ASHESI UNIVERSITY

The Impact of Increasing Productivity on Ghana's Exchange Rate: A Time Series Approach to Test the Productivity Bias Hypothesis in Ghana

Undergraduate Thesis Report submitted to the Department of Business Administration, Ashesi University in partial fulfilment of the requirement for the award of Bachelor of Science degree in Business Administration

B.Sc. Business Administration

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May 2020

DECLARATION

I hereby declare that this undergraduate thesis is my original work and that no part of it has been presented for another degree in this university or elsewhere.

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Student Date:

I hereby declare that the preparation and presentation of this undergraduate thesis was supervised in accordance with the guidelines on supervision of theses established by Ashesi University College.

Supervisor's Signature: ___

Supervisor's Name: Dr. Stephen Emmanuel Armah

Date: 11th May, 2020

ACKNOWLEDGEMENT

My gratitude goes to God almighty for His grace and guidance, which aided in my successful undertaking of this study. My deepest appreciation also goes out to my supervisor, Dr. Stephen E. Armah, without whose guidance and practical advice, this thesis will not be what it is today.

My gratitude also goes to my mates, whose inputs guided me while working on this thesis. Special thanks to Samuel Fordjuor, Jacques Wemegah, Kudakwashie, Francisca, Mawunyo, and Keziah for their valuable contributions, which helped mold the study.

Finally, I would like to my family who put up with me during the trying times of the Convis-19 pandemic. Their reassurances and words gave me strength to push through the uncertain times the pandemic brought upon us.

ABSTRACT

The Productivity Bias Hypothesis (PBH) is a theory that has been used to try to explain the long-run behavior of Purchasing Power Parity. The extensive literature on the validity of the Productivity Bias Hypothesis has yielded mixed results. These results are dependent on the econometric model used (Officer, 1976) and the type of dataset employed (Bahmani-Oskooee & Nasir, 2005).

This study tested the validity of the PBH using data from Ghana. To do so, the study answered the following questions; Will increasing productivity in Ghana prove to be an effective strategy to stabilize the cedi exchange rate? Does the productivity Bias Hypothesis hold in Ghana? Is the exchange rate in Ghana affected by price levels? Is the exchange rate in Ghana affected by productivity levels?

To answer the questions, a model by Zakaria and Ahmad (2009) was employed to test data between Ghana and its major trading partners by running a regression analysis. The variables used in the model were; nominal exchange rate, price levels, and productivity indices.

Regression results validated the PBH between Ghana and its major trading partners. From the analysis, the coefficients of price, domestic sector, and foreign sector were, in most cases, negative, negative and positive. This implies that Ghana has the potential to enjoy real appreciation in its bilateral exchange rates with its major trading partners if it goes through a period of sustainable growth.

DEFINITION OF TERMS

Financial Systems: A financial system is a system that allows the exchange of funds between financial market participants. They may operate at a global or national level

Purchasing Power Parity: A theory in economics which asserts that the price levels between two countries must be equal.

Productivity Bias Hypothesis: This is an economic hypothesis which states that a country experiencing a higher growth trajectory tends to experience real appreciation in its exchange rate as a result of positive productivity shocks.

Productivity: This is the output of a single worker in the labor force within a specified period.

Tradable Goods Sector: This refers to the sectors of a country whose goods are traded. For this study, the tradable goods sectors are Industry (Manufacturing, Construction, etc.) and Agriculture

Nontradable Goods Sector: This refers to the sector whose goods are not traded. For this study, the services sector of the economy will be used as a proxy for the nontraded sector.

LIST OF ABBREVIATION

ADF Test: Augmented Dicky-Fuller Test

GMM: Generalized Method of Moments

NED: Netherlands

OECD: Organization for Economic Cooperation and Development

PPP: Purchasing Power Parity

PBH: Productivity bias Hypothesis

SA: South Africa

USA: United States of America

UK: United Kingdom

VIF: Variance Inflation Factor

WLS: Weighted Least Squares

WWI: World War One

WWII: World War Two

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CHAPTER ONE: INTRODUCTION

1.1 Background

This thesis tested the validity of the Productivity Bias Hypothesis (PBH) using data from Ghana and seven of its major trading partners (USA, UK, China, India, South Africa, Netherlands, and Switzerland). It explored whether increasing productivity in Ghana is an effective strategy to stabilize the wildly fluctuating Ghana Cedi (GHS) to major currencies. It sought to confirm whether the Cedi exchange rate with currencies of Ghana's major trading partners was affected by price levels and if productivity levels influence the exchange rate in Ghana.

To answer the questions, a model by Zakaria and Ahmad (2009) was employed to investigate the existence and strength of the PBH relationship between Ghana and its major trading partners by running a regression analysis. The variables used in the model were the nominal exchange rate, change in price levels, and productivity indices. To provide some context to this study, however, some background information will be provided to situate the discussion. The history of past financial regimes like the Gold Standard and the Bretton Woods System will be discussed and how the successes and failures of both systems resulted in the adoption of the current floating exchange rate regime.

