to production deficits experienced in past years. Another determinant of cocoa price has been the civil unrest that followed the 1999 coup d'état in Côte d'Ivoire and threatened to disrupt cocoa supplies from the world's largest cocoa exporter ICCO (2003) and ICCO (2004). The political instability in Côte d'Ivoire raised fears of a shortage in cocoa beans, and as a result, world cocoa prices increased to the highest levels, and the highest recorded was US$1,884 per ton in March 2005.

A common practice among individuals living in cocoa communities across Ghana is communal labour (Vigneri, 2008; Kolavalli and Vigneri, 2011). At the onset of the cocoa season, members of the extended family including children, supply labour in harvesting and drying cocoa beans. Community members are also employed by the cocoa farmers to help on the farms. A cocoa price boom presents opportunities for unemployed persons in the community even during the cocoa off-season, as farmers require help in clearing their lands and planting due to larger volumes of production (Vigneri, 2008).

The rural communities in Ghana mostly rely on the informal mode of child care where members of the extended family usually offer help with childcare for working mothers (Waterhouse et al., 2017). Individuals who typically offer this help usually do not charge a fee for their service, but their action may be purely driven by altruistic motives. Increased maternal labour supply on cocoa farms, may lead to reduced health care investments for children, such as reduced breastfeeding days and doctor visits.

[7] Harvest is typically done twice a year. The primary crop season in Ghana is between September and March, and the mid-crop season is between May and August of each year. For this reason, a crop year is 12 months between September of one year and August of the following year.

2.3 Literature

A large number of studies have assessed the relationship between different exogenous shocks on various health outcomes, and the evidence suggests that this relationship varies a great deal by geographical regions and by the nature of the shock.

2.3.1 Impact of Shocks on Mortality

In the United States and other North American countries, some studies report that during economic downturns, child mortality declines (Ruhm, 2000a; Dehejia and Lleras-Muney, 2004; Ariizumi and Schirle, 2012). Ruhm (2000a) uses state-level aggregate data and a fixed-effect model to investigate the effect a transitory change in economic conditions has on age-specific mortality rates and ten of the most observed causes of death in the United States. He reports that economic downturns are positively and significantly related to mortality and eight of the ten specific causes of fatalities. Dehejia and Lleras-Muney (2004) examine the relationship between the unemployment rate at the time of a baby's conception, parental characteristics and behaviours, and babies' health. They find that babies conceived in times of high unemployment are less likely to have low birth weight, congenital malformations, and a decreased likelihood of post-neonatal mortality. The authors attribute these findings to selection in the type of mothers that conceive, and improvements in healthy behaviours during downturns. Ariizumi and Schirle (2012) provide evidence from Canada to support the conclusions of studies in the United States. The authors report that a 1% increase in the unemployment rate lowers the predicted mortality rate of individuals in their 30s by about 2%; however, they do not find a significant pro-cyclical pattern in the mortality rates of infants.

Chay and Greenstone (2003) and Dehejia and Lleras-Muney (2004) provide possible reasons why mortality declines during economic downturns. According to Chay and Greenstone (2003), recessions induce substantial reductions in air pollution across sites. They estimate that during the 1980-82 recession, a 1% reduction in total suspended particulates

(TSPs) resulted in a 0.35 percent decline in the infant mortality rate at the county level. Dehejia and Lleras-Muney (2004) note that during economic downturns, the opportunity cost of time is low, and mothers substitute their time away from the labour market to health-preserving activities for their children.

Other studies that have examined the impact of economic booms on mortality in developed economies report that mortality increases during economic booms (Gerdtham and Ruhm, 2006; Granados, 2005). Gerdtham and Ruhm (2006) use data from 23 member nations of the Organization for Economic Co-operation and Development (OECD) to estimate a linear regression model that controls for both the time-varying and invariant factors between these countries. They find a positive relationship between economic booms and mortality especially for countries with weak social insurance systems. According to Granados (2005), the expansion of traffic and industrial activity during economic booms decrease immunity levels (owing to rising stress and reduction of sleep time, social interaction and social support), and leads to an increase in the consumption of tobacco, alcohol and saturated fats, that increase mortality.

For middle-income countries in Europe, Asia, South America and Mexico, there is mixed evidence on how economic shocks affect child mortality. According to Miller and Urdinola (2010), the declines in coffee prices in the early 1990s in Columbia led to reductions in infant mortality rates. In contrast to these findings, some studies suggest that adverse shocks to income increase infant mortality (Bhalotra, 2010; Rukumnuaykit, 2003). Cutler et al. (2002) and Paxson and Schady (2005) also provide evidence from Peru and Mexico to support that infant mortality increases during an economic crisis; both studies show that household expenditure reduction in essential health-promoting goods and the collapse in public and private expenditures on health during the crises period contributed to the decline.

In other related studies, Miller and Urdinola (2010) use exogenous variation in the price of coffee to show that infant and child mortality rises when prices (and incomes) increase in coffee-growing areas in Colombia. Miller and Urdinola (2010) note that the relative cost of child health falls whenever parents return to work, and this accounts for the reason why we observe the procyclical pattern in coffee price fluctuations and child mortality. Schady and Smitz (2010) assess the impact of income shocks on infant mortality in middle-income countries but are unable to draw a definitive conclusion on the signs and magnitudes of the effect of the shock on child mortality in the countries they examine. The authors reveal that infant mortality is procyclical or acyclical in all but a small number of countries facing profound economic shocks.

Studies from Africa and other developing countries reveal a sizeable negative association between economic shocks and infant mortality. Baird et al. (2011) report that short term fluctuations in aggregate income have a negative and significant impact on child mortality. The authors reveal that, on average, a 1% decrease in per capita GDP leads to an increase in infant mortality by about 0.24-0.40 per 1000 children born, and mortality during this period is higher in girls compared to boys. Friedman and Schady (2013) estimate that the 2008/2009 global financial crises led to about 28,000-50,000 excess infant deaths throughout Sub-Saharan Africa, with most deaths concentrated among girls.

Evidence from developing countries suggests that positive economic shocks lead to a decline in infant mortality (Benshaul-Tolonen, 2018). According to Benshaul-Tolonen (2018) the expansion of large-scale gold mines in nine Sub-Saharan African countries led to a decline in infant mortality rates by more than 50% in communities where the development of the gold mines occurred.

2.3.2 Impact on Nutrition and Anthropometric Measurements

Studies from parts of Europe and North America report mixed evidence on the impact of economic shocks on child health. Schaller and Zerpa (2019) reveal that paternal rather than maternal job loss due to economic downturns, has a detrimental effect on child health, particularly among children in low-socioeconomic status families. Page et al. (2019) report that improvements in maternal employment opportunities are associated with adverse child health outcomes, as women are more likely than men to substitute time in the labour market directly for time spent with children. According to Stillman and Thomas (2008), the 1996-1998 economic crises that occurred in Russia had no significant effect on the nutritional status of both adults and children. The authors attribute this to households switching from more expensive to less expensive sources of calories within food categories.

In Asia and Central America, studies have shown that adverse shocks have negative impacts on the anthropometric measures for children (Foster, 1995; Liu and Zhao, 2014; Maluccio, 2005). Foster (1995) reports that children in Bangladesh experienced a decline in weight following the severe flooding that occurred within parts of the country in 1988; he further reveals that children in landless households are more vulnerable in the aftermath of floods as credit market imperfections prevented these households from smoothing their consumption. According to Liu and Zhao (2014), paternal job loss rather than maternal job loss caused by high unemployment has a direct impact on height- and weight-for-age Z scores of children. The authors argue that when mothers become unemployed, they increase their time inputs to childcare, and this alleviates the negative impact of maternal job loss on child health. They base their findings on six waves of China Health and Nutrition Survey covering the period from 1991 to 2006. Maluccio (2005) reveals that in Nicaragua, the collapse in coffee prices from 2000 to 2002 led to a significant decline in height-for-age Z scores for children living in coffee-growing regions. The author uses a rich source of panel data from Nicaragua and a difference-in-difference approach to arrive at this conclusion. Banerjee and Klasen (2018) examine the impact of mothers on child anthropometric indicators when food price shock occurs. They find that when mothers spend time on childcare during a food price shock, it significantly improves the nutritional status of children. Yamauchi and Larson (2019) report that in Indonesia, unanticipated food price increases harm the nutritional status of children that live in non-farm households; however, food-producing families are able to minimize the impact of the food price spike on child health.

Some studies from Asia, also, report a negative relationship between positive economic shocks and child nutrition. Chatterjee (2007) and Subramanyam et al. (2011) note that economic booms in India do not necessarily lead to reductions in child under-nutrition. According to Chatterjee (2007), households invest the extra income they obtained from the booming economy in extravagant lifestyles and house improvements and allocate little to no investment in child health-promoting goods. The author reveals that during the 1998 to 2006 economic boom period in India, the prevalence of wasted children in Dundahera village located in the booming Gurgaon district of Haryana increased from 5.3% to 16.7% while mothers became anemic and bore children with below-average birth weights. Subramanyam et al. (2011) use repeated cross-sectional data between 1992 and 2006 to estimate the association between economic growth at the state level and child undernutrition in India. They find an inverse association between state economic growth and the risk of undernutrition in models that did not account for time fixed-effects. In specifications that included state time fixed-effects, they find no significant relationship between state economic growth and underweight, stunting, and wasting. Jayachandran and Pande (2017) reveal that some reasons why child stunting may be more prevalent in India compared to relatively poorer countries are due to the steep birth order gradient resulting from favouritism towards the eldest sons that affect fertility decisions and resource allocation across children.

In sub-Saharan African countries, adverse exogenous shocks may represent droughts (Hoddinott and Kinsey, 2001; Jensen, 2000), commodity price drops (Cogneau and Jedwab, 2012) or a macro crisis (Carter and Maluccio, 2003; Pongou et al., 2006), and research shows that these shocks to income have a deteriorating effect on child health. It is also important to note that the findings of these studies are robust to methodology and health outcomes. In Cote d'Ivoire, Jensen (2000) uses cross-sectional data and a difference-in-difference approach to examine whether children living in geographical regions which experienced adverse weather shocks had lower investments in health and education. He finds evidence to suggest that children living in areas that experience adverse rainfall shocks have lower weight-for-height Z scores compared to other similar children. Hoddinott and Kinsey (2001) report that children from 12-24 months in Zimbabwe lose about 1.5-2cm of height in the aftermath of drought. The authors base their findings on a panel data of households residing in rural Zimbabwe. Studies have shown that economic crises in Sub-Saharan African countries negatively impact child health (Carter and Maluccio, 2003; Pongou et al., 2006) . Carter and Maluccio (2003) use household panel data from South Africa and a fixed-effects estimation approach to examine the impact of economic shocks on child health and estimate that a 1% increase in the economic loss leads to approximately 10% decline in height-for-age z-scores. According to Pongou et al. (2006), the financial crises that occurred in Cameroon in the 1990s increased the prevalence of malnutrition in pre-school children from 16 to 23%. The authors rely on pooled cross-sectional data from two waves of the Demographic and Health Surveys conducted in 1991 to 1998 to make their inference. Cogneau and Jedwab (2012) use pre- and post-crisis longitudinal data from Côte d'Ivoire to identify the causal effect of cocoa price cuts on child outcomes and they estimate that the height-for-age z-scores for children between 2 and 4 years of age living cocoa households is about 0.435 points less than those of similar children living in homes that do not produce cocoa.

According to Harttgen et al. (2013), positive shocks to gross domestic product (GDP) per capita cause only modest reductions in child under-nutrition in sub-Saharan Africa. The authors base their findings on 23 sub-Saharan African countries, at both the macro and micro levels using repeated cross-sectional data between 1991 and 2009.

In developing economies, households are unable to smooth consumption due to underdeveloped financial systems in these regions. Also, institutions face a high degree of risk for lending monies, and these pose a challenge for individuals and households to access credit during hard economic times (Carter and Maluccio, 2003; Hoddinott and Kinsey, 2001; Pongou et al., 2006). According to Foster (1995), there is a positive relationship between credit access and child health.

2.3.3 Impact of Shocks on other Health Outcomes

Ruhm (2005) uses microdata of adults collected across 34 states in the United States to support that economic downturns improve health through healthy living habits. He notes that during an economic recession, there is a decline in smoking and obesity, as well as an increase in physical activity.

Adhvaryu et al. (2019), investigate how cocoa producer price shocks in the early years of life impact mental health in later years of individuals that live in regions of Ghana that produce cocoa. The authors find that a one percent increase in cocoa producer price in early life leads to a three percent decline in the likelihood of severe mental distress in adulthood for cohorts born in cocoa-producing regions relative to those born in other regions.

This research differs from Adhvaryu et al. (2019) in several ways. First, I focus on children that are sixty months old or less. This allows me to avoid the implications child labour will possibly have on my results. I use children because their physiological appearance is easily affected by changes in their surrounding environment. Second, I use anthropometric measures as my health outcomes rather than mental health. Third, I define my treatment groups using districts in Ghana that produce cocoa, rather than the entire regions. The use of districts rather than regions allows me to know precisely how individuals in relatively smaller cocoa areas are directly affected by the farm-gate cocoa price increases.

2.4 Data Description

The main source of data for the present study is the Ghana Demographic Health Survey (DHS). [8] The DHS data is a nationally representative sample that provides information to help monitor the population and health situation in Ghana. DHS collects the data as a repeated cross-section (i.e. the same individual is not followed over the years) for each round. The surveys contain information on household characteristics as well as individual-level characteristics. More importantly, they contain information on health and nutritional status for children 0-5 years old. The DHS data also has sample weights that can be used to produce population-representative estimates.

At the time of this study, DHS had conducted five rounds of surveys in Ghana; 1988, 1993, 1998, 2003 and 2008. I exclude the first wave of data because it does not contain any variable that allows me to identify districts where children are located in Ghana. My analysis uses four waves of data, 1993, 1998, 2003 and 2008, during this period, the farm-gate price of cocoa increased by about 46% (See Figure 2.1). I focus on children 60 months and younger who lived in the survey communities, and for whom valid measures of height-for-age and weight-for-age z-scores can be calculated.

The DHS selects households from enumeration areas defined in Ghana's 1984 and 2000 population census. These enumeration areas are defined as clusters in the DHS data. In 1993

[8] Ghana Statistical Service, Ministry of Health [Ghana], and ICF International. 2012. Ghana Demographic and Health Survey 1993, 1998, 2003, 2008 (various) [Datasets]. Calverton, Maryland: Ghana Statistical Service, Ministry of Health, and ICF International [Producers]. ICF International [Distributor], 2012.

and 1998, households were sampled from 400 clusters, while in 2003 and 2008, households were sampled from 412 clusters across Ghana (See Figure 4.3). The Ghana DHS data also has Geographic Position System (GPS) information for all survey clusters since 1993. The GPS data contains information on specific location of each cluster within the boundaries of Ghana. Although this data is available for public use, one has to request it before it is made available. It is stored as a shapefile and can only be accessed using software packages like ArcGIS.

I rely on the GPS data to be able to identify individuals that live in cocoa districts and those that live in non-cocoa districts. The second administrative boundaries in Ghana are called districts. There were 110 districts present in 1993 and 1998. Larger districts were split into smaller ones resulting in 137 districts by 2003 and 2008. I obtain the spatial data on the location of each district within the boundaries of Ghana from the Database of Global Administrative Areas (GADM). I then perform a geospatial merge of the GPS data and the Ghana administrative boundary data in the ArcGIS software, to determine the location of each child in my sample. The ArcGIS software traces an outline of the Ghana map and all the districts within the map using the shapefiles from GADM. Next, it plots the location of each cluster [9] on the map and produces an output table linking each survey cluster to a specific district. This table is then merged with the DHS survey dataset using the cluster numbers.

Annual farm-gate cocoa prices between 1993 - 2008, is downloaded from the database of the Food and Agriculture Organization (FAO) of the United Nations. These prices are similar to those collected from the Ghana Cocoa Board. Figure 2.1 presents a graph showing the trend in farm-gate cocoa prices in Ghana from 1993 to 2018. I obtain village-level data on annual cocoa production from the Research Department of the Ghana Cocoa Board. Within each district, I aggregate all village-level production data to get the yearly cocoa production at the district-level. The GPS data provided by the DHS only allows me to identify children at the cluster level to keep the health information of the children in my sample anonymous. I aggregate the information obtained at the cluster level data to the district level to allow me

[9]DHS provides the longitude and latitude coordinates for each cluster in the GPS data

to merge this data with the rest of my data sets. I collect information on district size from the district reports released by the Ghana Statistical Service.

2.5 Descriptive Statistics

All children used in this study are aged 60 months and below. For children in these age groups, the World Health Organization (WHO) suggests the use of either Height-for-Age Z-scores (HAZ), Weight-for-Age Z-scores (WAZ) or Weight-for-Height Z-scores (WHZ) when measuring their nutritional status. HAZ scores measure investments to nutritional status for longer time horizons. For example, a HAZ score of minus one means that the child's height is one standard deviation below the median height of similar children of the same sex and age. A HAZ score of below minus two is classified as stunted. WAZ score measures short-run variations in nutritional status. A WAZ score of minus one means that the child's weight is one standard deviation below the median weight for similar children of the same sex and age. A child with a WAZ score below minus two is considered to be underweight. HAZ and WAZ scores of below -2 are indicative of malnutrition. In this study, I use stunting ($HAZ < -2$) and underweight ($WAZ < -2$) as my health outcomes.[10] I use these measures because they correlate well with investments in child nutrition (Mei and Grummer-Strawn, 2007).

Table 2.1 presents summary statistics showing the proportion of children in my sample data that are stunted and underweight. To minimize measurement errors within my health outcomes, I only include children in my sample whose HAZ and WAZ scores fall between 5.99 and -5.99. The proportion of stunted children in cocoa districts are 33%, 36%, 43% and 41% compared to 34%, 37%, 38% and 37% for children living in non-cocoa districts for the 1993, 1998, 2003 and 2008 sample years respectively. Also, the proportion of underweight children in cocoa districts are 30%, 20%, 36% and 34% compared to 29%, 22%, 26% and 27% for children in non-cocoa districts for the years 1993, 1998, 2003 and 2008 respectively.

[10] I do not use WHZ scores as an outcome measure because both WAZ and WHZ measure short term investments in health.

In Table 2.1, I also show the proportion of children in both cocoa and non-cocoa districts vaccinated for Bacillus Calmette–Guérin (BCG), Diphtheria Tetanus and Pertussis (DPT), Measles and Polio in my sample years. In the survey data, mothers of children in my sample were asked to indicate all the vaccinations that their children had received from birth. The information on vaccinations was directly obtained for a child with the full consent of their parents. For each sample year and each child, 1 is recorded for each vaccination type if a child is found to have been vaccinated at least once for that vaccination type. I observe from my summary statistics that across my sample years, the proportion of children in cocoa districts vaccinated for BCG and Polio was higher than those in non-cocoa districts. Except for 1993, the percentage of children vaccinated for DPT was higher in non-cocoa areas than those in cocoa areas. Also, except for 1993, the percentage of children vaccinated for measles in the remaining sample years was higher in cocoa districts than those in non-cocoa areas.

Table 2.2 provides summary statistics of the households, maternal, and child characteristics. The average household size across all periods is about six individuals per household. On average, approximately 75% of household heads are male, and the average age of household heads is about 40 years across all sample years. The variable "toilet facilities" takes a value of 1 when respondents report that they have flush toilets or a ventilated improved pit latrine in their homes, and 0 when they do not have flush toilets. Conventional alternatives to flush toilets include unventilated pit latrines and bucket latrines. Across my sample years, about 50% of surveyed households have either a flush toilet or ventilated improved pit latrines facilities. The remaining 50% use either a bucket or regular pit latrines, or have no toilet facilities. The variable "the water source" takes the value of 1 when survey respondents report that their water source is via the tap, and 0 when they report otherwise. Alternative sources of water may include wells, boreholes, rivers, streams and unprotected springs. From 1993 through 2003, about 20% of respondents reported that water source for their households was through taps, and in 2008, 76% of respondents indicated that their drinking water was from the tap.

In Table 2.2, I also report the characteristics of surveyed females and children used in this study. The average age of females across my sample period is approximately 30 years, and they have an average of about four years of formal education. On average, four under-five children have been born to females in each of my sample periods. The proportion of boys to girls across my sample years is about 50%, and the average age observed for surveyed children is about 24 months. In 1993 the duration of breastfeeding and the number of antenatal visits was 14 months and five trips, respectively. From 1998 to 2008, however, the average length of breastfeeding and the number of prenatal visits increased to 18 months and seven visits, respectively.

2.5.1 Treatment Buffer and Control Districts

The unit of analysis in this study is child. The treatment and control districts are defined using cocoa production per district size, which is the annual amounts of cocoa produced by each district divided by their respective sizes. I generate a scatter plot of districts on production per district size to reveal the sharp contrasts in production among areas, which allows me to establish a cut-off point to define my treatment, control and buffer districts. My scatter plot indicates clustering at 0 tons per square kilometre and sparse observations between 0 and 5 tons per square kilometre. Based on this distribution, I set the following cut-offs: treatment districts produce more than 5 tons of cocoa per square kilometre, buffer districts generate between 0 and 5 tons per square kilometre, and control districts do not produce cocoa.