1.1.1 History of Global Financial Systems

The Gold Standard

The global financial system has gone through major upheavals, which can be split into two phases; the **Gold Standard** and the **Bretton Woods System**. The Gold Standard was the dominant system in place pre-World War I. The gold standard, as a monetary

system, emerged when major European countries decided to adopt gold as a basis for international payments (Igwe, 2018).

These countries, which included Britain, USA, France, Germany, and other European countries, allowed gold to flow freely across their territories and agreed upon a price that the gold can be converted into their local currency. The gold standard ushered in a new age of global economic growth and integration in which Britain was the dominant player in the international market (Igwe, 2018). This was because Britain was a colonial giant with colonies and former colonies extending from India to Africa to Asia and as far as Australia and Canada, so it was a wealthy country with an extensive reach. So, Britain's development was integrally linked to global growth, with Britain assuming the position of the lender of last resort (Igwe, 2018).

The advent of the WWI led to the gold standard's demise (Igwe, 2018). This was because major European countries began to take independent steps, inconsistent with the gold standard, which resulted in a floating exchange rate system tied to wartime uncertainties (Igwe, 2018). This was not the only reason the gold standard collapsed.

Faulty monetary policies of central banks of major European and other players also played a part in causing the gold standard to collapse (Nadler, 1933). During the war, countries such as Great Britain and Germany borrowed large amounts of short-term instruments to finance long-term investments. Thus, they were unable to convert these investments to ready cash when creditors, in particular, the United States, came to request for their funds back (Nadler, 1933). The above factors, among others, facilitated the collapse of the gold standard after WWI, and it took twenty-five (25) years for another system, the Bretton Woods System, to be adopted in 1944.

The Bretton Woods System

The Bretton Woods System was implemented in 1944 to serve as a replacement for the gold standard. Under this system, strict codes of conduct were formulated, which were intended to ensure that countries could not take unilateral steps to devalue their currencies (Igwe, 2018), as was the case post World War 1. The system also provided for an adjustable pegged-exchange rate, linked to the US dollar, with the US dollar being pegged to gold (Igwe, 2018). Thus, all countries continued to be pegged to gold through the dollar. However, the system was not without its problems, as will be discussed below.

First, the two institutions set up under the Bretton Woods System, to lead global redevelopment after the war, the International Monetary Fund (IMF) and the World Bank, did not entirely take-off as expected (Morse, 1983).

This was, in part, due to some assumptions made by the formulators of the agreement, which did not pan out. Some of the assumptions they had included; they expected the countries of the world to remain peaceful and united, they expected those countries to satisfy their economic needs without considering political implications, and that all the signees of the Bretton Woods agreement will adopt multilateralism (Morse, 1983).

Furthermore, the failure of the Bretton Woods could be attributed to the unwillingness of the United States of America to act as the central manager of the system; thus, they were unwilling to put global interest above domestic ones (Bordo, 1995). This development led to the US government pursuing policies beneficial to their local economy, but not very palatable to foreign countries. An example could be the imposition of a global

inflation rate in the 1960s, and a rate other nations were unwilling to accept (Bordo, 1995). This eventually also led to the demise of the Bretton Woods System.

The fall of the Bretton Woods system ushered in an era of the managed floating exchange rate system, where most states allowed their exchange rates to be determined by the market, with some governmental intervention when the need arose (Madura, 2008).

1.1.2 The Ghanaian Situation

In the preceding section, the changes that the global financial systems went through were discussed in terms of exchange rate policy. It can be observed that the gold standard introduced a system of a floating exchange rate pegged to the price of gold. In contrast, the Bretton Woods System introduced a fixed rate system, with an adjustable peg, where only the dollar was tied to gold, while other currencies were tied to the dollar (Igwe, 2018). Thus, this section will discuss the case of Ghana and the major exchange rate regimes the country has gone through

Ghana, as a developing nation and one heavily dependent on imports, cannot afford to take exchange rate appreciation or depreciation lightly. This is because a high rate of importation has a significant effect on the importing country's domestic currency (Calderon & Duncan, 2003; Diebold, Husted & Rush, 1991, as cited by Nyarko, 2016). Since almost all goods were imported, a weak domestic will make things expensive and visit untold hardships upon Ghanaians. Thus, to improve the exchange rate situation, previous governments implemented various policies for exchange rate control, which led to the country going through two exchange rate regimes (Nyarko, 2016).

The first regime, which was implemented by governments in the 1960s and 1970s, was a fixed-rate regime (Asuming-Brempong, 1998). A characteristic of the fixed exchange rate regime was the periodical devaluation of the cedi in response to changes in demand and supply (Asuming-Brempong, 1998).

The cedi, however, went through a significant devaluation in 1971 because the fixed-rate regime led to an unfavorable balance of payments and a deflationary spiral (Dordunoo, 1994). Other adverse effects of the fixed-rate system were rampant inflation, scarcity of foreign exchange enforcement of exchange controls, and the growth of a black market for foreign currency, all of which were mostly caused by a breakdown in the monetary and fiscal discipline (Bawumia, 2014). One thing that should be noted is that the devaluations were artificial, which is arbitrarily carried out by the government to protect the fixed exchange rate regime. The high inflation, meanwhile, is a direct effect of poorly managed fixed exchange rate regimes.

The fixed exchange rate regime was abandoned in 1983 for the floating exchange rate regime under the Structural Adjustment Program (SAP) (Bawumia, 2014). Under the floating exchange rate regime, the market for foreign exchange was gradually liberalized, with the cedi exchange rate being determined by the market, implying that an increase in demand for foreign currency leads to depreciation (Bawumia, 2014). In contrast, an increase in the supply of foreign currency leads to an appreciation of the cedi (Bawumia, 2014).

The liberalization went further to cover foreign exchange bureaus, legalizing them in the early 1990s (Bhasin, 2004 as cited by Nyarko, 2016), thus absorbing the black market for foreign exchange.

The history of Ghana's exchange rate regimes provides a pattern of experimentation by previous governments. This implied that no government could find a winning formula for the exchange rate issue. The question or concern which has run through various policies was how the country could arrest the persistent annual depreciation of the cedi.

1.2 Problem Statement

An exchange rate can be defined as how much a currency is in terms of another, that is, the price of one currency in terms of another (Grandolfo, 1998). The exchange rate, as was stated in section 1.1.2, in the case of an import-based economy like Ghana, is an essential economic concept.

This is because the appreciation and depreciation of the cedi exchange rate have a direct effect on the number of foreign goods which can be imported into the country, with depreciation leading to fewer goods being imported, while appreciation leading to more goods being imported. The Ghanaian cedi, however, has been in a persistent depreciation spiral since Ghana's independence (Bawumia, 2014). As of 2014, the cedi had lost cumulatively since 1965, about 99.99% of its value against the US dollar (Fig. 2) (Bawumia, 2014).

The above trend is worrying, although there exists some school of thought which claims this may be a proper development because it will encourage domestic exports. However, since the exchange rate forms a major component of prices utilities and other petroleum products, a depreciation in the cedi will imply that Ghanaians will pay more for those and other products tied to them (Bawumia, 2014). This, among many other reasons, is why steps must be taken to address the exchange rate crisis in Ghana.

Another issue that cropped up during research is the apparent deviation of Ghana from the Productivity Bias Hypothesis theory. The theory says a country's exchange rate is supposed to appreciate in the long run, as their productivity differentials increase. But as the graphs below will show, this appears not to be the case for Ghana. From historical data, it seems that even as gross domestic product per capita (GDP per capita), a measure of productivity was rising, the Ghanaian cedi was still depreciating against the US dollar. The graphs below illustrate this point more clearly

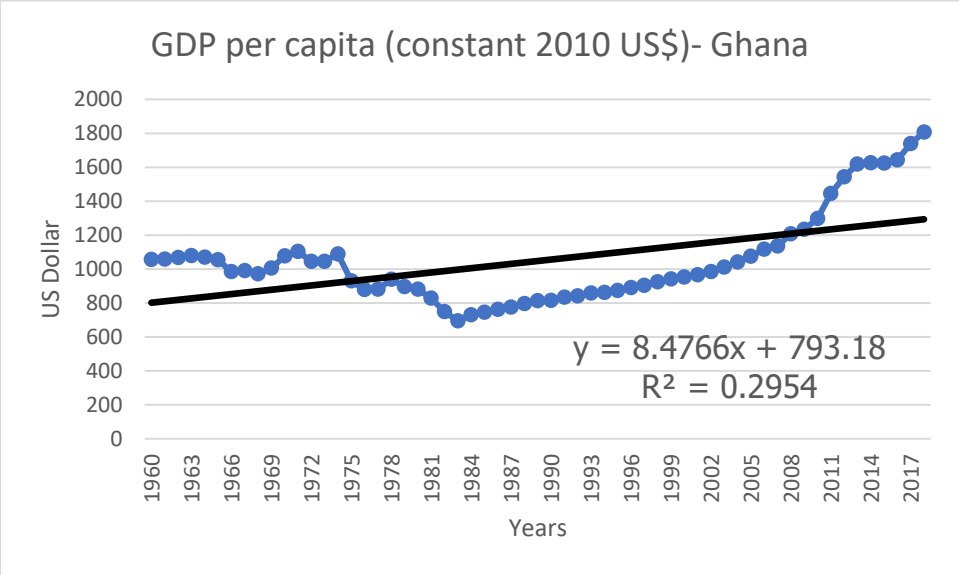

Figure 1. Graph Showing GDP per Capita

Source: Authors own calculation from World Bank Data.