I drop districts with regional capitals since these districts tend to have substantial populations. These districts are removed to ensure that the average number of inhabitants in the treatment and comparison districts are approximately equal. According to Marchand (2012), dropping areas with large populations also enables me to get an appropriate comparison group for my treatment. Also, the buffer districts ensure that districts do not switch between treatment and comparison districts over my sample years. Also, I define all districts adjacent to my treatment districts as buffer districts. In Figure 2.2, I show the treatment, buffer and control districts in Ghana based on my treatment definition.

2.6 Empirical Methodology

I estimate the impact of the cocoa price boom on child health using a Linear Probability Model (LPM).[11] I use an LPM for two reasons; first, my dependent variables are binary and second, the coefficients obtained from an LPM are easy to interpret. The problem with the LPM is that in some cases, it predicts probabilities outside the bounds of 0 and 1. However, according to Wooldridge (2002), "if the main purpose is to estimate the partial effect of the independent variable on the response probability, averaged across the distribution of the independent variable, then the fact that some predicted values are outside the unit interval may not be very important."[12] In this study, I am only interested in how my variable of interest affects my outcome variable, and since my variable of interest lies within 0 and 1, my coefficient estimates are unbiased. I address the problem of heteroskedasticity that is often associated with the estimation of an LPM by using robust standard errors in my estimated models.

I estimate the LPM in Equation 2.1 below.

$$H_{idt} = \alpha + \beta T_i + \gamma I[t = 2003, 2008] + \delta(T_i * I[t = 2003, 2008]) + \mathbf{X}'_{\mathbf{idt}}\eta + \theta_{dt} + \varepsilon_{idt} \tag{2.1}$$

where H_{idt} is an indicator variable for whether or not child i in-district d at time t is stunted [13], or underweight [14] H_{idt} takes the value 1 when a child is stunted (i.e. $HAZ < -2$), and 0 otherwise. In a separate model, H_{idt} takes the value of 1 when a child is underweight (i.e. $WAZ < -2$), and 0 otherwise. T_i indicates the treatment districts, $I[t = 2003, 2008]$ is an indicator function that takes the value of 1 for the periods in 2003 and 2008 and 0 for periods in 1993 and 1998. δ_{dt} is my coefficient of interest. It represents the probability that a child is stunted or underweight and lives in a cocoa district compared to a child living in a non-cocoa district during the price boom period. $\mathbf{X}_{idt}$ is a vector of control variables,while θ_{dt} is

[11] Alternatively I could use a logit or probit model.

[12] Wooldridge, J. M. (2002). Econometric analysis of cross section and panel data MIT press. Cambridge, MA, 108., p.455

[13] Stunting is when the HAZ score of a child is less than -2.

[14] Underweight is when the WAZ score of a child is less than -2.

the district time trend. My model is estimated using the sample weights provided, and the standard errors are clustered at the district level.

In my baseline model, I control for child characteristics such as gender, age (in months), birth order, parental characteristics such as mother's age, years of formal education, total number of children born to mother and household characteristics such as age and gender of household head, family size, and household wealth measured by the wealth index. I control for genetics and background endowment of the child using height-for-age and weight-for-age of the mother. Finally, I control for community characteristics using the availability of a toilet facility and type of water source. I capture variation in child health caused by geographical differences using indicators for rural and urban areas and district fixed effects.

2.7 Baseline Results

Table 2.3 shows the results for my baseline model. Column (1) presents results for all children included in my sample. I explore heterogeneity among subgroups of children in my sample and report the results in the remaining columns. In columns (2) and (3), I show the impact of the price boom on the health outcomes of all boys and girls. I divide my sample into different subgroups based on gender and age (children aged above 24 months and below 24 months), and investigate how the price boom affects health outcomes for children in each of these subgroups. I report these results in columns (4) and (5). In columns (6) to (9), I present results for different gender age groups.

In Table 2.3, I show that there is a procyclical relationship between the 1993-2008 farmgate cocoa price boom and stunting for children living in cocoa areas of Ghana. The cocoa price boom led to a 39% points differential increase in the probability of stunting among children in cocoa districts compared to those in non-cocoa districts. The relative increase in the probability of stunting among children in cocoa districts is consistent across all sub-groups of children. The cocoa price boom differentially increased the probability of stunting in all girls in cocoa districts by 41% points compared to girls in non-cocoa districts. The differential change in the probability of stunting in all boys increased by 56% points compared to similar boys in comparison districts. For all children above and below 24 months, the probability of stunting differentially increased by 23% and 53% points respectively compared to similar children in the comparison group. The probability of stunting in boys above and below 24 months differentially increased by 18% and 95% respectively compared to boys in similar age cohorts in the comparison group. Finally, the probability of stunting in girls above and below 24 months differentially increased by 44% and 45% points respectively compared to girls in similar age cohorts living in comparison districts.

Table 2.3 presents results showing the impact of the farm-gate price boom on underweight. I find that during the price boom period, underweight was more prevalent among children living in cocoa areas of Ghana compared to those in non-cocoa areas. The evidence suggests that there was on average a 11% points differential increase in the probability of children being underweight in cocoa areas compared to those in non-cocoa areas. The rise in the probability of being underweight among children in cocoa districts is consistent across all subgroups of children except boys under 24 months. During the cocoa price boom, probability of being underweight in all boys and girls in cocoa districts increased by 18% and 8% points respectively compared to similar children in non-cocoa areas. For children living in cocoa districts, the probability of being underweight in those above and below 24 months increased by 14% and 4% points respectively compared to those in non-cocoa districts. Also, while I find no evidence to suggest that the cocoa price boom had any significant impact on the weight of boys 24 months and below, there is evidence to suggest that the probability of being underweight increased for boys over 24 months living in the cocoa district compared to those living in non-cocoa areas. Lastly, during the price boom, I also observed a differential increase in the probability of being underweight among girls 24 months and below and those above 24 months by 9% and 4% points respectively compared to those in non-cocoa districts.

The results from my analysis reveal that a procyclical relationship exists between a farm-gate cocoa price increase and child malnutrition. My finding is consistent with Miller and Urdinola (2010) and Harttgen et al. (2013). Miller and Urdinola (2010) reports that the fluctuations in coffee prices that occurred in the 70s had a procyclical effect on child mortality in Colombia. Harttgen et al. (2013) reports that in Sub-Saharan African countries, economic booms are often associated with an increase in the likelihood of being stunted and underweight.

2.8 Mechanisms

A farm-gate cocoa price boom affects child health through an income and substitution effect. The relative strength of the income or substitution effect determines whether child health improves or deteriorates.

2.8.1 Household Wealth

According to Tucker and Sanjur (1988), opportunities that lead to income generation for households tend to have positive pay-offs for child welfare provided there is adequate substitute care.

To investigate the impact of the cocoa price boom on household income, I use data from the DHS survey and use the wealth index provided in the dataset as a proxy for household wealth. The wealth index is a composite measure of a household's cumulative living standard. It is calculated using data on a household's ownership of assets, such as televisions and bicycles, housing construction materials, and types of water access and sanitation facilities. The wealth index is a good representation of a households' wealth in Ghana since most cocoa farmers and other individuals who engage in similar activities prefer to hold assets rather than cash.

To examine the impact of the cocoa price boom on household wealth, I estimate the model in Equation 2.1 and make the following modifications. H_{idt} is a continuous measure that represents the logarithm wealth index. My vector of controls, $\mathbf{X}_{idt}$, includes the age and sex of the household head, household size, and whether the household is situated in a rural or urban area. My model is estimated using the sample weights provided, and the standard errors are clustered at the district level. Table 2.4 presents results to support that there is a positive and significant impact of the cocoa price boom on household wealth in cocoa areas relative to those in non-cocoa areas. During the boom, household wealth differentially increased by 13% points in the cocoa districts relative to non-cocoa districts. The increase in household wealth during the price boom period allows cocoa households to increase their consumption in all goods, including child health-promoting goods.

2.8.2 Time Allocation

An increase in the farm-gate cocoa price increases the opportunity cost of leisure, particularly for individuals living in cocoa, producing households. If the increase in labour demand led to an increase in employment for mothers living in cocoa areas, then it is likely that employed mothers during the price boom may have substituted time-intensive child health-promoting activities for work. If the cost of substituting childcare for work exceeds the benefits brought about by household wealth, then child health will deteriorate. However, if the benefit derived from an increase in household wealth outweighs the cost of time spent away from children, then the child health will improve.

I hypothesize that the 1993 - 2008 cocoa price boom resulted in an increase in labour demand in cocoa areas of Ghana, and this consequently led to a decline in leisure during the same period. To test this hypothesis, I estimate a regression model to determine how mothers allocated their time between work and leisure during the 1993-2008 period. First, I investigate maternal labour participation in cocoa areas of Ghana following the cocoa price boom. Then I examine how the price boom affected maternal behaviours, which possibly have long term health consequences on children. I focus on activities such as breastfeeding, antenatal care and vaccination[15] [16]. While there is no monetary cost attached to these activities, they can be very time-consuming.

[15]In 1998, prenatal care was free for all pregnant women through the Safe Motherhood Program. In 2003, this program changed to become the Free Maternal Delivery Policy, which continued to administer free maternity services to all pregnant women. In 2007, Ghana implemented the National health insurance scheme, which exempted pregnant women from paying a premium but allowed them to receive free maternity services.

[16]Ghana has maintained a policy of free immunization against the six childhood killer diseases. National EPI Policy is that each child should receive one dose of BCG at birth, three doses of DPT, (at 6, 10 and 14 weeks), four doses of OPV (at birth, 6, 10 and 14 weeks) one dose of measles (at 9 months) and one dose of yellow fever (at 9 months). Every woman of childbearing age (12-44 years) should receive five doses of tetanus toxoid.

Maternal Labour Participation

Studies have shown that an increase in maternal employment affects breastfeeding[17], antenatal visits[18] and vaccination[19], and these consequently have a negative impact on child health (Ruhm, 2000b; Blau et al., 1996). To assess the causal impact of the cocoa price boom on maternal labour participation in cocoa areas, I use the model in Equation 2.1 with modifications to the outcome measure and the vector of controls. H_{idt} is a binary indicator function that represents whether or not a mother is employed, and my vector of controls $\mathbf{X}_{idt}$, include the mother's age, years of education, whether or not she is married, household size and the location of the household.

My results show that, during a cocoa price boom, there is a 9% points differential increase in the probability of mothers in cocoa areas getting employed compared to similar mothers in non-cocoa areas (See Table 2.4).

Breastfeeding and Antenatal Care

I use the DHS data to assess the impact of the cocoa price boom on maternal behaviour in cocoa growing areas towards breastfeeding and antenatal visits. The DHS survey asks respondents a comprehensive set of questions on the breastfeeding habits of mothers, as well as their attitude towards prenatal activities. Mothers of surveyed children provided details on the duration of breastfeeding up to the time of weaning. Other specific questions asked were the number of times mothers visited health centres for antenatal care before childbirth. To examine the impact the cocoa price boom had on these maternal behaviours, I estimate the model in Equation 2.1 with modifications to the outcome measure and the vector of controls. My outcome variable H_{idt} is continuous and represents months of breastfeeding and the number of antenatal visits. My vector of controls $\mathbf{X}_{idt}$ include the mother's age, mother's education, number of children under five years old, age of household head and household wealth.

[17]Ryan et al. (2006), Baker and Milligan (2008), and Mandal et al. (2010)
[18]Miles-Doan and Brewster (1998)
[19]Becker et al. (1993) and Ueda et al. (2014)

Table 2.4 presents my regression results from my estimated models. The impact of the cocoa price boom on breastfeeding is negative and significant at the 10% level. I find evidence to suggest that during the cocoa price boom, the duration of breastfeeding in cocoa districts declined by about 26 days compared to non-cocoa areas. Also, the 1993-2008 farm-gate cocoa price boom had a negative and significant impact on the number of times mothers visited health centres for antenatal services. During the price boom, the average number of prenatal visits in cocoa areas decreased by about two visits compared to those observed in non-cocoa areas. I infer from my results that, the decline in the duration of breastfeeding and antenatal visits can be attributed to the increase in female labour participation during the boom period. This finding is consistent with studies by (Ryan et al., 2006; Baker and Milligan, 2008; Mandal et al., 2010; Miles-Doan and Brewster, 1998). It also aligns with Ramirez et al. (2012), who report that there is a significant and positive relationship between antenatal care and child malnutrition. In Ghana, users of prenatal services are not required to pay fees for this service. I can, therefore, rule out the effect of high user fees as the cause of the negative impact. In sum, the declines in the duration of breastfeeding and the number of antenatal visits account for some reasons why I observe an increase in stunting and underweight during the cocoa price boom period.

Vaccinations

Some studies have shown that vaccinations have positive long-term health impacts on children (Bloom et al., 2005). Anekwe and Kumar (2012) report that vaccination reduced stunting among Indian children by about 22-25% points. In Ghana, parents are not charged service fees when their children get vaccinated. However, the travel and long wait times spent in health centres are some of the reasons working parents get discouraged from getting their children vaccinated[20].

This study assesses the impact a farm-gate cocoa price boom has on vaccinations in cocoa areas of Ghana. I estimate Equation 2.1 and make the following modifications; H_{idt} is a binary indicator variable that takes the value of 1 when a child is vaccinated for an

[20]See Ghana (2003) for discussion on immunization challenges in Ghana

immunizable disease [21] and zero otherwise. My vector of controls includes mother's age, mother's education, number of children under five years old, age of household head, household wealth and the district time trends.

Table 2.4 presents the results of the impact of the cocoa price boom on vaccinations. The impact of the farm-gate cocoa price boom on vaccinations for polio and DPT is not statistically significant. However, the price boom led to a differential decline in the probability of children in cocoa areas being vaccinated with Measles (11% points) and BCG (28% points) compared to children in non-cocoa districts. This finding is consistent with Miller and Urdinola (2010), who report that the coffee price increase that occurred in Colombia in 1997 caused a decline in the likelihood of children being vaccinated. Based on my results, I can attribute the differential increase in stunting and underweight of children in cocoa areas to the declines in vaccination during the price boom period.

2.9 Robustness Checks

2.9.1 Pre-shock Trends

In Figure 4.4, I present a graph to show that before the farm-gate cocoa price boom, there was no significant difference in the proportion of children that were stunted and underweight in both cocoa and non-cocoa areas. I use the 1993 and 1998 waves of the DHS data to test whether there were existing trends in stunting and underweight for the children in cocoa areas before the cocoa price boom. I hypothesize that if trends existed before the boom, then these trends may contribute to explaining what I observe during the boom period. To investigate the existence of pre-shock trends, I estimate Equation 2.1 and make the following modifications. I replace $I[t = 2003, 2008]$ with $I[t = 1998]$ which is an indicator function that takes the value of 1 for observations in 1998, and zero otherwise. I define all other variables similar to those in the baseline equation.

In Table 2.5 I present results to show that prior to the farm-gate cocoa price boom, there were no existing trends in stunting and underweight (with the exception of girls above 24

[21] Due to data availability, I focus on the four vaccinations DPT, BCG, Measles, Polio.

months) among children living in cocoa growing districts compared to those in non-cocoa districts.

2.9.2 Alternate Treatment Definitions

The baseline results in Table 2.3 are obtained using the treatment definition based on cocoa production per size of the district. However, I note that some districts may be sparsely populated, and the normalization based on district size may not be representative of how the cocoa price boom impacts individuals. For this reason, I use an alternative definition for my treatment districts based on production per person. I compute production per person by dividing the annual cocoa produced in each district by the estimate of the district population. The district population for the 1998 and 2003 years is estimated using the 2000 population census, while those of the years 2008 are estimated using data from Ghana's population and housing census conducted in 2010. Based on the distribution of production per person in each district, districts with more than 40 tons of production per 1000 persons are classified as the treatment districts, those with zero production are control districts and those with ratios between 0 to 40 tons per 1000 persons are buffer districts. Table 2.6 presents the coefficient estimates from my estimated model when my treatment is defined using production per person. Comparing these coefficient estimates to those from the baseline results show that the impact of the cocoa price boom on stunting and underweight is similar in sign and magnitude to those produced by the baseline regression.

While cocoa production per person may be a good indicator of the size of the production concerning the population size, it may be insufficient to assess the share of the population that is truly affected by cocoa production. Some may suggest that in some districts, only a small number of farmers produce large amounts of cocoa, which may be less relevant for development outcomes on more extensive parts of the population. As a result, I construct another alternative treatment definition based on the share of households engaged in cocoa production. The GLSS questionnaire asks respondents in farming households "specific farming activity they are engaged in." This information allows me to estimate the proportion of cocoa farming households within a district. Upon obtaining the percentage of households that produce cocoa within each area, I create a scatter plot to enable me to set the cut-off for my treatment districts. Based on the distribution from the scatter plot, I classify districts with over 10% of households engaged in cocoa farming as treatment districts. Districts with 5% to 10% of families involved in cocoa activities are buffer districts and those with less than 5% of households engaged in cocoa activities as controls. Survey weights provided in the data are applied to enable me to generalize my inference at the population level. I report results under this treatment definition in Table 2.6. I find that the impact of the 1993-2008 cocoa price boom on the differential change in the probability of stunting and underweight produces results that are consistent with results produced under the baseline definition of treatment districts.

2.9.3 Exclusion of Gold Mining Districts

Gold mining is a prevalent occupation in Ghana. During the cocoa price boom period, gold prices were experiencing a similar boom. To determine whether the gold price boom had any impact on child health, I drop all districts where major mining activities occur [22], and estimate Equation 2.1 using the baseline treatment definition.

In Table 2.7, I show results that exclude districts in Ghana where major gold mining activities occur. My results suggest that there is no significant difference in sign and magnitude between the model coefficients when cocoa districts with mining towns are dropped. After dropping the mining districts from my model, I observe that during the cocoa price boom, there was a differential increase in the probability of stunting and underweight by 38% and 11% points respectively between children in cocoa areas and those in non-cocoa areas. The differential change in stunting and underweight are similar in sign and magnitude to those observed in my baseline results, 39% and 11% points respectively.

[22] The six major mining towns identified are Ahafo Mine, Chirano Gold Mine, Damang Mine, Iduapriem Gold Mine, Obuasi Gold Mine, Tarkwa Mine.

2.9.4 Exclusion of Urban Children

Cocoa is typically produced in the rural areas of Ghana, which means that a large number of children in the treatment districts are those from the rural areas of Ghana. In this study, I ensure that children in the treatment and control areas are comparable by dropping all districts with larger populations and those with district capitals. While all this helps to make the children in the treatment and control areas comparable to each other, one can argue that the physical characteristics of children in urban areas might differ from those in rural areas due to the differences in environmental characteristics. [23] To account for the differences in geographical location, I drop all children in urban districts and estimate Equation 2.1 using the baseline treatment definition.

Table 2.8 shows results when all urban districts are excluded from my sample. I find that while there is consistency in the signs of the coefficients from the current model and the baseline model, the magnitude of coefficients in the current model, are generally larger than those produced by the baseline model, except boys older than 24 months. After dropping children in urban districts, I find that during the cocoa price boom period, there was a differential increase in the probability of stunting by 52% points in cocoa areas. Also, the probability of underweight differentially increased by 26% points for children in cocoa areas compared to those in non-cocoa areas.

2.10 Other Potential Factors

2.10.1 Migration

During a cocoa price boom, individuals may migrate into cocoa districts to take advantage of the employment opportunities. All else equal, migration into cocoa districts may result in an oversupply of labour and consequently lead to lower wages. The lower wages caused by migration may dampen or eliminate any income effect that may result from the cocoa

[23] In urban areas, there is easy access to basic amenities such as running water, flush toilets, electricity and social infrastructure such as hospitals,

price boom. To investigate the migration patterns between cocoa and non-cocoa districts in Ghana, I use data from the 4th and 6th rounds of the GLSS. [24]

In Figure 4.5A, I show that between 1998 and 2012, the proportion of individuals that migrated into cocoa areas due to work-related reasons increased by about 2% points while those that migrated to non-cocoa areas declined by approximately 1% point. If individuals are migrating from non-cocoa districts to cocoa districts due to work reasons, then I expect that the distribution of labour force in both districts would change to reflect the migration patterns. Figure 4.5B, shows that between 1998/99 and 2012/13, the relative proportions of the labour force increased from 46.41% to 61.41% points in cocoa districts and 49.89% to 62.05% points in non-cocoa areas. Based on the statistics presented, the relative growth in the labour force in these two geographical areas does not support the argument that individuals migrated from non-cocoa districts to cocoa districts.

To further investigate whether the cocoa price boom had any impact on migration, I estimate the following model.

$$M_{dt} = \alpha + \beta T_d + \gamma I[t = 2012] + \delta(T_d * I[t = 2012]) + \theta_{dt} + \varepsilon_{dt} \tag{2.2}$$

The unit of analysis for Equation 2.2 is district. M_{dt} is my outcome variable, migration. It measures the proportion of individuals who moved away from the district due to work-related reasons, relative to the total number of individuals living in the districts. I also measure migration using the change in the labour force as a proxy. The proportion of labour force in-district d at time t relative to the total number of individuals living in the district is compared for cocoa and non-cocoa districts. T_d indicates the treatment districts, $I[t = 2012/13]$ is an indicator function that takes the value of 1 for observations in 2012/13 and 0 otherwise,δ_{dt} is my variable of interest, which represents the differential change in my outcome variables for persons living in cocoa areas compared to those in non-cocoa areas of Ghana. θ_{dt} is the district fixed effects.