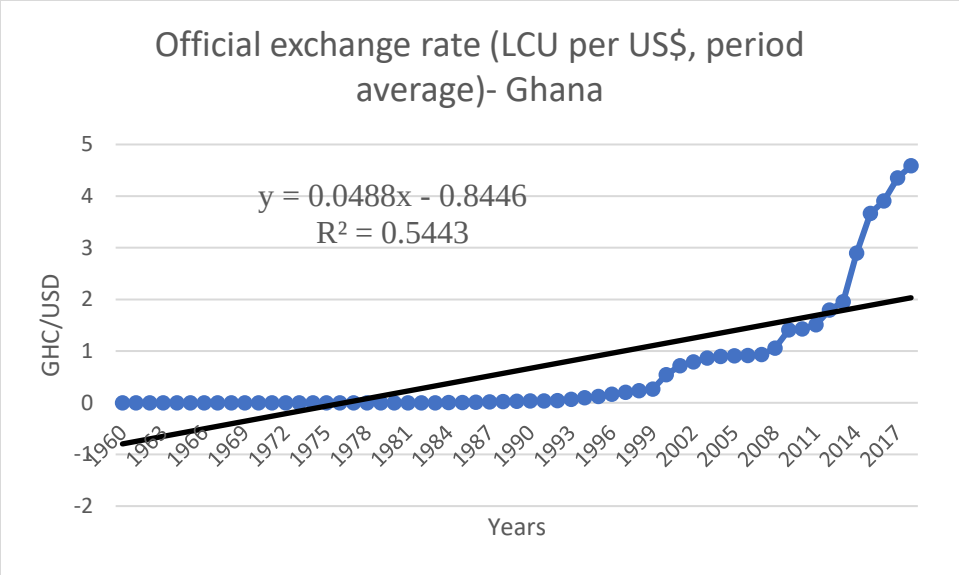

Figure 2. Graph Showing Exchange Rate

Source: Author's calculation from World Bank data

From the graphs above, it can be observed that both figures have a positive slope. That is, both GDP per capita and exchange rate values appear to be rising over time. This trend is contrary to the productivity bias hypothesis theory. Had the theory held, the graph for the exchange rate should have had a negative slope. Thus, on the surface at least, it appears the productivity bias hypothesis does not hold in Ghana. It is against this backdrop that this study seeks to find out why the cedi is in a depreciation spiral, even though productivity differentials such GDP per capita are rising over time.

1.3 Objectives of The Study

The main objective of the study is to argue the case of increasing productivity as an effective strategy of stabilizing the Ghanaian cedi and in the process test for the productivity bias hypothesis.

The theoretical basis of this is the **Productivity Bias Hypothesis** which says the large deviations in productivity differentials between countries lead to significant differences in wages and prices, leading to a more substantial gap in the purchasing power parity and exchange rates of the two countries involved (Balassa, 1964, as cited by Bahmani-Osookee, 1992). This means that a country experiencing increasing productivity will see a real appreciation in its currency.

The study, through its methodology, will also compare Ghana with some of its major trading partners (United States of America, United Kingdom, China, Switzerland, Netherlands, India, and South Africa) and test for the validity of the Productivity Bias Hypothesis.

1.4 Research Questions

With the literature reviewed so far, it can be observed that setting up the perfect exchange rate management strategy is not an easy task. Developing countries like Ghana, whose economies are also import-based, always struggle with the effects of currency depreciation on their economies. Thus, the study will seek answers to the following questions:

1. Will increasing the productivity of the Ghanaian economy be an effective strategy in stabilizing the cedi exchange rate?
2. Does the Productivity Bias Hypothesis hold in Ghana?
3. Is the nominal exchange rate in Ghana affected by domestic price levels?
4. Is the nominal exchange rate in Ghana affected by national productivity levels?

1.5 Significance of the Study

Past literature reviewed has shown that countries are still struggling to find the perfect exchange rate management strategy. The current widely adopted policy is the managed floating exchange rate (Nyarko, 2016). However, one disadvantage the floating rate poses, especially to developing countries that are import-based, is the threat of depreciation of their currencies.

Thus, this research will look at the issue in the Ghanaian scenario and lend strength to the increasing productivity argument. The study may also prove a helpful guide to policymakers as they plan for developmental policies because it will highlight the need to focus on projects which will increase productivity in the economy to obtain a stronger Ghanaian Cedi.

The study will also provide empirical evidence as to whether the productivity bias hypothesis holds in Ghana. This will further inform policymakers in their decisions regarding the long-term strategies regarding exchange rate stabilization.

1.6 Organization of Study

This thesis is comprised of five chapters. Chapter One, the introduction, provides information on the background of the study, the research questions, the objectives of the thesis, the significance of the research and organization of the thesis. Chapter Two, the literature review, critiques existing literature on the productivity bias hypothesis and exchange rate strategies. Chapter Three, the methodology, lays down the steps the author took to achieve the objectives of the study; it provides information on the type of research undertaken, data collection methods and methods of data analysis. The fourth chapter focuses on processing, analysis, and presentation of findings, as well as limitations the

author faced. Finally, Chapter Five provides conclusions and recommendations based on the results of the research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the prevailing literature relevant to the research topic. It is divided into two major sections, each with subdivisions. The first section deals with the theoretical frameworks which underpin the research, the *Purchasing Power Parity Theory*, and the *Productivity Bias Hypothesis*. Relevant literature responsible for advancing the theories will be discussed, as will some of its shortcomings. The second section will review existing literature on the empirical studies carried out to test the Productivity Bias Hypothesis.

2.2 Theoretical Frameworks

This study is underpinned by the Purchasing Power Parity and the Productivity Bias Hypothesis theories.

2.2.1 Purchasing Power Parity (PPP)

One of the most prominent theories which is mentioned in the discussion of exchange rates is the Purchasing Power Parity (Terborgh, 1926). According to Taylor & Taylor (2004), the theory of purchasing power parity holds when the nominal rate between two currencies of two separate countries is equal to the ratio of the price levels in the countries in question; this is the absolute version of the Purchasing Power Parity theorem (Irandoust & Sjoo, 2002). That is, the theory holds when one unit of one country's currency has the same purchasing power in another, foreign country (Taylor & Taylor, 2004). According to theory, the Purchasing Power Parity is the ratio between the domestic purchasing powers of two countries, and it is the fundamental determinant of the exchange rate (Terborgh, 1926). The Purchasing Power Parity theory, in relative terms, suggests that

the real exchange rate is constant, but deviations from the long-run PPP can occur (Irandoust & Sjoo, 2002). That is, the relative exchange rate between two currencies is expected to remain constant over time, but some unforeseen factors can cause deviations from the long run Purchasing Power Parity value.

Thus, per the theory, the ratio at which two countries exchange their currencies should, in the long run, average out to equal their domestic prices.

Determining the Purchasing Power Parity of countries has not been a manageable undertaking, with some studies highlighting the failure of the theory holding in the long run (Taylor & Taylor, 2004). Some impediments which prevent prices from going into equilibrium as theorized by the Purchasing Power Parity model are mostly called market imperfections (Norbin & Conover, 1998), some of which include; transaction costs, information costs, transportation costs, etc.

Studies carried out have also failed to find any empirical evidence in support of purchasing power parity using post-war data (Frenkel 1981; Baille & Selover, 1987; Corbae & Ouliaris, 1988: Taylor & Taylor, 2004). However, a study carried out by Bilson (1984) and later reaffirmed by Norbin and Conover (1998) over a larger sample size, both of whom used a simple trading method strategy, found notable support for the PPP hypothesis in the world of business. This evidence points to the fact that determining the significance of PPP is not a set process and that different methods yield different results

2.2.2 Productivity Bias Hypothesis

As was mentioned in the preceding section, the literature on Purchasing Power Parity has shown that its failure can be attributed to some factors like the existence of

transaction costs, lack of free trade, etc. (Bahmani-Oskooee & Niroomand, 1996). The variable which has received the most attention in the literature, however, is the productivity differentials between two countries (Bahmani-Oskooee & Niroomand, 1996).

The productivity differential differences among countries' arguments were popularized in 1964 by Balassa and Samuelson, where they argued that the reason for the deviation of purchasing power parity from the equilibrium was the difference in the productivity levels between those two countries (Balassa, 1964; Samuelson, 1964). These arguments gave rise to the Productivity Bias Hypothesis, which says that the large deviations in productivity differentials between two countries lead to significant differences in wages and prices, leading to a more substantial gap in the purchasing power parity and exchange rates of the two countries involved (Balassa, 1964, as cited by Bahmani-Osookee, 1992), implying that a country with increasing productivity enjoys a real appreciation in its currency.

The studies carried out to test the hypothesis, have, however, produced mixed results. Officer (1974) argued that the Productivity Bias Hypothesis does not tell the full story when it comes to the difference in the quality of nontraded commodities (consumption goods). Officer (1976) argued that a more productive country is expected to have an efficiency advantage when it comes to nontradable products such as education and healthcare, the efficiency of the more productive country in these areas makes the quality of their labor better. Thus, combining this more quality labor with physical capital to produce the tradable goods gets rid of the productivity bias argument. Officer (1976) went further to test the validity of the Productivity Bias Hypothesis, where he concluded that the general acceptance of the hypothesis is unwarranted because it lacks firm empirical

evidence. He based this argument on the fact that, after he changed the experimental design in his 1976 paper, he found that the productivity bias had no impact on the PPP/exchange rate relationship (Officer, 1976).

The empirical study of the hypothesis can also be influenced by the type of data used in the econometric analysis. Bahmani-Oskooee and Nasir (2005), who conducted one of the most comprehensive reviews into the Productivity Bias Hypothesis, grouped the empirical studies into three categories; cross-sectional studies, time-series studies, and panel studies. The next section of the literature review will discuss the studies conducted under these categories and their significance to my research.