[24]The 4th and 6th rounds of the GLSS surveys occurred in 1998/99 and 2012/13 respectively. I use these years because they captured the period when the boom occurred. The GLSS questionnaire also asks survey respondents their reason for migrating into their current place of residence.

Table 4.3 shows results from Equation 2.2. Columns 1-6 present the impact of the cocoa price boom on migration. The results reveal that the cocoa boom had no significant impact on migration. Among the many reasons why the cocoa price boom failed to have any impact on migration is due to the communication barrier (Hagopian et al., 2005; De Brauw et al., 2014) and the cost of travel between districts due to poor road networks (De Brauw et al., 2014). According to De Brauw et al. (2014), the strong social ties in the rural communities provide a safety net in the absence of functioning insurance and credit markets and could serve as a barrier to migration between districts.

2.10.2 Fertility

If the cocoa price boom causes households to choose the time to have children, then children born at the time of the price boom may be self-selected into my sample; this results in bias coefficients[25] since my samples will not be representative of the population I seek to investigate. I use the GLSS survey data to investigate the impact of the cocoa price boom on fertility. The GLSS data asks respondents survey questions about their place of birth. I use this information to compute the proportion of children under ten years born before the boom and during the boom.

In Figure 4.5C, I present statistics to show that the cocoa boom did not significantly change the composition of children born in cocoa and non-cocoa districts. Before the price boom, 0.05% and 0.18% of residents in cocoa and non-cocoa districts respectively were ten years or younger. During the boom, 10.41% and 10.80% of residents in cocoa and non-cocoa districts respectively were ten years or younger. So while there is a significant increase in the composition of children ten years and younger during the boom, the same trend is observed in both cocoa and non-cocoa districts. Further, I investigate the causal impact of the cocoa boom on fertility by estimating Equation 2.2. I report the results in columns 7,8,9 in Table 4.3. The results indicate that the cocoa price boom had no significant impact on fertility.

I further assess the impact of the cocoa price boom on fertility by estimating my baseline equation, Equation 2.1, on a sample of first time mothers. I hypothesize that if the impact of

[25]Heckman (1979).

the price boom on children born to first time mothers produces similar results to my baseline results, then the price boom did not have any effect on fertility. I present my results in Table 4.4, and reveal that the cocoa price boom led to a differential increase in the probability of stunting and underweight by 12-24% and 18-55% points respectively for children of first time mothers living in cocoa areas. I note that the impact of the cocoa price boom was statistically significant in six out of the nine cohorts of children I examined. As expected, the coefficients in Table 4.4 are smaller compared to those in my baseline results because first time mothers are more likely to give a greater level of care to their children and reduce the incidence of under-nutrition than mothers with two more more children.

2.11 Conclusion

This research measures the impact of the 1998-2008 farm-gate cocoa price boom on the differential change in the probability of stunting and underweight for children living in cocoa districts compared to those in non-cocoa districts of Ghana. I find evidence to show that, the farm-gate price boom led to a differential increase in the probability of stunting and underweight by about 39% and 11% points respectively for children in cocoa districts compared to those in non-cocoa districts. I also explore the mechanisms through which the farm-gate cocoa price increase affect child health, and find that during the price boom period, there was a differential increase in household wealth by about 13% points in cocoa districts compared to non-cocoa districts. Also, a 9% points differential increase in female labour participation in cocoa areas subsequently led to declines in breastfeeding and antenatal visits by about 26 days and 2 visits respectively. The was also a differential decline in the probability of children who were vaccinated for measles and BCG during the farm-gate price boom period.

In this research I argue that households in cocoa areas benefited financially from the price boom and possibly made investments towards child health-promoting goods. However, this did not compensate for the loss in child health caused by declines in child care intensive activities such as breastfeeding, antenatal visits and vaccinations.[26] I draw on the theoretical framework presented in Dehejia and Lleras-Muney (2004) and Ferreira and Schady (2009)

[26] I maintain the assumption in this study that mothers are primarily responsible for raising their children.

and note that during the farm-gate price boom, the substitution effect exceeded the income effect and led to a decline in child health.

The results in this research are consistent with Miller and Urdinola (2010) and Harttgen et al. (2013). This study contributes to the growing body of evidence on the relative importance of time and income in determining the health outcomes of children during periods of a commodity price boom.

Findings from this research have implications on policy. First, it reveals that while a farm-gate cocoa price increase has positive economic implications in cocoa producing areas, it also presents challenges of child malnutrition in areas of Ghana that produce cocoa. Second, it highlights that during farm-gate cocoa price booms, publicly funded health programs such as antenatal and immunization services offered at health centers in cocoa areas may not be fully utilized by their intended targets. Finally, stunting in early life results in reductions in lifetime earnings and, consequently, loss of productivity (Shekar, 2013; Galasso and Wagstaff, 2019; Himaz, 2018).

2.12 Figures

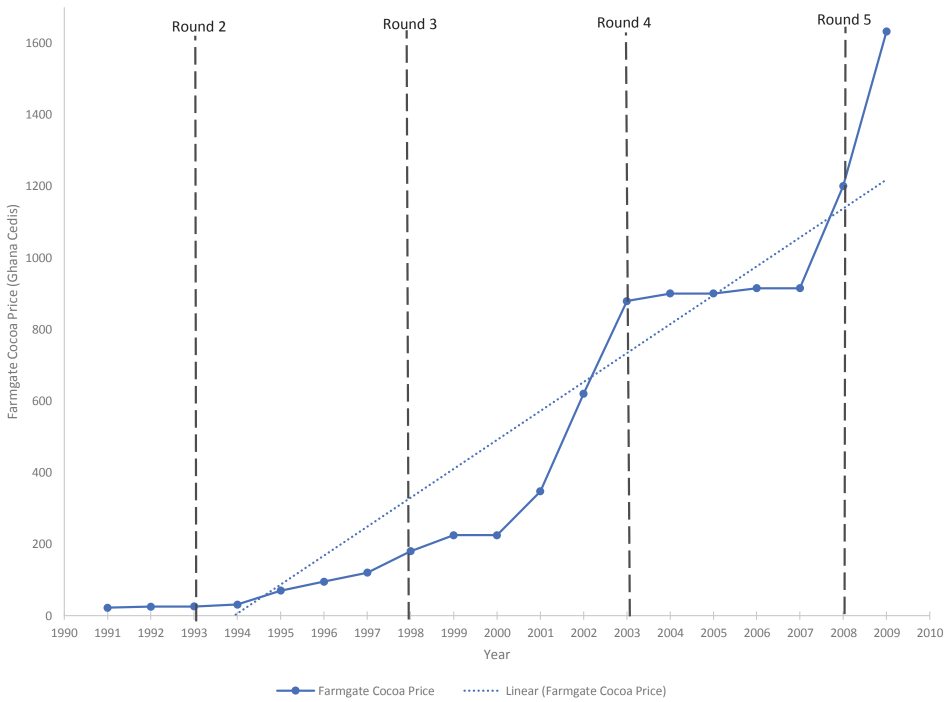

FIGURE 2.1: Historical Trend in Ghana's Farm-gate Cocoa Prices (1990/1991-2010/2011)

Notes: Graph shows the trend in farm-gate price of cocoa from 1990/1991-2010/2011. *Source:* Authors own calculation based on historical farm-gate cocoa price data from Ghana Cocoa Board. The producer prices indicated on the graph is the farm-gate per tonne of cocoa beans paid by Licensed Buying Companies to all cocoa farmers in Ghana

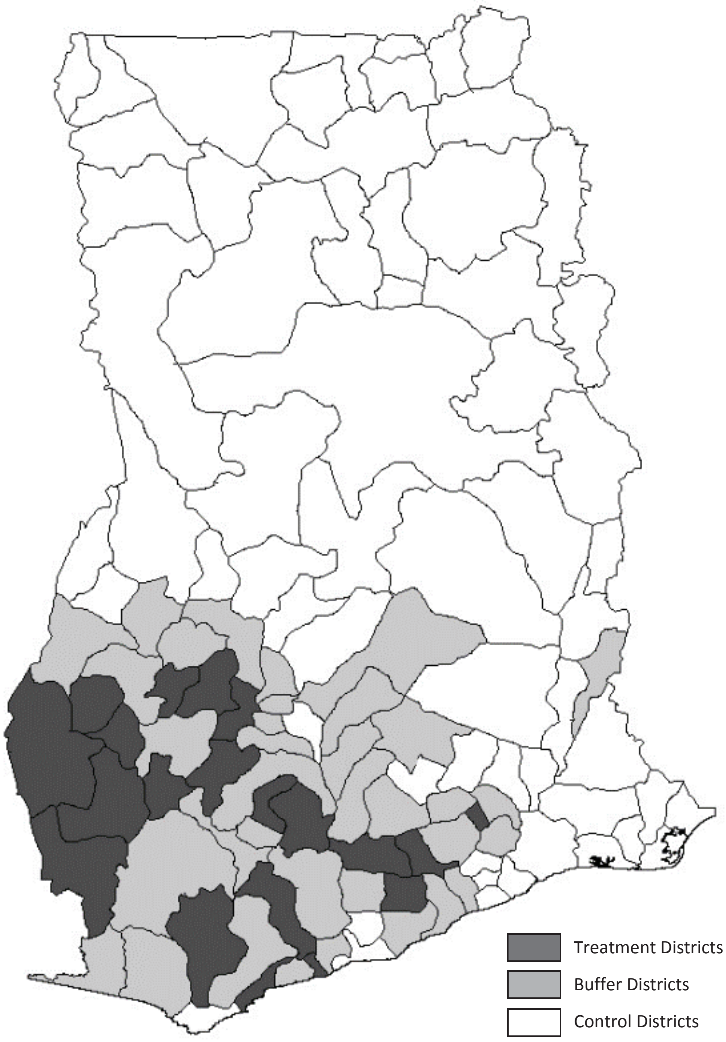

FIGURE 2.2: Treatment, Buffer and Control Districts

Notes: Map presents treatment and control areas districts based on cocoa production per district size. The darker shades are the treatment districts, the lighter shades are buffer districts and the white areas are control districts.*Source:* Authors own calculation, created and imported from ArcGIS.

2.13 Tables

TABLE 2.1: Summary Statistics: Health Outcomes and Vaccinations

	Cocoa Districts							
	1993		1998		2003		2008	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Health Outcomes								
Proportion of Stunted Children	0.33	0.47	0.36	0.48	0.43	0.47	0.41	0.46
Proportion of Underweight Children	0.30	0.46	0.20	0.40	0.36	0.36	0.34	0.35
Vaccinations								
Received bcg	0.76	0.43	0.86	0.32	0.82	0.33	0.87	0.25
Received dpt	0.55	0.50	0.34	0.47	0.26	0.44	0.23	0.42
Received measles	0.45	0.50	0.66	0.47	0.62	0.47	0.60	0.42
Received polio	0.46	0.50	0.66	0.48	0.77	0.42	0.75	0.44
Observations	1,105		1709		1636		1520	
	Non-Cocoa Districts							
Health Outcomes								
Proportion of Stunted Children	0.34	0.47	0.37	0.48	0.38	0.49	0.37	0.46
Proportion of Underweight Children	0.29	0.45	0.22	0.43	0.26	0.44	0.27	0.37
Vaccinations								
Received bcg	0.74	0.44	0.85	0.36	0.84	0.37	0.91	0.28
Received dpt	0.54	0.50	0.37	0.48	0.35	0.48	0.24	0.43
Received measles	0.46	0.50	0.64	0.48	0.64	0.48	0.74	0.44
Received polio	0.46	0.50	0.62	0.49	0.65	0.48	0.73	0.45
Observations	1,105		1709		1636		1520	

Notes: Estimates are based on Ghana Demographic Health Survey (DHS) for the years 1993, 1998, 2003 and 2008. Sample weights are used in estimation.

TABLE 2.2: Summary Statistics: Child, Maternal and Household Characteristics

	1993		1998		2003		2008	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Household Characteristics								
Household Size	5.98	3.03	6.25	2.93	6.60	3.03	6.38	2.97
Wealth Index	-0.28	0.71	-0.54	0.68	-0.50	0.61	-0.56	0.84
Sex of Household head	0.71	0.46	0.77	0.42	0.81	0.39	0.78	0.41
Age of Household head	39.02	13.06	41.67	13.95	42.40	14.15	40.74	13.27
Toilet Facilities	0.55	0.50	0.46	0.50	0.47	0.50	0.42	0.49
Water Source	0.22	0.42	0.19	0.40	0.17	0.38	0.76	0.43
Maternal Charateristics								
Age	29.02	6.94	30.45	7.25	30.34	7.22	30.58	7.16
Years of education	3.84	4.35	2.90	4.16	2.89	3.99	3.54	4.30
Employed	0.81	0.39	0.82	0.39	0.89	0.31	0.89	0.31
Total Children Ever Born	3.77	2.25	4.03	2.45	4.01	2.42	3.92	2.35
Child Charateristics								
Birth order	3.69	2.25	3.76	2.42	3.82	2.40	3.63	2.32
Sex	0.51	0.50	0.48	0.50	0.51	0.50	0.51	0.50
Age (months)	16.63	10.23	28.68	17.17	23.16	14.35	28.44	17.31
Duration of breastfeeding (months)	14.01	8.99	18.83	13.03	17.82	13.81	19.93	17.57
Antenatal vistits	4.85	8.59	5.47	10.56	8.56	19.16	7.97	15.47
Observations	1,105		1709		1636		1520	

Notes: The estimates are based on Ghana Demographic Health Survey (DHS) for the years 1993,1998, 2003 and 2008. Sample weights are used in estimation.

TABLE 2.3: Baseline Results: Impact of Cocoa Price Boom on Child Health

Stunting	All	Boys	Girls	<24 Months	<24 Months	Boys<24 Months	Boys>24 Months	Girls<24 Months	Girls>24 Months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Time*Treatment	0.39***	0.56***	0.41***	0.53***	0.23***	0.95***	0.18***	0.45***	0.44***
	(0.01)	(0.04)	(0.02)	(0.02)	(0.02)	(0.08)	(0.05)	(0.04)	(0.03)
Observations	5,935	2,972	2,963	3,134	2,801	1,595	1,377	1,539	1,424
R-squared	0.13	0.15	0.16	0.18	0.15	0.24	0.20	0.22	0.20
Underweight									
Time*Treatment	0.11***	0.18***	0.08***	0.04**	0.14***	-0.06	0.33***	0.09**	0.04**
	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.04)	(0.06)	(0.04)	(0.02)
Observations	5,939	2,974	2,965	3,136	2,803	1,595	1,379	1,541	1,424
R-squared	0.08	0.10	0.10	0.11	0.12	0.16	0.15	0.16	0.17

Notes: Regression estimates for the change in stunting or wasting follow the Linear Probability Model in Equation 2.1. Data is based on the Ghana Demographic Health Survey (DHS) for the years of 1993, 1998, 2003 and 2008. Treatment districts are defined as those that produce more than 5 tons of cocoa per square kilometer. Sample weights are used in estimation.Robust standard errors in parentheses, these are clustered at the district level. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%)

TABLE 2.4: Mechanisms Through Which Cocoa Price Boom Affects Child Health

	Household Wealth (1)	Female Labour Market Participation (2)	Duration of breastfeeding (months) (3)	Number of Antenatal Visits (4)
Time*Treatment	0.13***	0.09***	-0.85*	-2.30***
	(0.00)	(0.02)	(0.49)	(0.25)
			Immunizations	
	Polio	Measles	DPT	BCG
Time*Treatment	-0.00	-0.11***	0.00	-0.28***
	(0.01)	(0.01)	(0.01)	(0.01)

Notes: Regression estimates from modified linear probability model in Equation 2.1. Data used are based on Ghana Demographic Health Survey (DHS) for the years 1993, 1998, 2003 and 2008.Sample weights are used in estimation. Robust standard errors in parentheses, these are clustered at the district level. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%)

TABLE 2.5: Pre-Shock Trends

Stunting	All	Boys	Girls	<24 Months	<24 Months	Boys<24 Months	Boys>24 Months	Girls<24 Months	Girls>24 Months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Time*Treatment	-0.01	0.04	-0.07	0.07	-0.04	0.05	0.14	0.10	-0.24
	(0.05)	(0.07)	(0.06)	(0.04)	(0.10)	(0.09)	(0.14)	(0.06)	(0.15)
Observations	2,830	1,397	1,433	1,577	1,253	795	602	782	651
R-squared	0.17	0.20	0.18	0.11	0.15	0.18	0.22	0.13	0.20
Underweight									
Time*Treatment	-0.07	-0.02	-0.12**	-0.06	-0.09	-0.06	-0.00	-0.06	-0.22*
	(0.05)	(0.06)	(0.05)	(0.05)	(0.08)	(0.09)	(0.11)	(0.06)	(0.11)
Observations	2,832	1,397	1,435	1,579	1,253	795	602	784	651
R-squared	0.10	0.12	0.12	0.12	0.13	0.17	0.18	0.17	0.19

Notes: Regression estimates for the change in stunting or wasting follow the Linear Probability Model in Equation 2.1. Data for the pre-shock trends are based on the Ghana Demographic Health Survey (DHS) for the years of 1993 and 1998. Sample weights are used in estimation.Robust standard errors in parentheses, these are clustered at the district level. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%)

TABLE 2.6: Robustness Checks: Use of Alternative Treatment Definitions

	Treatment 2 Share of cocoa Households per district		Treatment 3 District cocoa production per person	
	Stunting	Underweight	Stunting	Underweight
All Children	0.44***	0.10***	0.44***	0.10***
	(0.01)	(0.01)	(0.01)	(0.01)
Boys	0.63***	0.18***	0.63***	0.18***
	(0.02)	(0.02)	(0.02)	(0.02)
Girls	0.42***	0.04*	0.42***	0.04*
	(0.02)	(0.02)	(0.02)	(0.02)
<24 months	0.58***	0.06***	0.58***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
>24 months	0.26***	0.06***	0.26***	0.06***
	(0.03)	(0.02)	(0.03)	(0.02)
Boys<24 months	0.98***	-0.10**	0.95***	-0.10**
	(0.05)	(0.05)	(0.05)	(0.05)
Boys>24 months	0.22***	0.30***	0.22***	0.30***
	(0.04)	(0.05)	(0.04)	(0.05)
Girls<24 months	0.52***	0.16***	0.52***	0.16***
	(0.03)	(0.03)	(0.03)	(0.03)
Girls>24 months	0.37***	-0.14***	0.37***	-0.14***
	(0.04)	(0.04)	(0.04)	(0.04)

Notes: Regression estimates for the change in stunting or wasting follow the Linear Probability Model in Equation 2.1. Model is based on alternative treatment definitions.The alternative treatment districts used are; 1) Districts that have over 10% of households engaged in cocoa production (Treatment 2) and 2) Districts that produce over 40 tons of cocoa per 1000 persons(Treatment 3). Data is based on Ghana Demographic Health Survey (DHS) for the years of 1993, 1998, 2003 and 2008.Sample weights are used in estimation. Robust standard errors in parentheses, these are clustered at the district level. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

TABLE 2.7: Robustness Checks: Exclusion of All Mining Districts

Stunting	All Children	Boys	Girls	<24 Months	<24 Months	Boys<24 Months	Boys>24 Months	Girls<24 Months	Girls>24 Months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Time*Treatment	0.38***	0.56***	0.41***	0.53***	0.23***	0.98***	0.18***	0.44***	0.43***
	(0.01)	(0.04)	(0.02)	(0.02)	(0.02)	(0.08)	(0.05)	(0.04)	(0.03)
Observations	5,889	2,947	2,942	3,112	2,777	1,581	1,366	1,531	1,411
R-squared	0.13	0.15	0.16	0.19	0.15	0.24	0.19	0.22	0.20
Underweight									
Time*Treatment	0.11***	0.19***	0.08***	0.04**	0.14***	-0.05	0.33***	0.09**	0.04*
	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.04)	(0.06)	(0.05)	(0.02)
Observations	5,893	2,949	2,944	3,114	2,779	1,581	1,368	1,533	1,411
R-squared	0.08	0.10	0.10	0.11	0.12	0.16	0.15	0.16	0.17

Notes: Regression estimates are based on the Ghana Demographic Health Survey (DHS) for the years of 1993, 1998, 2003 and 2008. Treatment districts are defined as those that produce more than 5 tons of cocoa per square kilometer. Sample weights are used in estimation. Robust standard errors in parentheses, clustered at the district level. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

TABLE 2.8: Robustness Checks: Exclusion of All Urban Districts

Stunting	All Children	Boys	Girls	<24 Months	<24 Months	Boys<24 Months	Boys>24 Months	Girls<24 Months	Girls>24 Months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Time*Treatment	0.52***	0.42***	0.68***	0.56***	0.33***	0.36***	0.20***	0.56***	0.53***
	(0.02)	(0.05)	(0.02)	(0.03)	(0.04)	(0.08)	(0.07)	(0.02)	(0.06)
Observations	4,825	2,374	2,451	2,531	2,294	1,265	1,109	1,266	1,185
R-squared	0.14	0.17	0.18	0.21	0.14	0.27	0.20	0.24	0.21
Underweight									
Time*Treatment	0.26***	0.33***	0.29***	0.10***	0.33***	0.04	0.47***	0.18***	0.25***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.05)	(0.06)	(0.02)	(0.05)
Observations	4,829	2,377	2,452	2,533	2,296	1,266	1,111	1,267	1,185
R-squared	0.08	0.11	0.11	0.11	0.12	0.17	0.17	0.16	0.20

Notes: Regression estimates are based on the Ghana Demographic Health Survey (DHS) for the years of 1993, 1998, 2003 and 2008. Treatment districts are defined as those that produce more than 5 tons of cocoa per square kilometer. Sample weights are used in estimation.Robust standard errors in parentheses, these are clustered at the district level. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

Chapter 3

Distributional Impact of a Cocoa Price Boom on Welfare. Evidence from Ghana

3.1 Introduction

Cocoa is a cash crop that is grown by small farm holders in Ghana, primarily for income rather than consumption. Research suggests that about 11-20% of Ghanaian households depend on the cocoa sector for employment, and a large share of their income (Anim-Kwapong and Frimpong, 2004; ICCO, 2006; Gibson, 2007; Kolavalli and Vigneri, 2011). The high dependence of families on cocoa income makes income in these areas susceptible to fluctuations caused by the exogenous shocks on world cocoa prices. Fluctuations in farm-gate cocoa prices have implications on the welfare and on the distribution of income as this cash crop is mostly produced by the smallholder farmers (Jacks and Stuermer, 2015). In Ghana's case, fluctuations in farm-gate cocoa prices have direct impacts on residents living in the areas that produce cocoa.