2.3 Empirical Evidence- Data Samples Used

Cross-Sectional Studies

A cross-sectional study is one that uses a dataset consisting of a sample of variables taken at a given point in time (Wooldridge, 2014). In a cross-sectional study, time is not a factor taken into consideration, that is, the effect time is assumed to have on data is random and produces variance and not bias (Lavrakas, 2008).

One limitation of a cross-sectional study is that it does not allow for testing causal relationships (Lavrakas, 2008). This can be attributed to the fact that data is collected on different variables at the same point in time, within a short interval. Thus, there may not be a chance to study year on year changes and relationships. Cross-sectional studies have some advantages, however. These include; they are less expensive; it allows for researchers to collect data on multiple variables and it is more convenient for respondents (Lavrakas, 2008).

Cross-sectional studies have, in general, provided mixed results for the PBH (Bahmani-Oskooee & Niroomand, 1996). De Vries (1968) investigated the depreciation of nominal and real exchange rates of a sample of members of the International Monetary Fund, using the period from 1948 to 1967. She found that the less developed countries either devalued their currencies or experienced depreciation more frequently than the developed countries (de Vries, 1968). She attributed this phenomenon to the superior productivity levels of the developed countries, especially in the production of exportables.

Another study was carried out by Clague and Tanzi (1972) on a sample of 12 countries in the Organization for Economic Corporation and Development (OECD) and 19 Latin American countries to determine the importance of other variables in addition to per capita income to test for productivity Bias. They found that when only per capita income was used as a determinant in the 12 OECD countries, the test showed strong support for the PBH. However, it showed a weaker effect in the case of the 19 Latin American Countries (Clague & Tanzi, 1972). Grunwald and Salazar-Carrillo (1972), also carried out a test for the Productivity Bias Hypothesis in 11 Latin American Countries. But this time used Venezuela as the base country instead of the United States of America. They also did not find any support for the data, concluding that data from Latin American countries do not support the PBH and that there are "significant differences between the developing and developed countries which Balassa examined" (Grunwald & Salazar-Carrillo, 1972).

Kravis and Lipsey (1983), in addition to per capita income, introduced the relevance to Gross Domestic Product, the openness, and share of nontradable goods in a sample of 34 countries. The study concluded that it was mostly per capita income that had

a significant positive effect on the exchange rate. The authors obtained similar results when they reduced the sample size to 10 countries.

Time Series Studies

Time-series studies are studies that make use of data sets of observations of single or multiple variables over time (Wooldridge, 2014). Thus, time series data takes into account the different values of the same variable as it changes over time. This is especially important when taking into account the influence of the past on future events and how lags in behavior are prevalent in social sciences (Wooldridge, 2014). Time-series studies to test for the Productivity Bias Hypothesis are in two forms; the first form is the ordinary test where raw time series data is tested for the validity of the hypothesis in country cases. The second form involves an integration approach where various variables are integrated using integration models to check for the Productivity Bias Hypothesis.

Ordinary Time Series Data

Hsieh (1982), established that the time-series methodology was more disposed to provide welcome confirmation of the Productivity Bias Hypothesis than the cross-sectional analysis in literature. Bahmani-Oskooee (1992), tested the Productivity Bias Hypothesis using time series data, rather than cross-sectional data. This was done to check whether the PBH is a long-run phenomenon. Out of a sample of 7 industrial countries, with the United States as the base country, he found that at least three of the countries showed long-run support for the PBH (Bahmani-Oskooee, 1992).

Zakaria and Ahmad (2009) carried out a study to test the effect of increasing productivity differentials on the nominal exchange rate of Pakistan. Their model consisted

of a simple two-country model with a traded and non-traded goods sector, developed to examine the impact of increasing productivity in the respective sectors. Per the results of their study, the long-run movement of the Pak-Rupee nominal rate could be fully explained by the sectorial productivity differentials in a flexible economy (Zakaria & Ahmad, 2009). Thus, their results support Hsieh (1982), that the productivity Bias Hypothesis holds in a time series analysis.

Time Series Data using Cointegration Models

Bahmani-Oskooee and Miteza (2004) adopted the panel integration approach to test for the productivity bias hypothesis across a sample of 61 countries. In the study, the authors modeled a function where exchange rate, productivity ratios, and the openness to trade of the country were integrated. The study went further than to just test for the Productivity Bias Hypothesis but also employed the cointegration method to test for the deviation of long-run Purchasing Power Parity based on a country's openness to trade. Thus, their study not only supported the Productivity Bias Hypothesis but also proved that, apart from a few cases, the openness of a country to trade had a significant impact on its exchange rate, that is, it was statistically significant. Thus, they concluded that the exchange rate, productivity ratios, and openness to trade are cointegrated.

Halicioglu and Ketenci (2018), tested the hypothesis in seventeen Middle Eastern countries using the Autoregressive Distributed Lag (ARDL) cointegration approach. Per their results, they found that it holds in only three (Bahrain, Kuwait, Saudi Arabia) out of the seventeen countries they tested for; thus, they concluded that there was only partial support for the Productivity Bias Hypothesis in Middle Eastern countries. The most persuasive case for the Productivity Bias Hypothesis they found was in Bahrain, where a

1% rise in relative productivity leads to a 0.73% appreciation in real exchange rate. They attributed the failure of the hypothesis to account for factors such as the impact of globalization on developing countries and the impact of government policies in the areas of trade and exchange rate, which they had not included in their study (Halicioglu & Ketenci, 2018).

Bahmani-Oskooee and Rhee (1996) applied the Johanson and Juselius cointegration approach to test for the Productivity Bias Hypothesis in the case of Korea using time-series data from 1979 to 1993. They tested the hypothesis' validity between Korea and four of its major trading partners; the United States of America, Germany, the United Kingdom, and Japan. The study concluded a long-run relationship between the deviation of purchasing power parity from the equilibrium exchange rate and the productivity ratios applied in the study. This implies that the Korean won experiences a real appreciation when Korea becomes more productive.

Panel Studies

Panel data (or longitudinal data) refers to a dataset that consists of a time series for each cross-sectional element in that dataset (Wooldridge, 2014). That is, it consists of data collected about the same variables for specific individuals, firms, countries, etc. Thus, its differentiating factor from another type of dataset, the pooled cross-section, is that it is the same units (individuals, firms, etc.), which are followed over a period (Wooldridge, 2014).

A disadvantage of the panel dataset is that it is more difficult to obtain because the same units have to be observed overtime to ensure the replication of data. This, however, does not mean it has no advantage over the other types of datasets. The first advantage is

that it gives the researcher more power to control for specific unobserved characteristics of the units being observed; this facilitates easier causal inference (Wooldridge, 2014). A second advantage is that the panel dataset allows for the study of lags in behavior or the outcomes of economic decisions taken (Wooldridge, 2014). This is especially useful in studying the impact of economic policies because we expect these policies to have an effect only after some time.

Asea and Mendoza (1994), employed the use of panel data to test the validity of the Productivity Bias Hypothesis in the case of fourteen OECD countries. The productivity differential used in their study was the marginal productivity of labor in the tradeable and nontradable goods sectors. The results of the study indicated that labor productivity could explain the long-run differences in relative prices between countries. They, however, could not find conclusive evidence demonstrating the long-run deviations from purchasing power parity.

Bahmani-Oskooee and Nasir (2001), expanded the sample size to sixty-nine to test for the validity of the Productivity Bias Hypothesis using sample data. Their model consisted of the United States as the base country, and the productivity differential employed was real GDP per worker. The empirical results obtained provided strong support for the Productivity Bias Hypothesis, and it was not sensitive to the estimation procedure used nor the model specifications (Bahmani-Oskooee & Nasir, 2001). The relevance of other variables, measure of resource abundance, and black-market premium, was tested. Due to the lack of data, the sample sizes for the tests for the measure of resource abundance and black-market premium were sixty-six and forty-three countries

respectively. The results for these two tests confirmed previous research because the outputs obtained carried the expected signs and had the predicted significance levels.

2.4 Relevance to The Study

The literature reviewed has shown that testing for the Productivity Bias Hypothesis in country cases can be grouped into three approached being used, depending on the type of data the researcher is employing. It has also been proven that using the time series approach, in majority of the cases, results in the acceptance of the hypothesis. Using cross-sectional data provides mixed results, and not enough studies have been carried out using panel data to determine whether it is predisposed to validating the Productivity Bias Hypothesis or not.

Per the literature reviewed, the focus of a lot of the studies into for the long-run behavior of Purchasing Power Parity is concentrated on the industrialized countries, with few focusing on the less developed countries (Arize, Kalu, Okoyeuzu & Malindrethos, 2019). Studies to test for the validity of Purchasing Power Theory in African countries are even harder to come by. Reviewed literature also shows that a lot of the studies carried out were just to test whether the Productivity Bias Hypothesis holds in country cases. Thus, the researchers did not situate their studies in the policy. So, the studies may either prove or disprove the hypothesis in the country case, but policymakers are not advised on how to apply the findings and integrate these findings into decisions they make. Halicioglu and Ketenci (2018) came closest to tying their findings to policy attributing the results they obtained to specific macroeconomic factors like globalization.

Thus, this study is going to fill the two gaps. Firstly, the study is going to test for the behavior of the Purchasing Power Parity Theory, in the long-run, through the PBH.

Thus, the validity of the PBH in Ghana will be tested to see whether it can explain the behavior of the long-run behavior of the Ghanaian Cedi. The test will be carried out between Ghana and its major trading partners. The implication of this is that this study can provide relevant policymakers with tools needed to formulate Ghana's trade policies, based on the behavior of the Ghanaian cedi against the currencies of Ghana's major trading partners.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The purpose of this study is to test, empirically, the validity of the Productivity Bias Hypothesis in Ghana. In this chapter, a detailed description of the research design adopted to investigate the relationship between selected productivity differentials in Ghana, and the long-run behavior of Purchasing Power Parity is discussed.