A cocoa price boom will result in a positive shock to the income of cocoa producers. All else equal, this will lead to an increase in income and a decline in poverty in cocoa areas. The impact of a cocoa price boom on inequality is, however, ambiguous. This is because if every household shares equally in the gains of the cocoa price boom, then inequality will remain unaffected. If families in the lower half of the distribution benefit more than those in the upper half, I expect inequality to decline, and if families in the upper half of the distribution benefit more than those in the lower half, then inequality will increase.

In this paper, I examine the impact of a farm-gate cocoa price increase on the welfare of residents living in areas of Ghana that produce cocoa. I assess the welfare impact over two boom periods [1] and also estimate the combined price boom effect across the two boom periods. I measure how the cocoa price boom affect wage income and consumption expenditure per capita across the distribution, and also investigate the implication of the price boom on poverty and inequality for my outcome measures.

This research contributes to the existing literature in several ways. First, it documents that while a cocoa price boom in Ghana improves wage incomes and consumption of households, households benefit unequally from the gains of the farm-gate cocoa price increase. This finding motivates me to investigate the distributional impact of the price boom on welfare. I pay particular attention to landowning families and those that do not own any farmlands. Second, I combine data from the Ghana Living Standard Survey (GLSS) and administrative data from the Ghana Cocoa Board to produce a unique dataset used to document that the price shocks generally led to declines in poverty and inequality for cocoa households. This paper also adds to the literature by exploring the distributional impacts of the price shock using a natural experiment, in the case of Ghanaian cocoa prices, which has not been previously examined by studies. The Ghanaian case has the advantage of providing sharp comparisons in agro-ecological properties across districts, which allows cocoa plants to be cultivated exclusively in the southern regions. The differences across the regions and communities, along with detailed information on production, and Ghanaian households allow me to assess the implication of the cocoa price shock on the welfare of families living in areas that produce this cash crop.

In this research, I find evidence to show that the combined effect of the farm-gate cocoa price boom led to an increase in the differential change in wages and consumption of households by about 20-71% and 8-11%, respectively. The combined price boom also led

[1] The first boom occurred from 1998/1999 to 2005/2006 and the second boom, from 2005/2006 to 2012/2013.

to a differential decline in wage and consumption inequality by about 37-60% and 16-40% respectively. However, it is essential to note that the impact of the price boom on consumption inequality was only significant at the 10% level. Further, there was a 7% decline in the poverty headcount ratio for households in cocoa districts compared to those in non-cocoa districts, and households in cocoa areas who were living below the poverty line after the boom became less poor than those in non-cocoa areas. My results also reveal that there was a differential decline in the poverty gap ratio by about 4% for households in cocoa districts relative to those in non-cocoa districts. Finally, I find evidence to support that both landless and landowning households at the bottom half of the wage and consumption distribution benefited more from the gains of the price boom than those at the top half. However, landowning households were the higher beneficiaries of the price boom compared to the landless households.

3.2 Background

3.2.1 1998-2012 Cocoa Price Boom

Cocoa prices, like many other commodities, respond to supply and demand influences. One of the critical drivers of cocoa price increases on the global market post-1998 was the increase in global demand for cocoa beans. In the early 2000s, the civil unrest that followed the 1999 coup détat in Côte d'Ivoire threatened to disrupt cocoa supplies from the world's largest cocoa exporter (ICCO, 2003; ICCO, 2004). This raised fears of a shortage of cocoa beans, and as a result, world cocoa prices increased to the highest levels the world had ever experienced. The International Cocoa Organization(ICCO) also reported that the cumulative production deficits caused by the adverse weather conditions experienced in most cocoa-producing countries had also been an essential factor in the rising cocoa prices. Cocoa production was at its peak of 3.6 million metric tons in 2005/6 (ICCO, 2006), yet the supply of cocoa beans failed to meet the high global market demand. In the 2006/07 and 2007/08 cocoa season, cocoa prices on the world market rose by 19% and 36% respectively, and production deficits primarily caused these increases.

Other determinants of the global prices of cocoa beans include the ratio between stocks and grindings, corporate acquisition and disinvestment in the cocoa trade and processing industry, disease and pest infestation, availability or the lack of pesticides and fertilizers, producers withholding stocks in anticipation of higher prices and speculative trading on the futures markets (ICCO, 2007).

3.2.2 History of Farm-gate Cocoa Price in Ghana

Farm-gate cocoa prices are prices paid to cocoa producers, mostly farmers, for the sale of their cocoa beans. In Ghana, these prices are determined at the commencement of the harvest season for the entire crop year by the Producer Price Committee. This price depends on the export price expected by the Ghana Cocoa Board (COCOBOD) after selling about 70 percent of cocoa beans. From the export prices received, COCOBOD nets out their costs of operations and the export tax to arrive at what it calls "net free on board (f.o.b.) price." The share of the f.o.b price paid to farmers is what is known as the farm-gate price.

Farm-gate cocoa prices in Ghana has evolved over the years. Before the late 1970s, Ghana's cocoa sector was near collapse, primarily due to the fiscal burden placed on cocoa revenues. Also, all cocoa producers at the time had to sell the produce from their crop to one buyer who determined the price. In the early 1980s, macroeconomic reforms were passed to streamline the Ghanaian economy and boost economic growth. These reforms included a recommendation to introduce competition among purchasers of cocoa beans as well as develop a system whereby a large share of the export price of cocoa is passed on to farmers (Kolavalli and Vigneri, 2011; Gibson, 2007). The latter was to alleviate poverty in cocoa communities. Reports indicate that by the late 1980s, farm-gate prices had risen by three-fold compared to amounts paid to farmers in the late 1970s (Tollens and Gilbert, 2003; Varangis and Schreiber, 2001).

3.2.3 Land Tenure System in Ghana

In Ghana, 20% of the lands are state lands; the remaining 80% is managed through customary tenure arrangements (Larbi et al., 2004; Nolte and Väth, 2013; Boamah, 2014). Cocoa is farmed on customary lands that are administered through conventional tenure arrangements and vested in chiefs, families or other traditional authorities. The typical tenure arrangements in Ghana include allodial title, customary freehold, leasehold, share-cropping and caretaker. Two of the conventional methods commonly used by cocoa producers are share-cropping and caretakers.

There are two types of share-cropping in Ghana, “Abunu” and “Abusa” (Robertson, 1982; Vigneri, 2008). Under an “Abunu” arrangement, a share-cropper farms the cocoa farm to maturity, and the crop proceeds are shared equally between the share-cropper and the landowner. Under an “Abusa” arrangement, a share-cropper is responsible for farming and maintaining the cocoa farm to maturity. A third of the crop proceeds are given to the share-cropper, while two-thirds of the crop proceeds go to the landowner. However, the landowner is responsible for financing the farm inputs.

Sometimes caretakers are brought in after establishing the cocoa farms and paid with a portion of the crops. Caretakers, however, have no ownership claim to any part of the land and their services are terminated whenever their service is no longer required. Studies report that during times when the cost of hiring waged workers become too high, alternative forms of labour are used on cocoa farms, including sharecropping arrangements or informal labour groups known as “nnoboa” (Blowfield, 1993; Teal, Zeitlin, et al., 2006; Teal, Vigneri, et al., 2004).

3.3 Literature Review

Goderis and Malone (2011) use a two-sector theoretical growth model to explain that the time path of income inequality following a natural resource boom. According to the authors, when the labour market in the non-traded sector is filled with unskilled labour, inequality falls immediately after a boom and then increases steadily over time until the initial impact of the boom disappears. They provide empirical evidence from 90 countries to support their theory and show that their argument is most consistent with countries experiencing an oil and mineral boom. Howie and Atakhanova (2014) provide empirical evidence from

Kazakhstan to support the theoretical findings of (Goderis and Malone, 2011). Their research use household-level data across the entire income distribution, and their results show that in Kazakhstan, an increase in oil prices led to a decline in income inequality when they control for the effect of changing labour income, institutional quality, education levels, and public healthcare spending.

Reports from North America indicate that a boom in natural resources improves the standard of living of local residents through the labour market. According to Black et al. (2005) the coal boom that occurred in the counties of Kentucky, Ohio, Pennsylvania, and West Virginia during the 1970s led to an improvement in the standard of living and a decline in poverty. In similar research, Marchand (2015) exploits the variation in energy extraction intensity in Western Canada, and assesses the distributional impacts of the energy boom that occurred between 1996 to 2006. Specifically, he examines the relationship between inequality, poverty and the energy booms in Western Canada. He reports that while all individuals in oil extraction areas profited from the gains of the energy boom, the benefits of the price boom was unevenly distributed across the income and earning distribution. Marchand (2015) reveals that the energy boom increased local inequality and reduced low-income poverty, although a slight increase in relative poverty was observed. His results also showed a widening gap in local inequality for directly impacted energy extraction industries and a smaller gap for the indirectly affected industries such as construction and retail trade. He also reports that the boom slightly reduced local inequality in the sector of all services. Both Black et al. (2005) and Marchand (2015) measure the impact of the boom on their outcome variables by taking the differential change in their outcome variables between the treatment and the control areas. The difference in methodology between these two studies is that Black et al. (2005) uses the difference in annual growth rates of his outcome variables between treatment and comparison counties, whereas Marchand (2015) uses the differential change in outcome variables pre and post-boom periods.

Results from studies that have examined other positive shocks on income and earnings inequality in developed economies have been mixed. In Canada, Brzozowski et al. (2010)

reveal that despite the substantial growth in income inequality between skilled and unskilled labour force over the last three decades, taxes and transfer payments have managed to equalize this differential gap in income for these two types of workers. However, Inui et al. (2017) finds evidence to suggest that, before the 2000s, an expansionary monetary policy shock in Japan increased income inequality through a rise in earnings inequality for households with employed household heads. They also note that there is a minimal transmission of income inequality to consumption inequality.

According to Fum and Hodler (2010), the presence of natural resources raises income inequality in countries such as Mexico and Bolivia that are ethnically polarized compared to homogeneous countries like Norway. They argue that in ethnically polarized countries, there is a higher tendency for the wealth to be concentrated in the hands of small ethnic groups who are likely to indulge in rent-seeking behaviour, leading to a widening gap of inequality between the haves and have-nots.

Caselli and Michaels (2013) reveal that despite the massive amounts of oil revenues that flowed to specific municipalities in Brazil, this did not translate into any significant gains in the standard of living reported by the local population. The authors use an instrumental variable approach to estimate the causal impact of experiencing an oil windfall on several measures of welfare. They argue that most of the revenues meant for the local municipalities are either embezzled by the local decision-makers or are inappropriately used in rent-seeking behaviours. Marchand and Weber (2018) reveal that the reason oil production or its revenues failed to have any impact on the average household income among Brazilians was that only a few residents worked in the offshore oil industry.

Using household-level data from 1997 to 2006, Aragón and Rud (2013) examined the effect of a mining boom on the living standards of individuals living in the local communities of a mining town in Northern Peru. Their data allowed them to exploit the expansion of the mine's demand for local inputs and distance to a nearby city, which mostly served as the mine's supply market. They used a difference-in-difference approach, and defined the treatment areas as cities closer to the mines, while comparison areas are defined as those further away from the mines. They find evidence to suggest that the expansion of the mine had a positive and significant effect on both nominal and real income. They further reveal that the rise in income led to both an increase in household consumption and a reduction in poverty.

Loayza and Rigolini (2016) explore the impact of a mining boom in the local communities of Peru that have mines. Using a difference-in-difference approach, they compare socioeconomic outcomes in mining districts, to results in neighbouring non-mining areas that are similar in many respects to the mining districts. Their unit of observation is a district, and their sample includes 104 mining districts and 1,260 non-producing districts spread over 140 provinces and 17 regions in Peru. The authors find results to suggest that while the mining boom resulted in higher consumption per capita and lower poverty rates in mining districts compared to non-mining areas, the benefits were unevenly distributed. The authors revealed that higher consumption inequality was observed across districts of mining provinces. This was attributed to the influx of highly educated immigrant workers in the mining districts who attracted higher wages and consequently drove up the average wage.

Using a general equilibrium method and microsimulation model, Lay et al. (2008), assess the short to the medium-run impact of the Bolivian gas boom that occurred between the late 1990s and the early 2000s on poverty and the income distribution. Their study shows evidence to suggest that generally, growth in labour income alleviates poverty. However, the gas shock created both an equalizing and unequalizing effect on income inequality. They argue that during the gas boom, there was a demand for skilled workers, which in turn drove up their wages. Migration of unskilled workers to areas that produce gas during the boom caused an oversupply of these worker types and consequently drove down the wage of unskilled workers, resulting in a widening gap between the skilled and unskilled labour. They further revealed that in the rural areas with smallholder farmers, the gas boom resulted in a shortage of unskilled labour who were engaged in agriculture. This drove up the wages of unskilled labour in these areas and consequently led to an equalizing of the wage gap between the rich and poor in the rural areas.

Thiede (2014) uses household-level data from the Demographic and Health Surveys

(DHS) and a NASA agro-climatology dataset to investigate how differential vulnerability among households exposed to rainfall shocks affects wealth (proxied by livestock and household asset) inequality within the rural communities in Ethiopia in which these households are located. The author finds that the household-level impacts of the rainfall shock are generally negative, but may vary among families due to the heterogeneity characteristics exhibited by these households. Specifically, Thiede (2014) finds evidence to suggest that an equalizing effect exists within-community livestock inequality in parts of Ethiopia; however, regional differences are observed. On the other hand, he reports a non-significant impact concerning asset inequality.

Using household-farm data from three agroecological zones in Burkina Faso, Reardon and Taylor (1996) examine the impact of climatic shocks on income inequality and poverty. They find that the inability of poorer households to access off-farm income leads to a widening gap in income inequality between rich and poor households during periods of adverse climatic shocks. According to Reardon and Taylor (1996), in the geographical areas of Burkina Faso with poor agroclimatic conditions, income sources are usually diversified and not solely tied to crop income. Thus, a negative climatic shock decreases inequality as poorer households resort to selling off livestock but increases poverty. On the other hand, in areas with suitable climatic conditions, more impoverished families have most of their income tied in agriculture and a negative climatic shock results in increased inequality and increased poverty.

Marchand and Weber (2018) present summary results from several studies that have investigated the impact of natural resources on localities that produce them. The authors provide overwhelming evidence to support that generally, the extraction of natural resources increases earnings and income. They also report a general decline in poverty due to natural resource extraction and highlight that the evidence linking natural resources to inequality is mixed.

3.4 Data Description

In this study, I use data from the Ghana Living Standard Survey (GLSS) [2]. The GLSS was designed to monitor the welfare of Ghanaians and provide the necessary information needed to assess how policies and programmes impact the living conditions in Ghana. Some of the specific objectives of the GLSS are to provide individual and household level information on consumption and other expenditure patterns, provide local price information for the construction of a new basket for the next re-basing of the Consumer Price Index (CPI), offer local labour market information and so on.

Currently, six rounds of GLSS are available. The first was conducted in 1987, followed by the five-remaining series in 1988, 1991/1992, 1998/1999, 2005/2006 and 2012/2013, respectively. Historically, similar questionnaires have been used over the years to allow for the comparability of the survey indicators. However, minor additions are made in each round to expand the scope of data use for decision-making purposes. Each series of data is a repeated cross-sectional data, meaning that no particular individual or household has been deliberately followed over the years. Survey respondents for the GLSS are administered questionnaires on four broad categories. The questions revolve around households, non-farm households, the community and prices of food and non-food items. The household questionnaires usually collect information that include demographic data of survey respondents, education, employment, housing, among others. It also collects information on household income and expenditure as well as credit, assets and use of financial services. The community questionnaire gathers information on facilities within communities, while the price questionnaire collects data on the market prices of consumer items in local communities.

The sampling design adopted in the GLSS follows a two-stage stratified technique. In the first stage, enumeration areas (EAs) are selected to form the Primary Sampling Units (PSUs); after that, the EAs are divided into Urban and Rural localities of residence. A list of households is drawn from each PSU to form the Secondary Sampling Unit (SSU). Families

[2] The GLSS is an offshoot of the Living Standards Measurement Study (LSMS), a research project that was initiated in 1980 by the Policy Research Division of the World Bank. The LSMS makes data available for policy-makers to measure socio-economic indicators and evaluate what drives these indicators.

are systematically selected from each PSU in the second stage to obtain the sample size. Each sampled household did not have the same chance of selection into the survey sample, so weights are computed to reflect the different probabilities of selection. These weights allow a generalization of results at the population level.

I use data for the fourth (GLSS4, 1998/1999), fifth (GLSS5, 2005/2006) and sixth (GLSS5, 2012/2013) rounds. These datasets are appropriate because they captured the periods when the farm-gate cocoa boom occurred in Ghana. Also, these three rounds of data collect detailed information on the labour force, specifically focused on employment and time use in Ghana. These datasets also contain detailed information on cash expenditures from every household included in the survey. According to the sixth round GLSS report, the frequently purchased food expenditures are collected at five-day intervals over 35 days for all surveyed households. Costs on less regularly purchased items were, however, collected at three months or 12 months intervals depending on the frequency of purchase.

The 1998/1999 survey ran from April 1998 to March 1999. A total of 6,000 households were selected from 300 Enumeration Areas (EAs) in the GLSS4. Out of the selected households, a total of 5,998(99.7% coverage) households containing 25,694 individuals were covered in the survey. The 2005/2006 survey ran from September 2005 to September 2006. A sample of 8,687 households in 580 enumeration areas, containing 37,128 individuals were covered in GLSS5. The 2012/2013 survey was carried out from October 2012 to October 2013. Out of 18,000 households that were selected from 1200 EAs, a total of 16,772 households (93.2% coverage) containing over 60,000 individuals were covered in the 2012/2013 survey.

3.4.1 Poverty

3.4.2 Poverty Lines

A poverty line is a threshold of income, consumption or access to some goods and services below which individuals are deemed to be poor. This suggests that at any given point in time, the poverty line represents a minimum level of income or expenditure that is regarded as necessary for adequate participation in economic life (Ray, 1998). Different countries have different ways of estimating their poverty line. Some countries estimate the poverty line using prices of foodstuffs containing the minimum nutrient levels that make up an adequate diet and on costs of shelter and clothing. Others may use the legally decreed minimum wage, while some may use norms such as, say, 60% of the mean income of a country as the estimate of its poverty line (Ray, 1998). In Ghana, a nutrition-based poverty line is used. The Ghana Statistical Service (GSS) estimates the poverty line based on food expenditure required to attain 2900 kilocalories per equivalent adult. Food expenditure is derived from the consumption basket of the poorest 50 percent of Ghanaian households. The non-food poverty line is the expenditure on non-food consumption items that are essential for households, to the extent that they may be willing to forgo meeting their calorie requirements to purchase them. The methodology used by the GSS results in an overall poverty line of approximately GHC 90.00, GHC 370.89 and GHC 1314.00 per equivalent adult in 1998/1999, 2005/2006 and 2012/2013, respectively. In dollar terms, the poverty line is equivalent to $1, $1 and $1.83 in 1998/1999, 2005/2006 and 2012/2013, respectively per person per day.

3.4.3 Poverty Measures

Headcount Ratio

If a society has determined its poverty line using any of the methods discussed in the previous section, one measure of poverty is to count the number of people that fall below the poverty line. This method is known as the headcount, and it is ideal when one is interested in the absolute number of persons who are poor within a society. Also, the headcount can be used to compare poverty between societies that have equal populations. When comparing poverty among two or more societies with different populations, a relative measure of poverty is more appropriate. This measure of poverty is called the headcount ratio, and it is defined as a fraction of the population of the society. One flaw with the headcount ratio is that it fails to capture the degree to which one's income or expenditure falls below the poverty line. For instance, using the headcount ratio, a society with a poverty line of $1000 will consider individuals with earnings of $900 and $100 as poor. However, those with earnings of \$100 are poorer than those with earnings of \$900, yet the headcount ration is insensitive to this observation. The headcount ratio is calculated as:

$$HCR = \frac{HC}{N} \tag{3.1}$$

where HCR represents the headcount ratio, HC is the headcount or the number of persons below the poverty line, and N is the total population in the society of interest.

Poverty Gap Ratio

When measuring poverty, one way to capture the degree of poverty is to use a measure that takes into account the income (or expenditure) shortfall from the poverty line. This measure is called the poverty gap ratio, and it is defined as the average income (or extra consumption) needed to get all poor people to the poverty line, divided by the poverty line of the society. For individuals whose income (or expenditure fall above the poverty line, their gap is considered to be zero. Conceptually, the poverty gap ratio more significant than the resources needed to eradicate poverty. It is given by:

$$PGR = \frac{1}{N} \sum_{i=1}^{N} \left(\frac{z - x_i}{z} \right) \tag{3.2}$$

Where PGR represents the poverty gap ratio, N is the total number of individuals in the society, z is the poverty line and x_i is the income (or expenditure)of individuals.

Drawback of Headcount and Poverty Gap Ratios

When both the headcount ratio and poverty gap ratio are used together, they can capture to a large extent the incidence and intensity of poverty in a society. However, both the headcount and poverty gap ratios ignore the problem of inequality among the poor and hence violate the transfer principle, which requires poverty to strictly increase as a result of a transfer of income from the extremely poor to the less poor individuals (Ray, 1998; World Bank, 2005).

A measure of poverty that takes into consideration the inequality among the poor is the squared poverty gap index. The difference between the poverty gap ratio and the squared poverty gap is that the poverty gap in the former are weighted equally while those in the latter puts more weight on observations that fall well below the poverty line (World Bank, 2005). The squared poverty gap is written as:

$$SPGR = \frac{1}{N} \sum_{i=1}^{N} \left(\frac{z - x_i}{z} \right)^2 \tag{3.3}$$

Where $SPGR$ represents squared poverty gap, N is the total number of individuals in the population, z is the poverty line and x_i is the per capita household wealth.

3.4.4 Inequality Measures

There are several measures used to assess inequality in the distribution of random variables. Some include the Mcloone index, coefficient of variation, Gini index, Theil's index and Atkinson index. Each index has its strengths and limitations, and each may be employed based on a researchers' preferences and how they help to address the question of research. In the current study, I use the Gini coefficient, Theil T statistic and the Atkinson index to assess inequality in the distribution of my outcome variables. I opt for these inequality measures because each one of them exhibits sensitivity on different parts across a distribution.

3.4.5 Gini Coefficient

The Gini coefficient is a measure of inequality, and several studies have used this measure to assess inequality in income or wealth (Alvaredo, 2011). It is constrained between 0 and 1, where 0 implies perfect equality and 1 implies perfect inequality. On a Cartesian plane, perfect equality is represented by the 45-degree line, and deviations from this line represent points of inequality. It is important to note that when the reported or observed net outcome measures are negative, say a negative net income; this will result in a Gini coefficient that exceeds 1. About the Lorenz curve [3], the Gini coefficient is defined as the ratio of the area enclosed by the lines of perfect equality and the Lorenz curve to the total area under the line of perfect equality. The Gini coefficient (G) of a random variable y_i for a population (k) with individuals $i = 1...k$ is computed as:

$$G = \frac{1}{k}\left(k + 1 - 2\frac{\sum_{i=1}^{k}(k+1-i)y_i}{\sum_{i=1}^{k} y_i}\right) \tag{3.4}$$

Aside from being a relatively easy measure to compute and understand, the Gini coefficient also holds the advantage in its ability to compare income or welfare distributions across different subgroups within the population. For instance, within the population, G can be obtained for both rural and urban areas as well as various states or provinces. It can also be used to determine how my outcome variable has changed within different subgroups over some time.

3.4.6 Theil's Index

The Theil index is part of a family of General Entropy (GE) measures that are used to measure the distribution of inequality in income. This class of GE measures range from 0 to infinity, where 0 represents equal income distribution and values greater than 0 refer to increasing levels of inequality. A vital feature of the GE measures is the sensitivity parameter α that assigns a weight to inequalities in incomes at different parts of the income distribution. Higher values of α imply greater sensitivity to changes in the upper tail of the distribution and lower values of α mean higher sensitivity to the lower tails of the distribution (Atkinson and Bourguignon, 2014). The values of GE measures that are typically used are 0, 1, and 2. When α=0, the index is called "Theil's L" or the "mean log deviation" measure. When α=1, then I have the "Theil's T" index or, more commonly, "Theil index." When α=2, the index

[3] The Lorenz curve is a graphical representation of the distribution of resources. It plots the cumulative percentage of the population against the cumulative percentage of resource types. The Lorenz curve captures the actual distribution of the resource.

is known as the "coefficient of variation." Thus the more positive the sensitivity parameter, the more sensitive the GE is to inequalities at the top of the income distribution. The GE measures are fully decomposable and can be determined for subgroups of a population or income sources, which allows for analysis to be done between- and within-area effects (Conceição and Ferreira, 2000).
The GE index is expressed as:

$$GE(\alpha) = \frac{1}{N\alpha(1-\alpha)} \sum_{i=1}^{N} \left[\left(\frac{y_i}{\bar{y}} \right)^{\alpha} - 1 \right] \forall \alpha \neq 0 or \qquad 1 \tag{3.5}$$

For $\alpha = 1$ the Theil index is defined as:

$$T = \frac{1}{N} \sum_{i=1}^{N} \frac{y_i}{\bar{y}} ln \left(\frac{y_i}{\bar{y}} \right) \tag{3.6}$$

Where T is the Theil index, N is the population or subpopulation of interest and y_i is the outcome measure.

3.4.7 Atkinson Index

The Atkinson index shows the proportion of total income that a given society would have to forego to attain an equal share of income among its citizens. According to Atkinson (1970), measures of inequality such as the Gini coefficient and the coefficient of variation are sensitive to inequality only in the middle of the distribution, and they do a poor job representing inequality at the tails of a distribution. The Atkinson index is a modified version of the Gini coefficient that is sensitive to inequality at the tails of the distribution. Specifically, it performs better when used to measure inequality at the lower end of the distribution (Marchand, 2015). It is a welfare-based measure of inequality, and one of its interesting features is its ability to provide welfare implications of alternative policies (Atkinson, 1987). The Atkinson index has a weighting parameter (ϵ) that measures the aversion of society to inequality.

A higher value of this parameter implies that individuals within a society are willing to accept smaller incomes in exchange for equal distribution. This index can be decomposed into both within- and between-group inequality.
The Atkinson index can be defined as:

$$A_\epsilon = 1 - \left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^{1-\epsilon}\right]^{\frac{1}{1-\epsilon}} \tag{3.7}$$

Where A is the Atkinson index, N is the population or subpopulation of interest, y is the outcome measure and ϵ is the measure of aversion of society to inequality.

3.5 Descriptive Statistics

Table 3.1 shows the summary statistics of the poverty measure used in this study. I use the headcount ratio as my preferred measure of poverty due to its ease of computation. I measure the poverty rate in each district as the number of households in a district that falls below the poverty line divided by the total number of households in that district. Based on the definition of poverty, a household is said to be poor if its calculated standard of living per household member falls below the poverty line [4].

In Table 3.1, I show that about 33% and 53% of households in cocoa and non-cocoa districts respectively were living below the poverty line in 1998/1999. During the cocoa price boom in 2005/2006, the incidence of poverty declined to about 18% and 43% in cocoa and non-cocoa districts, respectively. In 2012/2013, the incidence of poverty further declined to about 15% and 40% in cocoa and non-cocoa districts, respectively. In both cocoa and non-cocoa areas, I observe that the change in the incidence of poverty between 1998/1999 and 2005/2006 is relatively greater than the change observed between 2005/2006 and 2012/2013. A possible reason for the slowdown in decline in poverty between 2005/2006 and 2012/2013 was the global financial crises that occurred in 2008. In Table 4.8 I show that the poverty gap ratios for cocoa areas in 1998/1999, 2005/2006 and 2012/2013 were about 10%, 5% and 2%,

[4] The standard of living for each household member is the sum of food expenditures of the household divided by the equivalence scale of the household.

respectively. Similarly, in non-cocoa areas, the poverty gap ratios observed in 1998/1999, 2005/2006 and 2012/2013 were about 21%, 17% and 15%, respectively. In both cocoa and non-cocoa areas, there were declines in the poverty gap ratios from 1998/1999 to 2012/2013, suggesting that the intensity of poverty among individuals living below the poverty line declined in both areas over time.

Table 3.2 shows summary statistics for my outcome measures. In this study, I use real total household income and real per capita consumption as my welfare measures. According to Deaton (1997), income and consumption are the standard measures of economic welfare. I focus on real household wage income because it allows me to capture the changes in income when household members engage in employment activities within my sample years. The household wage income also allows me to pick up the effects of any cocoa price boom revealed through the labour market. In Ghana and some developing countries, some farm labourers receive payment in kind, mostly in the form of food items (Nsowah-Nuamah et al., 2012; Younger et al., 2017; Karg et al., 2019). The GLSS survey records all payments-in-kind received by survey respondents. The cash value of all payments in kind reported by survey respondents is estimated and recorded as wages, which means that employment income is captured reasonably well in my sample.

I measure total household wage income as the sum of all wages earned by household members within a fiscal year; this is adjusted by the regional price indices to obtain wage income relative to prices in the base region (Greater Accra). I then adjust the new relative wages to obtain prices in 2005 constant values. Another outcome measure I use in this study is per capita consumption. According to Deaton (1997), the difficulties of measuring income in developing countries results in relatively unreliable figures. However, consumption figures are much easier to measure and more reliable. To compute real per capita consumption, I first multiply annual total food consumption expenditure for each household by the regional price indexes provided in the GLSS dataset. Next, I deflate the consumption expenditure with CPI to obtain expenditure in 2005 constant values. Next, I divide the real food consumption expenditure for each household by the equivalence scale to get the per capita consumption expenditure.

In Table 3.3, I show the average inequality measures computed for the outcome measures. I measure inequality using the Theil, Gini and Atkinson index. I use these indexes because each of these three measures is sensitive on different parts of the household income and consumption distribution (Atkinson, 1970). Results from my summary statistics show that between 1998/1999 and 2012/2013 fiscal years, inequality in real total household wages increased by about 34-55% and 67-137% in cocoa and non-cocoa districts, respectively. During the same period, inequality in real per capita consumption declined by 11-35% in cocoa districts and increased by 6-13% in non-cocoa districts.

3.6 Method

3.6.1 Defining Treatment, Control and Buffer Districts

I define the criteria used to identify treatment and control households based on district-level information. Districts are the second-level administrative subdivisions in Ghana. My baseline treatment and control districts are defined using cocoa production per district size, which I calculate as the actual annual quantity of cocoa produced (in tons) divided by the districts' area sizes (in square kilometres). To determine a cut-off point that separates my treatment, control and buffer districts, I generate a scatter plot of production per district size to reveal the sharp contrasts in production among communities. My scatter plot shows clustering at 0 tons per square kilometre and sparse observations between 0 and 5 tons per square kilometre. Based on this distribution, I define treatment districts as areas that produce more than 5 tons of cocoa per square kilometre, buffer districts are those that produce cocoa between 0 and 5 tons per square kilometre, and control districts as areas that produce no cocoa. Figure 3.2 shows the districts in Ghana considered as treatment, control and buffer areas based on my baseline definition.

I drop districts with populations over 500,000 to ensure that the average number of inhabitants in the treatment and control districts are comparable. According to Black et al. (2005) and Marchand (2015), dropping larger communities helps to provide an appropriate comparison group for the treatment. I define all adjacent districts to the treatment districts as buffer districts. It is essential to introduce buffer districts as they prevent districts from switching between treatment and control districts over my sample years (Black et al., 2005).

My strategy is to use the differential change in household wages and per capita consumption between cocoa and non-cocoa areas from 1998/1999 to 2005/2006 and from 2005/2006 to 2012/2013 to identify the impact of the cocoa price boom on the welfare of residents. If I observe that the differential change in the welfare measures is positive and more significant in cocoa areas compared to non-cocoa districts during periods of the price boom, then I take this as evidence that the price boom has a positive impact on welfare in cocoa areas relative to non-cocoa areas.

During the 1998/1999, 2005/2006 and 2012/2013 GLSS surveys, there were 110, 137 and 170 districts respectively present in Ghana. This is because as time passed by, larger districts were split into smaller ones to improve the efficiency in resource allocation. To ensure consistency in the number of districts for all sample years, I defined districts that existed in 2005/2006 and 2012/2013 using 1998/1999 district definitions. I do this by merging the smaller districts that were split after 1998/1999 to match how they originally appeared prior to 1998/1999.

3.6.2 Empirical Methodology

To measure the impact of the cocoa price boom on welfare, I estimate quantile regressions using household-level data for three separate periods: first boom (1998/1999 - 2005/2006), second boom (2005/2006 - 2012/2013), and the overall boom (1998/1999 - 2012/2013).

Across my sample years, I calculate the differential change in the logarithm of household wages and per capita consumption between households in cocoa and non-cocoa districts as shown in Equation 3.8 below:

$$Outcome_{idt} = \alpha + \beta T_i + \gamma I[j]_t + \delta[j](T_i * I[j]_t) + \varepsilon_{idt} \tag{3.8}$$

where $Outcome_{idt}$ represents the outcome variables, logarithm of real wage income and consumption per capita of household i at district d at time t. T_i is an indicator variable for whether the household is in a treatment or control district, it takes the value of 1 if the household is in a treatment district and 0 if it is in a control district. $I[j]_t$ is an indicator function for the time period, where j = first boom (1998/1999 - 2005/2006), second boom (2005/2006 - 2012/2013), or overall boom (1998/1999 - 2012/2013); for the first boom, $I[j]_t$ takes the value of 0 for observation in 1998/1999 and 1 for observations in 2005/2006, for the second boom, $I[j]_t$ takes the value of 0 for observation in 2005/2006 and 1 for observations in 2012/2013 and for the overall boom $I[j]_t$ takes the value of 0 for observations in 1998/1999 and 1 for observations in 2012/2013. δ_{dt} is my variable of interest, which represents the differential change in household wage or per-capita consumption for households living in cocoa areas compared to those in non-cocoa areas. My model is estimated using sample weights provided in the data, and I cluster the standard errors at the district level.

Next, I measure the impact of the price boom on wage and consumption inequalities within cocoa districts. I use the STATA command "ineqdeco" to calculate the within-district welfare inequalities. The "ineqdeco" command produces results for Theil, Gini and Atkinson indexes for wage and consumption for each district. I take the logarithm of all the indexes generated and estimate a district level regression model shown in Equation 3.9 for three separate periods [j] as:

$$Outcome[k]_{dt} = \alpha + \beta T_d + \gamma I[j]_t + \delta[j](T_i * I[j]_t) + \lambda_d + \varepsilon_{dt} \tag{3.9}$$

where $Outcome_{dt}$ represents the within-district d inequalities for my outcome variables, wage and consumption at time t, and k = Theil index, Gini coefficient or Atkinson index . T_i is an indicator variable which shows whether the district is a treatment or control, it takes the value of 1 if the district is a treatment and 0 if it is a control. $I[j]_t$ is an indicator function for the period, where j = first boom (1998/1999 - 2005/2006), second boom (2005/2006

- 2012/2013), or overall boom (1998/1999 - 2012/2013). λ_d represents the district-fixed effect. The time indicator $I[j]_t$ behaves similarly as in Equation 3.8, and δ_{dt} represents the differential change in wage or consumption inequality between cocoa and non-cocoa areas of Ghana. I cluster my standard errors at the district level.

Finally, I assess the impact of the price boom on poverty within cocoa districts. I measure poverty in two ways. First, as a ratio of households within a district, that fall below the poverty line, to the total number of households in that district. While this measure gives me a good indication of the relative amount of households that are affected by the price boom across the years, it fails to provide any evidence on the intensity of poverty among households living in cocoa areas of Ghana. For this reason, I use the poverty gap to assess the impact of the price boom on the intensity of poverty within cocoa districts. I calculate the poverty gap, as shown in Equation 3.3.

After calculating the poverty gap ratio for each district I use them as my dependent variables in the district level regression model in Equation 3.9, and I replace the outcome variable in Equation 3.9 with poverty headcount or poverty gap ratio.

3.7 Results

3.7.1 Impact of Cocoa Price Boom on Wage Income for Households Across the Distribution

In Table 3.4, I report the differential change in the logarithm of wages across the distribution of households in cocoa and non-cocoa districts. I report the results obtained by estimating the model shown in Equation 3.8 over three separate periods.[5]

The first boom that occurred between the 1998/1999-2005/2006 fiscal years had no significant impact on the differential change in household wages across the wage distribution (see Table 3.4). As shown in Figure 3.1, the first price boom appears to be relatively weaker compared to the second; due to this relative weakness, its impact on the differential change in household wages was neither statistically nor economically significant. Another reason

[5]The first boom (1998/1999-2005/2006) the second boom (2005/2006-2012/2013) and the overall boom (1998/1999-2012/2013).

why the first boom failed to have any significant effect on household wages was possibly due to a time-inconsistency problem (Crain and Tollison, 1993; Fang and Silverman, 2009). The liberalization of the cocoa market in Ghana occurred during the first boom (Kolavalli and Vigneri, 2011; Varangis and Schreiber, 2001). The individuals living in the cocoa areas of Ghana may have expected the government to renege on its commitment to carry through with the policy, and as a result, they may have reacted slowly and failed to take advantage of the possible wage gains that accompanied the early price boom.

In Table 3.4, I show that the second price boom had a positive and significant impact on the differential change in wages across the distribution. The differential change in total household wages increased by about 18-49% points in treatment districts relative to those in comparison districts. Also, during the second boom, the differential change in wages for households in the 10th and 20th percentiles grew by about 46% and 43% points, respectively, while the differential change in wages for households in the 30th, 70th and 90th percentiles was approximately 49%, 18% and 31% points, respectively. My results show that wages for households in the 30th percentile are growing faster and appear to be catching up with those in the top half of the distribution, while wages of households in the 90th are moving further away from those below them. As a result of this, a U-shaped pattern is observed for the differential change in household wage from the 30th to 90th percentile, with a turning point at the 70th percentile. One reason why the second boom has a greater impact on wages is that the farm-gate cocoa prices paid to cocoa farmers during this period were significantly higher than those paid during the first boom (Figure 3.1). Because cocoa is a cash crop and not consumed directly by households, the higher farm-gate cocoa prices paid to farmers can only help to improve the incomes of cocoa households.

As shown in Table 3.4, the combined effect of the cocoa price boom on the differential change in wage income for households is also positive and significant. My findings are consistent with research that has shown that a boom in natural resources and commodity prices lead to an increase in household wages (Chant et al., 2004; Bussolo et al., 2006; Weber, 2012; Bellemare et al., 2013; Dimova, 2015; Lederman and Porto, 2015). During the 1998/1999 to 2012/2013 cocoa price boom period, the differential change in household wage across the distribution was about 20-71% points. The impact of the combined price boom allowed households in the lower tail of the distribution to catch up rapidly with those in the top half, while those in the top ten percentile drew farther away. Similar to what I observe in the second boom period, this results in a U-shaped pattern for the differential change in household wage from the 10th to 90th percentile, with a turning point at the 80th percentile. The U-shaped pattern that appear in the wage distribution as a result of the combined price boom shows evidence to suggest that households in the lower end of the distribution are catching up with those in the middle distribution while those in middle distribution are also catching up with those in the top 20th percentile.

3.7.2 Impact of Cocoa Price Boom on Per Capita Consumption of Households Across the Distribution

Table 3.4 also presents results to show the impact of the cocoa price boom on the differential change in per capita consumption for households across the distribution. During the first cocoa price boom, the differential change in consumption per capita between treatment and comparison was about 8-13% points. The first price boom generally had a positive and significant impact on the differential change in consumption per capita across the distribution except for households in the 50th, 60th and 90th percentiles. During the first boom, the differential change in consumption per capita for households in the 10-30th percentiles was relatively constant at about 12% points on average. The first price boom also had no significant impact on the differential change in consumption per capita for households in the middle of the distribution (i.e. 50th and 60th percentiles) and those in the 90th percentile. However, the differential change in consumption per capita remained relatively constant at about 11.5% points for households in the 70-80th percentiles. These results suggest that during the first boom, households in the lower end of the distribution were catching up with those in the middle of the distribution while those in the 70-80th percentiles were also catching up with those in the 90th percentile of the distribution.

The results from Table 3.4 reveals that the second price boom had no significant impact on the differential change in consumption per capita across the distribution except for households in the top 20th percentile.

Results from Table 3.4 shows that the combined price boom had a positive and significant impact on the differential change in consumption per capita for households across the distribution except for those in the bottom 10th and top 20th percentiles. The combined effect of the farm-gate cocoa price boom led to an increase in the differential change in wage income by about 8-11% points. My results align with findings from Helbling (2012), Aragón and Rud (2013), Dimova (2015), and Loayza and Rigolini (2016), who report that a boom in natural resources and commodity prices lead to an increase in household consumption. Households in the 20-70th percentiles of the distribution experienced a relatively constant increase in the differential change in consumption per capita at about 10% points on average. My results suggest that households in the middle of the distribution may be drawing away from those in the bottom 10th percentile, and catching up with those in the top 20th percentile of the distribution.

One reason why the first cocoa price boom had a positive impact on the differential change in consumption per capita is that residents in cocoa areas may have increased their consumption after they learned that the liberalization of the cocoa market that led to increased farm-gate cocoa prices would increase their permanent income. The second price boom failed to have any meaningful impact on the differential change in consumption per capita because residents in the cocoa areas may have already smoothed their consumption during the first boom (Kazianga and Udry, 2006; Chetty and Looney, 2006; Aguila et al., 2017) and as a result were not required to make any further adjustments to their consumption behaviour.

3.7.3 Impact of Cocoa Price Boom on Wage Inequality

In Table 3.5 I report regression results showing the impact of the cocoa price boom on the differential change in household wage inequality. For each of my outcome measures, I report separate results for the combined boom period (1998/1999-2012/2013), the first boom (1998/1999-2005/2006) and the second boom (2005/2006-2012/2013). My results focus on the Theil index, Gini coefficient and Atkinson index as these inequality measures are sensitive on different parts of the distribution.

Results from Table 3.5 reveal that the first cocoa price boom had no significant impact on the differential change in household wage inequality between cocoa and non-cocoa areas. This finding appears consistent with my earlier results that revealed that the first boom had no impact on the differential change in household wages across the distribution.

The impact of the second cocoa price boom on the differential change in household wage inequality is negative and significant. I, however, note that the impact of the second boom on wage inequality as measured by the Atkinson index is significant at the 10% level. The second price boom led to a differential decline in wage inequality by about 20-46% points in cocoa districts compared to non-cocoa districts. According to Bussolo et al. (2006), the reason why I observe a decline in the differential change in wage inequality is because households in the bottom half of the distribution benefit more from the gains of the price boom than those in the top half of the distribution (See Table 3.4).

Table 3.5 shows that the impact of the combined price boom on the differential change in household wage inequality is negative and significant, except for the wage inequality measured using the Theil index. This means that the combined price boom also leads to a differential decline in wage inequality for households in cocoa areas. In cocoa districts, the combined price boom led to a differential decline in wage inequality by about 37-60% points compared to non-cocoa districts. As shown in Table 3.4, during the combined price boom period, households in the bottom half of the distribution benefited more from the gains of the price boom than those in the top half of the distribution.

My finding contradicts Loayza and Rigolini (2016), who reports an increase in wage inequality during the mining boom in Peru. The authors note that the mining boom in Peru attracted skilled workers who earned higher wages than the local residents, and this led to an increase in wage inequality. In the case of cocoa production, however, majority of the workforce are unskilled labour who earn lower wages, and possibly fall in the bottom half of the income distribution. As noted by Bussolo et al. (2006) if households at the bottom of the wage distribution benefit more than those at the top during a resource boom, then I expect wage inequality to decline in cocoa areas of Ghana during the price boom.

3.7.4 Impact of Cocoa Price Boom on Consumption Per Capita Inequality

Table 3.5 shows the results for the impact of the cocoa price boom on the differential change in consumption inequality. The results show that except for the Atkinson index, the first cocoa price boom had a negative and significant impact on the differential change in consumption per capita inequality . This means that the first cocoa price boom led to a differential decline in consumption inequality by about 20-55% points in cocoa areas relative to non-cocoa areas. The reason for the decline can be attributed to how the first cocoa boom affected the differential change in consumption per capita of households across the distribution (See Table 3.4). I show in Table 3.4, that the first price boom led to a differential increase in consumption per capita for all households across the bottom half of the distribution. However, in the top half of the distribution, only households in the 70th and 80th percentiles experienced a differential increase in consumption per capita. The decline in consumption inequality can be attributed to households in the bottom half of the distribution catching up with those in the middle of the distribution, while those in the 70-80th percentiles catch up with those in the top 10th percentile of the distribution.

In Table 3.5, I show that the second price boom had no significant impact on the differential change in consumption per capita inequality. This finding is supported by the earlier reported results that indicate that the second price boom had no significant impact on the differential change in consumption per capita for all households across the distribution.

The impact of the combined price on the differential change in consumption per capita inequality yield similar to those obtained under the first price boom. However, the coefficients produced under the combined price boom are relatively smaller than those produced under the first price boom.

3.7.5 Impact of Cocoa Price Boom on Poverty

In Table 3.6, I present regression results to show the impact of the cocoa price boom on the differential change in the poverty headcount ratio between cocoa areas and non-cocoa areas. I find evidence to show that the combined price boom led to a differential decline in the poverty headcount ratio by about 7.29% points in cocoa areas relative to non-cocoa areas. The decline in the poverty headcount ratio can be attributed to the decline in the incidence of poverty from 33% in 1998/1999 to 18% in 2012/2013. During the price boom period, the number of individuals living under the poverty line decreased from 904,806 in 1998/1999 to 558,243 in 2012/2013. From Table 3.4, I can infer that the combined price boom had a positive and significant effect across the wage and consumption distributions, and this is a possible reason why individuals and households in cocoa areas are marginally lifted out of poverty. My finding is consistent with findings by Black et al. (2005), Aragón and Rud (2013), Marchand (2015), and Loayza and Rigolini (2016), who report that a resource boom is associated with a decline in poverty.

My results show that the differential decline in the poverty headcount ratio by about 4% points that occurred during the first price boom in cocoa districts relative to non-cocoa districts was not statistically significant. During the first price boom, the incidence of poverty declined from 904,806 to 508,124 in 1998/1999 and 2005/2006, respectively. Despite the decline in the absolute number individuals living below the poverty line, the first price boom did not have any impact on the differential change in poverty headcount ratio.

I also find no evidence to suggest that the second price boom had any significant impact on the differential change in the poverty headcount ratio in cocoa districts compared to non-cocoa districts. Given the higher impact of the second boom compared to the first, one would have thought that a relatively higher number of individuals and households would have been lifted out of poverty. During the second price boom, the incidence of poverty in cocoa areas declined from about 18% in 2005/2006 to about 15% in 2012/2013, this led to only a marginal change in the absolute numbers of individuals in cocoa areas living below the poverty line of 508,124 and 558,244 in 2005/2006 and 2012/2013 respectively.

In Table 3.6, I present results to suggest that while the combined price boom marginally lifted individuals and households out of poverty, I also find that the impact of the combined price boom on the differential change in the poverty gap ratio between cocoa and non-cocoa areas was negative and statistically significant. The combined price boom led to a differential decline in the poverty gap ratio of about 4% points. This means that some redistribution of wealth occurred below the poverty line as a result of the cocoa price boom, and this redistribution resulted in individuals under the poverty line being less poor in cocoa areas compared to non-cocoa areas.[6] Also, while the first price boom failed to have any significant impact on the poverty gap ratio, the second price boom led to a differential decline in the poverty gap ratio of about 2% points. The poverty gap ratios observed in 1998/1999, 2005/2006 and 2012/2013 are 9.98%, 4.71% and 2.11% in cocoa areas and 20.85%, 16.66% and 15.23% in non-cocoa areas respectively (see Table 4.8). My results from the combined price boom in Table 3.4 is consistent with what I find in the poverty gap ratios, as they seem to suggest that there appears to be some redistribution at the lower half of the wage and consumption distribution.

3.7.6 Impact of Cocoa Price Boom on Welfare of Landowning Households

To assess the impact of the cocoa price boom on welfare across the wage and consumption distribution of landowning households, I estimate the model in Equation 3.8 and restrict my sample to only families that are landowners. I define landowning households as those who own land typically used for farming.

In Table 3.7, I present my results to show that the combined impact of the cocoa price boom on the differential change in wage across the distribution of landowning households is positive and significant. From 1998/1999 to 2012/2013, wages of families across the distribution increased by 51-122% points. Wages of households in the bottom half of the distribution appear to be growing faster (86-122% points) than those in the top half of the distribution (41-70% points).

The impacts of the first and second booms on the differential change in wages of landowning households across the distribution are similar to what I observe when the impact of the booms are assessed on the wages of both landowning and landless households are pooled together. The first boom had no significant impact on the differential change in household

[6] I estimate that the poverty line occurs within the 30th percentile.

wages across the wage distribution of landowning households, while the second price boom had a positive and significant impact. This is due to similar reasons that have been highlighted in previous sections. I also note that the magnitude of the boom effects on the differential change in wages is significantly higher among landowning households compared to other households. This is not surprising as one would expect households that own the farmlands to receive a larger share of the gains obtained from the price boom.

Table 3.7 also shows the impact of the price boom on the differential change in consumption of landowning households across the distribution. The combined impact of the price boom has a positive and significant impact on the differential change in consumption per capita for landowning households except for those in the 90th percentile. The combined price boom differentially increased consumption per capita of landowning households in cocoa areas by about 17-35% points relative to those in non-cocoa areas. The first price boom generally had no impact on the differential change in consumption per capita across the distribution. However, the second price boom had a positive and significant impact on the differential change in consumption per capita of landowning households in cocoa areas except for those in the bottom 10th and top 20th percentiles of the distribution. I note that the impacts of the first and second price booms on the consumption per capita of landowning households contrasts that observed when landowning and landless households are considered together.

3.7.7 Impact of Cocoa Price Boom on Welfare of Landless Households

Similar to the previous section, I estimate the model shown in Equation 3.8 and restrict my sample to only landless households. I define a landless household as any household that does not own land used for agriculture purposes. The impact of the price boom on the differential change in wages for landless families is positive and significant across the distribution.

Table 3.8 shows the combined impact of the cocoa price boom on the differential change in wages of households in cocoa districts that do not own land. From 1998/1999 to 2012/2013, the combined price boom resulted in an increase in the differential change in wages of landless households in cocoa areas by about 20-63% points across the distribution. The first price boom failed to have any significant impact on the differential change in wages of landless households across the distribution. However, the second price boom, differentially increased wages of landless households by about 25-43% points across the distribution except those in the 60-80th percentile.

Table 3.8 also shows the impact of the price boom on the differential change in consumption per capita of landless households in cocoa areas. The combined price boom led to an increase in the differential change in consumption per capita by about 8-10% points across the distribution, except for those in the lower and upper 20th and 80th percentiles, respectively. I can also infer from my results that the first price boom had a positive and significant impact on per capita consumption across the distribution except those in the top 20th percentile. This means that the households in the middle distribution were able to catch up with those at the top of the distribution. The impact of the second price boom was barely significant on the differential change in consumption per capita across the distribution.

Overall, my results suggest that the cocoa price boom led to an increase in the differential changes in household wages, consumption and also a decline in poverty. This finding is consistent with Bussolo et al. (2006) who report that relatively poorer households experienced an increase in wages and consumption, and experienced a decline in poverty during the coffee price boom in Uganda.

When I compare the gains of households who are landowners to those that are landless, I observe that wages for the former increased by about twice that of the later during the price boom. Households that own lands are often those who own cocoa farms, and are wealthier compared to landless families. However, according to Bussolo et al. (2006), all the gains accrued by landowning households should not be solely attributed to the price boom. The authors argue that the while the direct impact of a price boom benefits poorer households than the richer ones(as shown on the distribution for these two groups of households), the wealthier households can take advantage of the vast opportunities that are associated with the boom, and as a result are able to increase their income during a boom period.[7]

3.8 Robustness Check

3.8.1 Alternative Treatment Definitions

In the current study, treatment districts are defined based on the amount of cocoa they produced relative to their size. However, some cocoa areas may be densely populated, and the standardization based on district size may fail to represent how well the cocoa price boom impacts individuals living in areas that produce cocoa. Due to this, I use an alternative treatment definition based on production per person. To obtain this measure for each district, I divide the annual cocoa produced by the district population. Since the Statistical Service in Ghana does not release annual population estimates, I use the population census conducted in Ghana in the year 2000 to proxy for population estimates for 1998/1999 and 2005/2006 fiscal years. I also use the population census conducted in 2010 to proxy for population estimates in the 2012/2013 year. Based on the distribution of production per person in each district, I classify areas that produce more than 40 tons of cocoa beans per 1000 persons as the treatment districts, and those that produce no cocoa as control districts. I classify cocoa areas that generate between 0-40 tons of cocoa per 1000 persons as buffer districts.

I also use an alternative treatment definition based on the share of households in cocoa districts that are engaged in cocoa production. One may observe only a small number of farmers producing large quantities of cocoa, which may not necessarily translate into widespread development for the broader population in the community. This means that the measure production per person may fail to fully capture the share of the people in cocoa-producing areas that are truly affected by the price boom. In the GLSS questionnaire, respondents provided an answer to the question, "what specific farming activity is your household engaged in?". The response to this question allows me to calculate the proportion of cocoa farming households that exist in each district. Based on the distribution of the share

[7]This includes the positive spillover effects of the price boom to other traded and non-traded sectors.

of households in cocoa districts, I classify areas with over 10% of families engaged in cocoa farming as treatment districts, those with 5-10% of families involved in cocoa activities as buffer districts and those with less than 5% as the control districts. I apply the survey weights provided in the data to the number of household counts in my sample, and this enables me to generalize my results to the population level.

To measure the impacts of the cocoa price boom on the differential change in poverty and inequality under alternative treatment definitions, I modify the models in Equations 3.8 and 3.9 by replacing the treatment indicator T_i with my new measures and report my new results in Tables 4.6 and 4.7.

In Table 4.6, I present regression results that show the impacts of the cocoa price boom on the differential change in poverty headcount and the poverty gap ratios under the alternative treatment definitions. The combined price boom led to a differential decline in the poverty headcount ratio by about 8% points on average. Also, while the first price boom had no significant impact on the differential change in the poverty headcount ratio, the second price boom led to a differential decline in poverty by about 4% points. The combined price boom also resulted in about a 4% points decline in the differential change in the poverty gap ratio. Similar to the headcount ratio, the first price boom failed to have any significant impact on the poverty gap ratio, but the second boom led to a differential decline in the poverty gap ratio by about 2% points.

Table 4.7 presents results to show the impact of the cocoa price boom on the differential change in wage and consumption per capita inequality for households in cocoa areas relative to non-cocoa areas under the alternative treatment definitions. In the baseline results, the combined price boom generally has a negative and significant impact on the differential change in wage and consumption per capita inequalities for households; however, under the alternative treatment definitions, the combined price boom fails to have any significant impact on the differential change in wage and consumption per capita inequalities. The signs on the coefficients are, however, the same compared to those on my baseline results. Similar to the baseline results, the first and second price booms under the alternative treatment definitions led to a differential decline in consumption per capita and household wages, respectively, for households in cocoa areas relative to those in non-cocoa areas. I note that under the alternative definitions, that the impact of the price booms on my welfare measures were significant at the 10% level, and the coefficients obtained were lower than those obtained under the baseline. Thus, under the alternative treatment definition, the first price boom led to a differential decline in consumption per capita by about 17-47% points, and the second price boom led to a differential decline in wages of households by about 24-34% points.

3.9 Conclusion

In this research, I assess the impact of Ghana's farm-gate cocoa price boom from 1998/1999 to 2012/2013, on households living in districts that produce cocoa. The current study contributes to the existing literature by exploiting the variation in cocoa production intensity caused by Ghana's unique agro-ecological properties, to understand the implications of a commodity price boom on wages and consumption of households.

My results reveal that the combined effect of the farm-gate cocoa price boom differentially increased wages and per capita consumption of households by about 20-71% and 9-11% points, respectively. The combined price boom also led to a differential decline in wage and consumption inequality by about 37-60% and 16-40% points, respectively. Furthermore, the cocoa price boom led to a differential decline in the poverty headcount ratio between households in cocoa districts and those in non-cocoa districts by about 7% points. I find that households in cocoa areas who were living below the poverty line after the boom were less poor than those in non-cocoa areas. This finding is supported by the differential decline in the poverty gap ratio by about 4% points for households in cocoa districts compared to those in non-cocoa districts. Last, I find evidence to suggest that both landless and landowning households at the bottom half of the wage and consumption distribution benefited more from the gains of the price boom compared to those at the top half. However, landowning households were the higher beneficiaries of the price boom compared to the landless households.

Findings from this research can be used by policy-makers to give guidance to decisions around the use of the Ghana farm-gate cocoa price as a policy tool to address issues of wage and consumption inequality, and poverty in areas that grow cocoa.

3.10 Figures

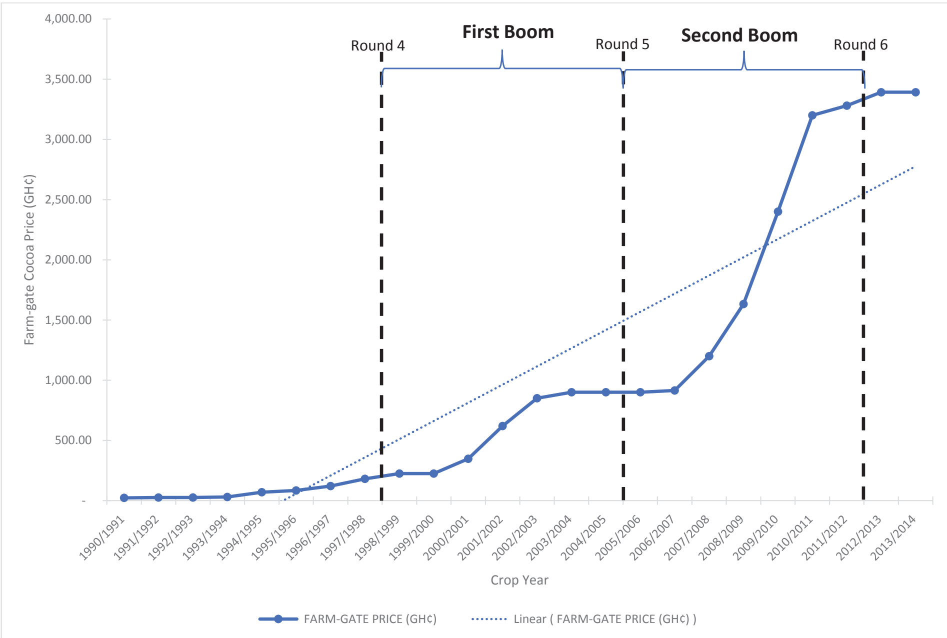

FIGURE 3.1: Historical Trend in Farm-gate Cocoa Price in Ghana (1990/1991-2013/2014

Notes: Graph shows the trend in farm-gate price of cocoa from 1990/1991-2012/2013. *Source:* Authors own calculation based on historical farm-gate cocoa price data from Ghana Cocoa Board. The producer prices indicated on the graph is the farm-gate per tonne of cocoa beans paid by Licensed Buying Companies to all cocoa farmers in Ghana

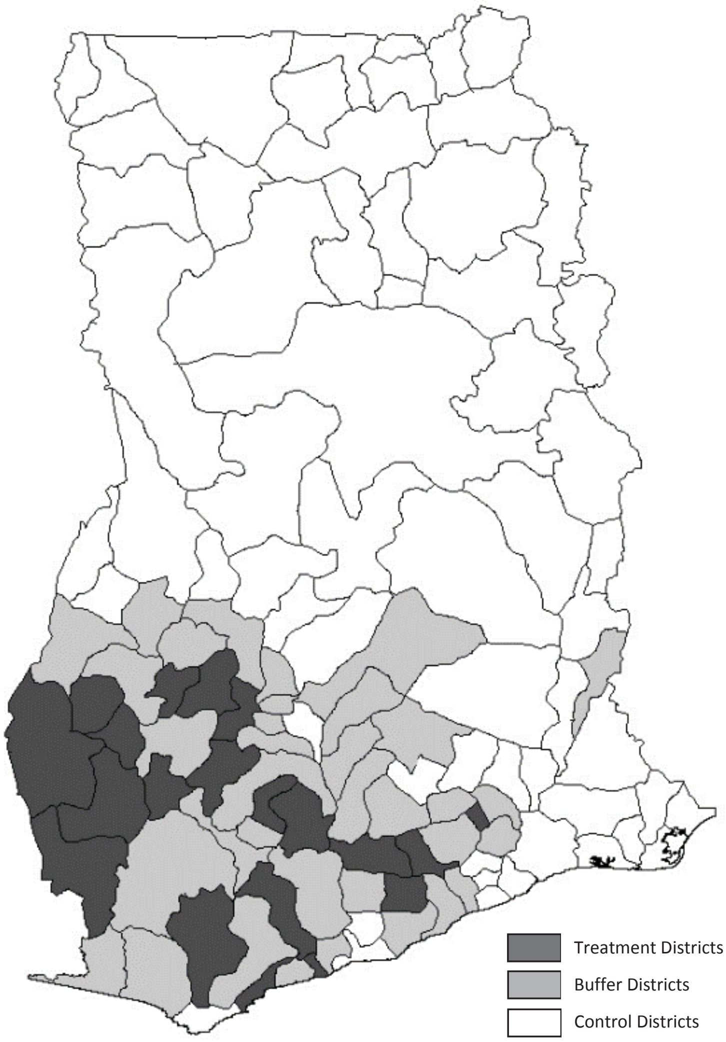

FIGURE 3.2: Treatment, Buffer and Control Districts

Notes: Treatment, control and buffer areas used in baseline definitions. The darker shades are treatment districts, the lighter shades are buffer districts and the white areas are control districts.*Source:* Authors own calculation, created and imported from ArcGIS.

3.11 Tables

TABLE 3.1: Summary Statistics: Poverty Measure

		Cocoa			Non-Cocoa			National Poverty
		Mean	Std. Dev	N	Mean	Std. Dev	N	Rates
	1998/1999	33.15	19.35	17	52.85	30.06	53	39.50
Poverty Headcount Ratio (%)	2005/2006	17.72	15.95	17	42.66	29.19	53	31.90
	2012/2013	14.54	8.94	17	39.65	17.40	53	24.20

Notes: These estimates are based on data from the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. The National Poverty rates are obtained from the 1998/1999, 2005/2006 and 2012/2013 GLSS Poverty Reports. Sample weights are applied when aggregating the household data.

TABLE 3.2: Summary Statistics: Welfare Measures

		Cocoa			Non-Cocoa		
		Mean	Std. Dev	N	Mean	Std. Dev	N
Real Total Household Wage Income (GHC)	1998/1999	278.41	1,353.15	979	208.12	569.33	2797
	2005/2006	543.92	2,018.73	1059	452.49	1,842.35	4811
	2012/2013	2,729.31	8,750.53	2309	1,980.14	7,061.60	8627
Real Household Per Capita Consumption (GHC)	1998/1999	358.18	491.77	979	298.35	414.13	2797
	2005/2006	656.38	994.04	1059	604.13	2,245.01	4811
	2012/2013	760.16	626.90	2309	669.42	824.91	8627

Notes: These estimates are based on data from the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. Sample weights are applied when aggregating the household data.

TABLE 3.3: Summary Statistics: Inequality Measures

		Cocoa			Non-Cocoa		
		Mean	Std. Dev	N	Mean	Std. Dev	N
Household Wage Inequality							
Theil Index	1998/1999	0.38	0.35	17	0.30	0.42	53
	2005/2006	0.46	0.25	17	0.34	0.21	53
	2012/2013	0.59	0.17	17	0.71	0.27	53
Gini Index	1998/1999	0.40	0.16	17	0.34	0.16	53
	2005/2006	0.48	0.10	17	0.40	0.16	53
	2012/2013	0.56	0.07	17	0.59	0.07	53
Atkinson Index	1998/1999	0.56	0.26	17	0.48	0.28	53
	2005/2006	0.61	0.17	17	0.53	0.25	53
	2012/2013	0.75	0.11	17	0.80	0.11	53
Household Per Capita Consumption Inequality							
Theil Index	1998/1999	0.31	0.22	17	0.24	0.21	53
	2005/2006	0.30	0.19	17	0.65	0.96	53
	2012/2013	0.20	0.05	17	0.27	0.22	53
Gini Index	1998/1999	0.38	0.10	17	0.35	0.09	53
	2005/2006	0.38	0.08	17	0.45	0.19	53
	2012/2013	0.34	0.04	17	0.37	0.09	53
Atkinson Index	1998/1999	0.37	0.15	17	0.32	0.11	53
	2005/2006	0.40	0.15	17	0.49	0.23	53
	2012/2013	0.37	0.12	17	0.36	0.12	53

Notes: These estimates are based on data from the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. The STATA command ineqdeco is used to generate the inequality measures. Sample weights are used in estimation.

TABLE 3.4: Impact of Price Boom along Distribution of Welfare Measures

	10%	20%	30%	40%	50%	60%	70%	80%	90%
Total Household Wage Income (GHC)									
All Years, 1998/1999-2012/2013									
Time*Treatment	0.71***	0.54***	0.51***	0.38***	0.37***	0.32***	0.25***	0.20**	0.35***
	(0.20)	(0.13)	(0.11)	(0.08)	(0.07)	(0.05)	(0.05)	(0.08)	(0.07)
First Boom, 1998/1999-2005/2006									
Time*Treatment	0.25	0.11	0.02	0.06	0.06	0.10	0.06	0.00	0.05
	(0.20)	(0.16)	(0.14)	(0.11)	(0.14)	(0.09)	(0.10)	(0.16)	(0.14)
Second Boom, 2005/2006-2012/2013									
Time*Treatment	0.46***	0.43***	0.49***	0.32**	0.31***	0.22**	0.18***	0.19*	0.31***
	(0.15)	(0.14)	(0.15)	(0.14)	(0.10)	(0.10)	(0.07)	(0.10)	(0.11)
Household Per Capita Consumption (GHC)									
All Years, 1998/1999-2012/2013									
Time*Treatment	0.05	0.08**	0.11**	0.10**	0.10**	0.10**	0.09***	0.03	-0.05
	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.05)
First Boom, 1998/1999-2005/2006									
Time*Treatment	0.11*	0.13***	0.12***	0.08*	0.06	0.06	0.12**	0.11*	0.11
	(0.06)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.06)	(0.10)
Second Boom, 2005/2006-2012/2013									
Time*Treatment	-0.06	-0.04	-0.01	0.01	0.03	0.04	-0.02	-0.08*	-0.16***
	(0.07)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.06)

Notes: Regression estimates for the change in logarithm of total household wage and consumption per capita follow Equation 3.8. Data is based on the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. Sample weights are used in estimation. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

TABLE 3.5: Impact of Price Boom on Welfare Inequality

	Theil Index	Gini Coefficient	Atkinson Index ($e = 2$)	N
Total Household Wage Income (GHC)				
All Years, 1998/1999-2012/2013				
Time*Treatment	-0.75	-0.37**	-0.60**	127
	(0.55)	(0.17)	(0.30)	
First Boom, 1998/1999-2005/2006				
Time*Treatment	-0.32	-0.17	-0.38	116
	(0.37)	(0.17)	(0.31)	
Second Boom, 2005/2006-2012/2013				
Time*Treatment	-0.46**	-0.20**	-0.24*	133
	(0.21)	(0.09)	(0.13)	
N				
Household Per Capita Consumption (GHC)				
All Years, 1998/1999-2012/2013				
Time*Treatment	-0.40*	-0.16*	-0.11	138
	(0.21)	(0.09)	(0.14)	
First Boom, 1998/1999-2005/2006				
Time*Treatment	-0.55*	-0.20*	-0.27	135
	(0.29)	(0.12)	(0.19)	
Second Boom, 2005/2006-2012/2013				
Time*Treatment	0.18	0.05	0.18	141
	(0.22)	(0.09)	(0.18)	

Notes: Regression estimates for the change in logarithm of household wage and consumption inequality follow Equation 3.9. Data is based on the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. Sample weights are applied in estimation where necessary. Robust standard errors in parentheses, these are clustered at the district level. Regression model accounts for district fixed effect. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

TABLE 3.6: Impact of Price Boom on Poverty

	Fraction of Households Below Poverty Line	Poverty Gap
All Years, 1998/1999-2012/2013		
Time*Treatment	-7.29**	-3.76**
	(3.64)	(1.70)
N	139	139
R^2	0.82	0.91
First Boom, 1998/1999-2005/2006		
Time*Treatment	-4.19	-1.78
	(4.06)	(1.62)
N	135	135
R^2	0.91	0.66
Second Boom, 2005/2006-2012/2013		
Time*Treatment	-3.13	-1.83*
	(2.35)	(1.06)
N	140	140
R^2	0.92	0.63

Notes: Regression estimates for the change in poverty follow Equation 3.9, where dependent variables are headcount ratio (%) and poverty gap for each district. Data is based on the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. Sample weights are applied in estimation where necessary. Robust standard errors in parentheses, these are clustered at the district level. Regression model accounts for district fixed effect. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

TABLE 3.7: Landowning Households: Impact of Price Boom Along Distribution of Welfare Measures

	10%	20%	30%	40%	50%	60%	70%	80%	90%
Total Household Wage Income (GHC)									
All Years, 1998/1999-2012/2013									
Time*Treatment	1.22***	1.16***	1.04***	0.86***	0.90***	0.70***	0.61***	0.41***	0.51***
	(0.28)	(0.19)	(0.16)	(0.16)	(0.12)	(0.11)	(0.10)	(0.14)	(0.15)
First Boom, 1998/1999-2005/2006									
Time*Treatment	0.49	0.17	0.20	0.11	0.09	0.09	0.03	0.04	0.01
	(0.31)	(0.21)	(0.15)	(0.11)	(0.11)	(0.07)	(0.08)	(0.10)	(0.17)
Second Boom, 2005/2006-2012/2013									
Time*Treatment	0.97***	1.06***	1.02***	0.80***	0.83***	0.60***	0.55***	0.41***	0.46***
	(0.25)	(0.17)	(0.15)	(0.14)	(0.12)	(0.11)	(0.11)	(0.14)	(0.16)
Household Per Capita Consumption (GHC)									
All Years, 1998/1999-2012/2013									
Time*Treatment	0.27**	0.35***	0.35***	0.33***	0.32***	0.26***	0.28***	0.17**	0.07
	(0.10)	(0.07)	(0.07)	(0.07)	(0.07)	(0.05)	(0.08)	(0.08)	(0.13)
First Boom, 1998/1999-2005/2006									
Time*Treatment	-0.11	-0.05	-0.04	-0.08*	-0.08*	-0.05	0.05	0.10	0.05
	(0.08)	(0.05)	(0.06)	(0.04)	(0.05)	(0.04)	(0.07)	(0.07)	(0.08)
Second Boom, 2005/2006-2012/2013									
Time*Treatment	0.15	0.22***	0.23***	0.25***	0.26***	0.20***	0.16*	0.06	-0.04
	(0.10)	(0.06)	(0.05)	(0.07)	(0.07)	(0.06)	(0.09)	(0.08)	(0.13)

Notes: Regression estimates for the change in logarithm of total household wage and consumption per capita follow Equation 3.8. Data is based on the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013 and restricted to only landowning households. Sample weights are used in estimation. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

TABLE 3.8: Landless Households: Impact of Price Boom along Distribution of Welfare Measures

	10%	20%	30%	40%	50%	60%	70%	80%	90%
Total Household Wage Income (GHC)									
All Years, 1998/1999-2012/2013									
Time*Treatment	0.63**	0.46***	0.45***	0.32***	0.31***	0.27***	0.23***	0.20**	0.37***
	(0.31)	(0.15)	(0.12)	(0.09)	(0.10)	(0.08)	(0.06)	(0.08)	(0.08)
First Boom, 1998/1999-2005/2006									
Time*Treatment	0.17	-0.14	-0.01	-0.18	-0.03	0.06	0.16	0.15	0.17
	(0.24)	(0.17)	(0.21)	(0.14)	(0.21)	(0.17)	(0.13)	(0.13)	(0.16)
Second Boom, 2005/2006-2012/2013									
Time*Treatment	0.38***	0.35***	0.43***	0.26**	0.25**	0.17	0.17	0.19	0.32***
	(0.13)	(0.13)	(0.14)	(0.10)	(0.10)	(0.10)	(0.11)	(0.14)	(0.10)
Household Per Capita Consumption (GHC)									
All Years, 1998/1999-2012/2013									
Time*Treatment	0.03	0.06	0.10**	0.08*	0.09***	0.10***	0.09**	0.03	-0.06
	(0.05)	(0.05)	(0.05)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.06)
First Boom, 1998/1999-2005/2006									
Time*Treatment	0.23***	0.26***	0.23***	0.20***	0.19***	0.15***	0.19***	0.10	0.12
	(0.08)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.07)	(0.07)	(0.13)
Second Boom, 2005/2006-2012/2013									
Time*Treatment	-0.08	-0.06	-0.02	0.00	0.03	0.04	-0.03	-0.08*	-0.17***
	(0.06)	(0.05)	(0.05)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.06)

Notes: Regression estimates for the change in logarithm of total household wage and consumption per capita follow Equation 3.8. Data is based on the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013 and restricted to only landless households. Sample weights are used in estimation. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

Chapter 4

Concluding Remarks

4.1

The two essays in this dissertation investigate the impact of the farm-gate cocoa price increase on the welfare of individuals living in the areas that produce cocoa in Ghana. I construct a unique data set by combining administrative data from the Ghana Cocoa Board and survey data from the DHS and GLSS and use it to assess empirically how a farm-gate cocoa price boom affects the welfare of residents in cocoa areas. I leverage on Ghana's unique agro-ecological properties together with detailed production data from the Ghana Cocoa Board to identify suitable treatment and comparison districts for this research. I identify the impact of the price boom by comparing my outcomes of interest in cocoa areas to those in non-cocoa areas.

In the first essay, I examine the impact of cocoa price boom on child malnutrition, and the channels through which the price boom affects child malnutrition. I find that the cocoa price boom led to a differential increase in the probability of stunting and underweight among children living in cocoa districts compared to those in non-cocoa districts. I show that a farm-gate cocoa price boom increases household income in cocoa areas, and provide evidence in Chapter 2 to suggest that part of this income is invested in increasing consumption per capita for household members. However, the income effect derived from the price boom fails to exceed the substitution effect that results in declines in antenatal visits, breastfeeding and vaccinations against diseases.

The second essay explores the impact of the farm-gate price boom on poverty and inequality in wages and per capita consumption. I find that the overall impact of the farm-gate cocoa price boom differentially increased wages and per capita consumption of households across the distribution. Also, inequality in wages and per capita consumption declined. Further, I find that both the poverty headcount ratio and the intensity of poverty declined during the price boom period. Finally, I find evidence to suggest that both landless and landowning households at the bottom half of the wage and consumption distribution benefited more from the gains of the price boom compared to those at the top half. However, landowning households were the higher beneficiaries of the price boom compared to the landless households.

The methodology used to identify areas of Ghana where a cocoa price boom has the most impact is novel and robust. This method can be applied in other research areas to identify geographical areas that will be impacted most by other commodity shocks.

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Appendix

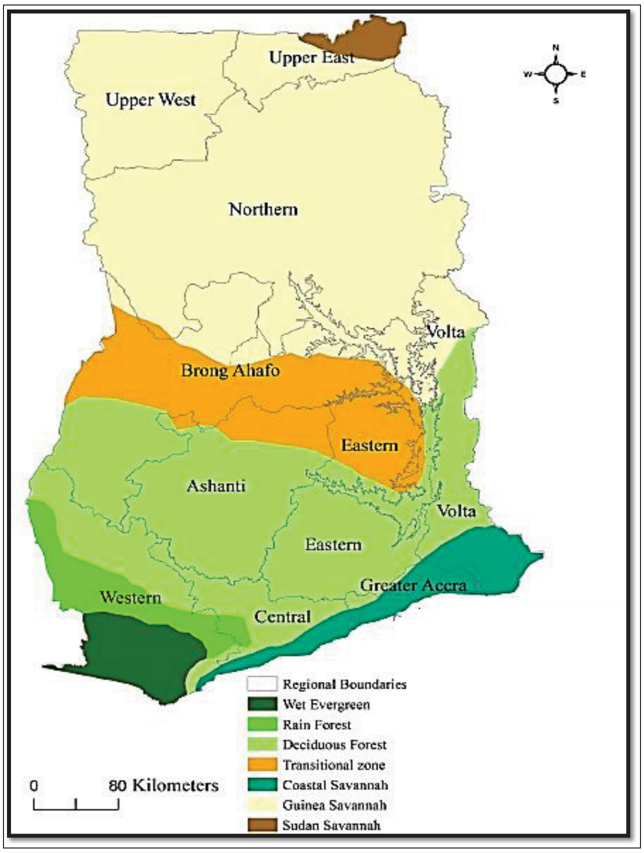


FIGURE 4.1: Agro-ecological zones in Ghana

Notes: A map showing the different agro-ecological zones in Ghana. *Source*: Adapted from Antwi et al. (2014)

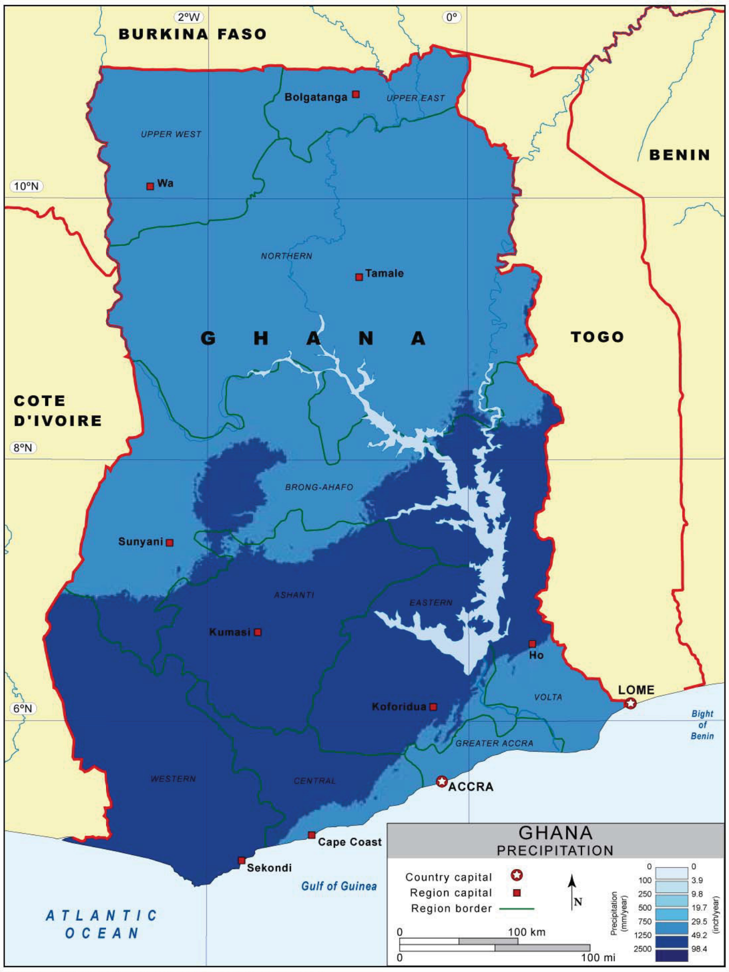


FIGURE 4.2: Precipitation Map of Ghana

Notes: A map showing precipitation rates across Ghana in inches per year. *Source*: World Trade Press

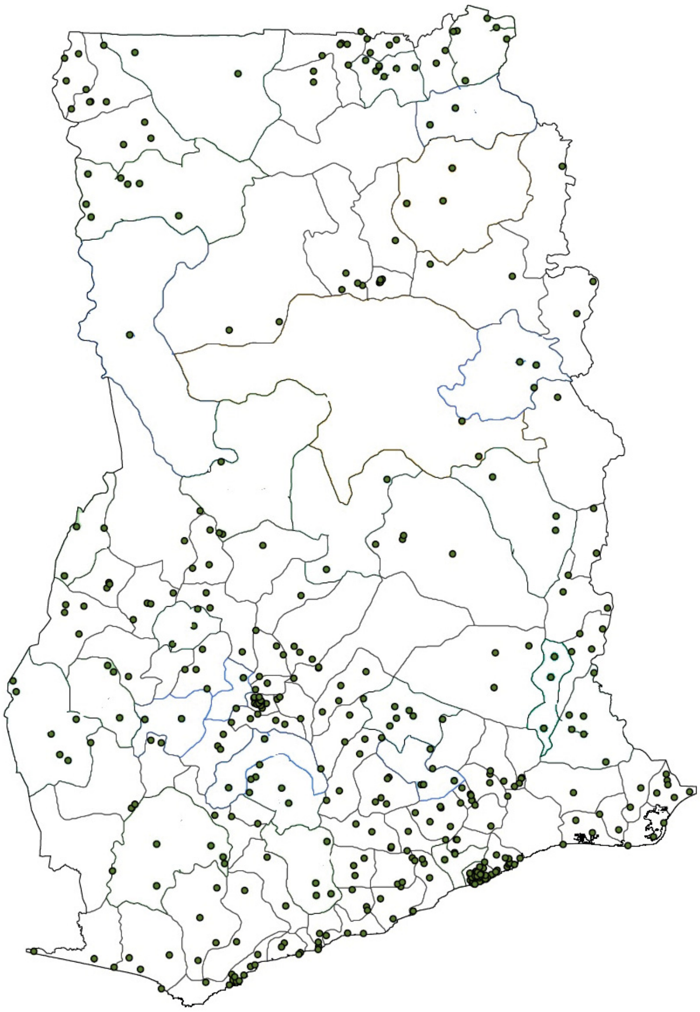
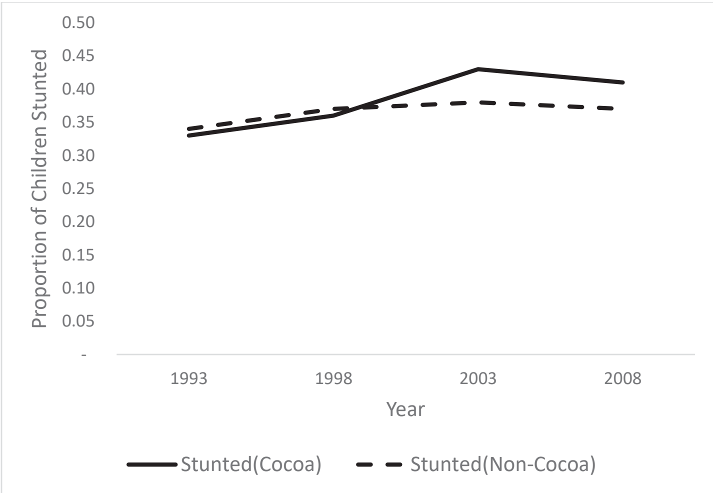
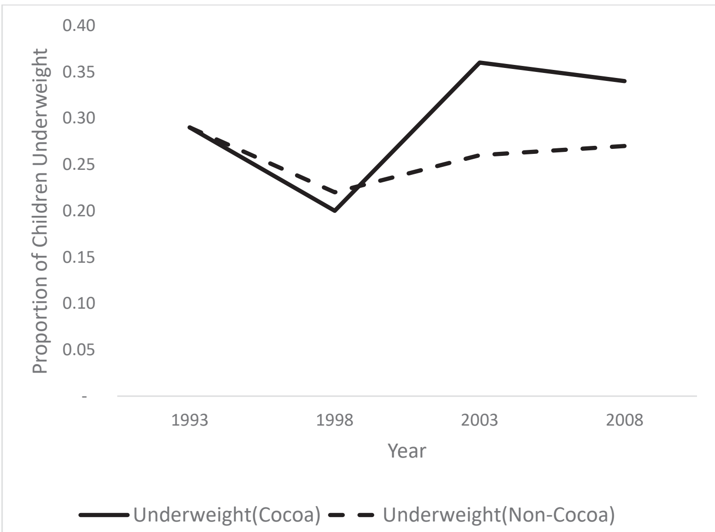


FIGURE 4.3: Distribution of Survey Clusters across Districts in Ghana

Notes: A map showing all 110 districts in Ghana.The solid dots within the map show the clusters at the time of survey *Source*: Authors' own calculations.



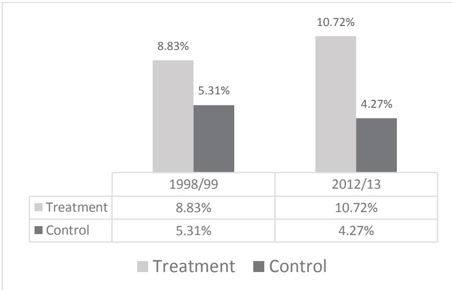
A. Linear trend showing the proportion of stunted children in cocoa and non-cocoa districts



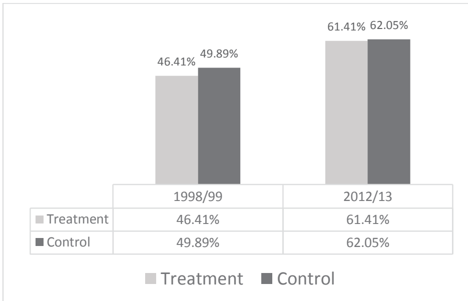
B. Linear trend showing the proportion of underweight children in cocoa and non-cocoa districts

FIGURE 4.4: Linear Trends of Health Outcome Variables

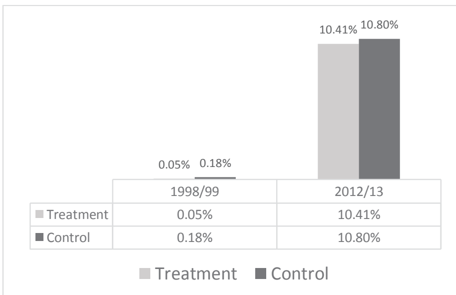
Notes: The Figures shown above, show the trends in the proportion of stunted and underweight children in cocoa and non-cocoa districts *Source*: Authors' own calculations using data from the Ghana DHS for the years 1993, 1998, 2003 and 2008.



A. Proportion of residents who moved to district for work



B. Proportion of residents who form the district labor force



C. Proportion of children 10 years and younger born in district

FIGURE 4.5: Impact of Cocoa Boom on Migration and Fertility within Districts

Notes: Figures A and B shows the impact of the boom on migration while Figure C shows the impact on Fertility *Source*: Authors' own calculations using data from GLSS.

TABLE 4.1: Employment Share, Production per Person, Production per District Size and Treatment, Comparison and Buffer District Dummies

District Name	Employment Share (%)	Production per district size (tons)	Production Per Person (sq km)	Employment Share Dummy	Production Per District Size Dummy	Production Per Person Dummy
Adansi East	55.00	12.27	131.30	1	1	1
Adansi West	8.00	6.40	22.44	B	B	B
Afigya Sekyere	5.00	3.66	23.89	0	B	B
Ahafo Ano North	25.00	6.08	50.05	1	1	1
Ahafo Ano South	27.50	6.54	54.95	1	1	1
Amansie East	25.00	4.62	40.72	B	B	B
Amansie West	45.00	6.79	71.06	1	1	1
Asante Akim North	10.00	2.81	32.57	B	B	B
Asante Akim South	25.00	3.37	44.35	1	B	1
Atwima	1.25	5.91	60.60	B	B	B
Bosomtwe-Kwanwoma	5.00	0.00	0.00	B	B	B
Ejisu-Juabeng	15.00	0.00	0.00	B	0	B
Ejura Sekyedumase	0.00	0.00	0.00	0	0	0
Kumasi	1.07	0.00	0.00	B	B	B
Kwabre	0.00	0.00	0.00	0	B	B
Offinso	7.50	2.65	27.83	B	B	B
Sekyere East	12.50	0.63	18.19	1	B	B
Sekyere West	1.25	0.00	0.00	B	0	0
Asunafo	87.50	14.87	182.89	1	1	1
Asutifi	7.50	1.06	22.65	B	B	B
Atebubu	0.00	0.00	0.00	0	0	0
Berekum	0.00	0.00	0.00	0	0	0
Dormaa	5.00	2.32	34.15	0	B	B
Jaman	20.00	0.00	0.00	B	0	0
Kintampo	0.00	0.00	0.00	0	0	0
Nkoranza	0.00	0.00	0.00	0	0	0
Sene	0.00	0.00	0.00	B	0	0
Sunyani	3.00	1.34	9.66	B	B	B
Tano	0.00	0.00	0.00	B	B	B
Techiman	0.00	0.00	0.00	0	0	0
Wenchi	8.75	0.00	0.00	B	0	0
Abura-Asebu-Kwamankese	5.00	0.00	0.00	B	B	B
Agona	27.00	5.09	20.22	1	1	B
Ajumako/Enyan/Esiam	5.00	0.00	0.00	0	0	B
Asikuma Odoben Brakwa	15.00	0.00	0.00	B	B	B
Assin	45.00	4.54	55.85	1	B	1
Awutu Efutu Senya	0.00	0.00	0.00	B	B	0
Cape Coast	0.00	19.91	22.78	B	B	B
Gomoa	1.67	0.00	0.00	B	B	0
Komenda-Edina-Eguafo-Abirem	0.00	0.00	0.00	B	B	B
Lower Denkyira	45.00	7.05	83.19	1	1	1
Mfantsiman	0.00	0.00	0.00	B	0	B
Upper Denkyira	55.00	3.21	33.83	1	B	B
Afram Plains	0.00	0.00	0.00	0	0	0
Akwapim North	0.00	0.00	0.00	0	0	0
Akwapim South	0.00	0.00	0.00	0	0	0
Asuogyaman	0.00	0.00	0.00	0	0	0
Birim North	10.00	3.47	34.94	B	B	B
Birim South	20.00	10.08	60.58	1	1	1
East Akim	16.25	2.42	18.94	1	B	B
Fanteakwa	2.50	0.00	0.00	0	0	0
Kwabibirem	16.67	3.59	23.01	1	B	B
Kwahu South	3.00	2.83	24.49	0	B	B
Manya Krobo	0.00	0.00	0.00	0	0	0
New Juaben	3.33	16.50	26.01	0	1	B

Notes: Relative measures of cocoa production based on district population, size and number of households engaged in cocoa activity. The dummies 1, 0 and B represent treatment, comparison and buffer districts respectively. *Source*: Authors own calculations using data from 4th rounds of the Ghana living Living Standard Survey(GLSS)data, district reports from the 6th rounds of GLSS and data from the 2000 Ghana population and housing census

TABLE 4.2: Employment Share, Production per Person, Production per District Size and Treatment, Comparison and Buffer District Dummies (Continued)

District Name	Employment Share (%)	Production per district size (tons)	Production Per Person (sq km)	Employment Share Dummy	Production Per District Size Dummy	Production Per Person Dummy
Suhum Kraboa Coaltar	11.67	4.60	26.92	1	B	B
West Akim	28.75	5.34	28.58	1	1	B
Yilo Krobo	0.00	0.00	0.00	0	0	0
Accra	0.00	0.00	0.00	B	B	B
Dangbe East	2.50	0.00	0.00	0	0	0
Dangbe West	0.00	0.00	0.00	0	0	0
Ga	0.00	0.00	0.00	B	B	B
Tema	0.00	0.00	0.00	B	B	B
Bole	0.00	0.00	0.00	0	0	0
East Gonja	0.00	0.00	0.00	0	0	0
East Mamprusi	0.00	0.00	0.00	0	0	0
Gushiegu Karaga	0.00	0.00	0.00	0	0	0
Nanumba	0.00	0.00	0.00	0	0	0
Saboba Chereponi	0.00	0.00	0.00	0	0	0
Savelugu Nanton	0.00	0.00	0.00	0	0	0
Tamale	0.00	0.00	0.00	0	0	0
Tolon-Kumbungu	0.00	0.00	0.00	0	0	0
West Gonja	0.00	0.00	0.00	0	0	0
West Mamprusi	0.00	0.00	0.00	0	0	0
Yendi	0.00	0.00	0.00	0	0	0
Zabzugu Tatale	0.00	0.00	0.00	0	0	0
Bawku East	0.00	0.00	0.00	0	0	0
Bawku West	0.00	0.00	0.00	0	0	0
Bolgatanga	0.00	0.00	0.00	0	0	0
Bongo	0.00	0.00	0.00	0	0	0
Builsa	0.00	0.00	0.00	0	0	0
Kassena Nankana	0.00	0.00	0.00	0	0	0
Jirapa Lambussie	0.00	0.00	0.00	0	0	0
Lawra	0.00	0.00	0.00	0	0	0
Nadowli	0.00	0.00	0.00	0	0	0
Sissala	0.00	0.00	0.00	0	0	0
Wa	0.00	0.00	0.00	0	0	0
Akatsi	0.00	0.00	0.00	0	0	0
Ho	0.00	0.00	0.00	B	B	B
Hohoe	0.00	1.47	13.46	B	B	B
Jasikan	0.00	0.00	0.00	B	B	0
Kadjebi	5.00	0.00	0.00	B	0	0
Keta	0.00	0.00	0.00	0	0	0
Ketu	0.00	0.00	0.00	0	0	0
Kpandu	12.50	0.00	0.00	B	0	0
Krachi	0.00	0.00	0.00	B	0	0
Nkwanta	0.00	0.00	0.00	B	B	0
North Tongu	0.00	0.00	0.00	0	0	0
South Tongu	0.00	0.00	0.00	0	0	0
Ahanta West	0.00	0.00	0.00	B	B	B
Aowin-Suaman	90.00	13.69	303.53	1	1	1
Bibiani Anhwiaso Bekwai	35.00	17.74	144.12	1	1	1
Jomoro	0.00	0.00	0.00	B	B	B
Juabeso Bia	73.33	18.34	314.06	1	1	1
Mpohor Wassa East	5.00	0.00	0.00	B	B	B
Nzema East	2.50	0.00	0.00	B	B	B
Sefwi Wiawso	40.00	11.14	198.31	1	1	1
Shama Ahanta East	1.25	14.51	15.18	B	B	B
Wassa Amenfi	63.75	3.97	43.90	1	B	1
Wassa West	20.00	7.83	166.87	1	1	1

Notes: Relative measures of cocoa production based on district population, size and number of households engaged in cocoa activity. The dummies 1, 0 and B represent treatment, comparison and buffer districts respectively. *Source*: Authors own calculations using data from 4th rounds of the Ghana living Living Standard Survey(GLSS)data, district reports from the 6th rounds of GLSS and data from the 2000 Ghana population and housing census .

TABLE 4.3: Robustness Checks: Migration and Fertility

	Migration						Fertility		
	Share of Residents who moved to District for Work			Share of District Residents in Labour Force			Share of Residents 10 years and younger Born in District		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Time*Treatment (%)	2.93	2.86	2.93	2.83	2.77	2.33	-0.26	-0.22	-0.24
	(1.86)	(1.92)	(2.01)	(2.75)	(2.85)	(4.09)	(0.65)	(0.70)	(0.68)
Constant	5.31***	9.02***	5.75***	49.89***	45.93***	49.66***	0.18**	0.16	-0.56
	(0.65)	(1.96)	(1.76)	(1.37)	(2.49)	(1.32)	(0.09)	(0.35)	(0.57)
Observations	139	139	139	139	139	139	139	139	139
R-squared	0.22	0.39	0.36	0.41	0.53	0.71	0.92	0.93	0.94
District FE	No	Yes	No	No	Yes	No	No	Yes	No
Region FE	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Estimates are based on the 4th and 6th rounds of the Ghana living Living Standard Survey(GLSS)data. Sample weights are used in estimation.

TABLE 4.4: Robustness Checks: Fertility

Stunting	All Children	Boys	Girls	<24 Months	<24 Months	Boys<24 Months	Boys>24 Months	Girls<24 Months	Girls>24 Months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Time*Treatment	0.12***	0.22**	0.02	0.13	0.16	0.24*	0.35	0.06	0.17
	(0.02)	(0.10)	(0.13)	(0.09)	(0.19)	(0.13)	(0.24)	(0.23)	(0.21)
Observations	695	342	353	489	206	230	112	259	94
R-squared	0.58	0.62	0.57	0.56	0.67	0.64	0.73	0.54	0.76
Underweight									
Time*Treatment	0.04	0.22***	0.28***	0.04	0.10	-0.18*	-0.08	0.23*	0.55***
	(0.05)	(0.08)	(0.10)	(0.06)	(0.12)	(0.10)	(0.18)	(0.13)	(0.20)
Observations	695	342	353	489	206	230	112	259	94
R-squared	0.23	0.29	0.26	0.23	0.42	0.34	0.56	0.25	0.53

Notes: Estimates are based on the 4th and 6th rounds of the Ghana living Living Standard Survey(GLSS)data. Sample weights are used in estimation.

TABLE 4.5: Summary Statistics of Welfare Measures Grouped by Percentiles

Real Per Capita Consumption (GHC)	1998/1999		2005/2006		2012/2013	
	Cocoa	Non-Cocoa	Cocoa	Non-Cocoa	Cocoa	Non-Cocoa
10%	116.39	77.02	190.57	112.90	252.81	158.88
20%	143.78	107.17	260.97	171.84	335.76	229.94
30%	175.44	140.67	324.20	229.63	414.67	296.74
40%	209.28	174.27	383.88	293.93	492.69	372.83
50%	245.71	213.57	448.93	366.32	585.53	462.02
60%	289.04	261.23	527.33	449.13	699.12	570.39
70%	350.82	330.77	662.75	556.15	844.17	723.55
80%	452.04	415.22	860.34	706.59	1,068.66	950.46
90%	642.17	577.24	1,260.19	1,012.18	1,450.34	1,373.12
Real Household Wage Income (GHC)						
10%	136.59	176.23	261.20	262.36	295.74	188.10
20%	260.59	307.43	438.07	463.81	519.42	357.05
30%	353.15	409.73	578.14	658.96	808.98	566.06
40%	473.79	508.02	824.17	830.77	1,138.61	830.42
50%	583.52	662.80	1,001.30	1,067.69	1,556.00	1,212.89
60%	723.23	778.17	1,348.74	1,309.80	2,199.71	1,719.39
70%	923.88	964.30	1,697.61	1,665.11	3,014.32	2,451.94
80%	1137.79	1197.98	2,249.97	2,358.88	4,190.03	3,615.96
90%	1421.37	1631.63	3,384.64	3,701.16	7,411.40	5,951.68

Notes: These estimates are based on data from the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. GHC is the local currency unit in Ghana.

TABLE 4.6: Impact of Cocoa Price Boom on Poverty: Use of Alternative Treatment Definitions

	Treatment 2 Share of Cocoa Households per District		Treatment 3 District Cocoa Production per person	
	Fraction of Households Below Poverty Line	Poverty Gap	Fraction of Households Below Poverty Line	Poverty Gap
All Years, 1998/1999-2012/2013				
Time*Treatment	-8.86***	-4.51***	-7.57*	-3.99**
	(2.95)	(1.46)	(4.06)	(1.81)
N	153	153	139	139
R^2	0.91	0.91	0.89	0.91
First Boom, 1998/1999-2005/2006				
Time*Treatment	-5.09	-1.94	-5.27	-2.16
	(3.46)	(1.46)	(4.49)	(1.76)
N	148	148	133	133
R^2	0.91	0.92	0.91	0.92
Second Boom, 2005/2006-2012/2013				
Time*Treatment	-3.89*	-2.40**	-2.48	-1.75
	(2.23)	(1.00)	(2.69)	(1.14)
N	155	155	140	140
R^2	0.92	0.9	0.92	0.93

Notes: Regression estimates for the change in poverty follow Equation 3.9, where dependent variables are headcount ratio (%) and poverty gap for each district. Model uses alternative treatment definitions. Data is based on the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. Sample weights are applied in estimation where necessary. Huber-White standard errors in parentheses. Regression model accounts for district fixed effects. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

TABLE 4.7: Impact of Cocoa Price Boom on Welfare Inequality: Use of Alternative Treatment Definitions

	Treatment 2 Share of cocoa Households per district			Treatment 3 District cocoa production per person		
	Theil Index	Gini Coefficient	Atkinson Index ($e = 2$)	Theil Index	Gini Coefficient	Atkinson Index ($e = 2$)
Total Household Wage Income (GHC)						
All Years, 1998/1999-2012/2013						
Time*Treatment	-0.38	-0.17	-0.22	-0.39	-0.17	-0.20
	(0.35)	(0.17)	-0.3	(0.48)	(0.23)	(0.44)
First Boom, 1998/1999-2005/2006						
Time*Treatment	-0.05	-0.03	-0.05	-0.08	-0.05	0.01
	(0.34)	(0.16)	-0.3	(0.48)	(0.23)	(0.43)
Second Boom, 2005/2006-2012/2013						
Time*Treatment	-0.35*	-0.15	-0.20	-0.35*	-0.14	-0.24*
	(0.19)	(0.09)	-0.14	(0.20)	(0.09)	(0.14)
Household Per Capita Consumption (GHC)						
All Years, 1998/1999-2012/2013						
Time*Treatment	-0.27	-0.09	-0.01	-0.27	-0.10	-0.02
	(0.16)	(0.07)	(0.12)	(0.20)	(0.08)	-0.13
First Boom, 1998/1999-2005/2006						
Time*Treatment	-0.47*	-0.17*	-0.24	-0.48	-0.19	-0.29
	-0.25	(0.10)	(0.15)	(0.31)	(0.13)	(0.21)
Second Boom, 2005/2006-2012/2013						
Time*Treatment	0.23	0.09	0.24	0.23	0.09	0.27
	-0.21	(0.08)	(0.15)	(0.25)	(0.09)	(0.19)

Notes: Regression estimates for the change in logarithm of household wage and consumption inequality follow Equation 3.9. Model is based on alternative treatment definitions. Data is based on the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. Sample weights are applied in estimation where necessary. Huber-White standard errors in parentheses. Regression model accounts for district fixed effects. Stars represent the statistical significance (* for 10%, ** for 5% *** for 1%).

TABLE 4.8: Summary Statistics of Other Poverty Measures

	1998/1999		2005/2006		2012/2013	
	Cocoa	Non-Cocoa	Cocoa	Non-Cocoa	Cocoa	Non-Cocoa
Incidence of poverty (%)	33.15	52.85	17.72	42.66	14.54	39.65
Absolute Number of individuals below poverty line	904,806	4,769,778	508,125	5,215,753	558,244	4,893,388
Poverty Gap (%)	9.98	20.85	4.71	16.66	2.11	15.23
Amount needed to bring each person out of poverty (GHC)	8.98	18.77	17.47	61.81	27.73	200.12

Notes: These estimates are based on data from the Ghana Living Standard Survey (GLSS) for the years of 1998/1999, 2005/2006 and 2012/2013. The National Poverty rates are obtained from the 1998/1999, 2005/2006 and 2012/2013 GLSS Poverty Reports. Sample weights are applied when aggregating the household data.