The sources data and method of data collection will be described, as will the period for which the data will be collected. The chapter will also explain the model employed in the study. Finally, the data analysis method will be described as will the statistical tool used in the analysis of the data.

3.2 Econometric Model Adopted

Since this study seeks to test the productivity Bias Hypothesis between Ghana and its major trading partners, it will adopt the model used by Zakaria and Ahmad (2009). The authors first developed a basic model for an economy with traded and nontraded goods building on empirical models in literature. The following assumptions apply:

1. Two sectors in the economy exist with one producing tradable goods (T) and the other producing nontraded goods (N), under perfect competition. Both these sectors have two different Constant to Scale Cobb-Douglas type production functions. The functions of the sectors are given below:

$$Y_{Tt} = A_{Tt} * L^{a}_{Tt} * K^{1-a}_{Tt} \quad (1)$$

$$Y_{Nt} = A_{Nt} * L^{b}_{Nt} * K^{1-b}_{Nt} \quad (2)$$

Where Yt, $A_{t,}$ and K_t refer to output, total factor productivity, labor, and capital, respectively. Whiles a, 1-a, b, and 1-b refer to the coefficients of their respective variables, where $0<a<1$ and $0<b<1$. The restriction for "a" and "b" makes sense because the study looks at the percentage changes in the variables, so the estimates must reflect that.

2. The elasticity of labor is larger in the nontraded goods sector than in the traded goods sector. That is, $b>a$.
3. Prices of traded goods are determined on the world market and are thus, exogenous to the model.
4. Interest rate parity holds because of international capital integration.
5. The capital stock is fixed.
6. Labor is perfectly mobile among the domestic sectors.
7. The marginal product of labor determines real wages in the traded goods sector. Due to wage equalization, the nominal salary paid in the traded goods sector holds for the nontraded goods sector.
8. The preference levels of both the domestic and foreign countries are assumed to be given by the Cobbs Douglas utilities for the respective agents.

Thus, based on the assumptions stated above and informed by literature, Zakaria and Ahmad (2009) adopted the model below:

$$e_t = \beta_1 + \beta_2(p_t^* - p_t) + \beta_3(x_{Tt} - x_{Nt}) + \beta_4(x_{Tt}^* - x_{Nt}^*) + \mu_t \quad (3)$$

$$\mu_t \sim (0, \partial^2)$$

where e_t, p_t, $x_{Tt,}$ and x_{Nt} refer to the natural log of nominal exchange rate, domestic price level, average productivity of labor in traded goods, and average productivity of labor in

nontraded goods, respectively. The superscript * indicates a variable belonging to a foreign country.

3.3 Hypotheses Description

The model in (3) above gives rise to the opportunity to test for the hypothesis regarding the various coefficients. In the model, the coefficients are β_1, β_2, β_3, and β_4. Per Zakaria and Ahmad (2009) the hypotheses are outlined as follows:

Hypothesis 1:

β_1; H_0: β_1 is a real number

H_1: β_1 is not a real number

Hypothesis 2:

β_2; H_0: $\beta_2 (-1) < 0$

H_1: $\beta_2 (-1) > 0$

The reason for the null hypothesis for β_2 is that if international price levels rise faster than domestic prices, this will cause the real exchange rate of the domestic country to depreciate, leading to an increase in the domestic country's competitiveness due to its goods becoming cheaper. The net increase in exports, however, causes the domestic country's currency to appreciate nominally. Thus, $(p_t^* - p_t)$ is inversely related to the nominal exchange rate (Zakaria & Ahmad, 2009).

Hypothesis 3:

β_3; H_0: $\beta_3 < 0$

H_1: $\beta_3 > 0$

The reason for the null hypothesis for β_3 is that, when productivity in the tradable goods sector rises, workers are drawn from the nontradable goods sector due to the increased wages. Thus, the domestic production of tradable goods rises, leading to a reduction in the prices of domestic tradable goods. The number of domestic tradable goods exports will rise, leading to improved trade balances. This will lead to an appreciation of the domestic currency.

Thus, PPP will still hold for the domestic tradable goods sector (Kim 1990; Rother, 2000; and Søndergaard, as cited by Zakaria & Ahmad, 2009). This means that the domestic labor productivity term ($x_{Tt} - x_{Nt}$) is expected to be negatively related to the nominal exchange rate.

Hypothesis 4:

β_4; H_1: $\beta_4 > 0$

H_0: $\beta_4 < 0$

The argument for this hypothesis 4 is similar to that of hypothesis 3. That is, an increase in the productivity in the tradable goods sector of the foreign country leads to a real appreciation in the foreign currency, which implies that the domestic currency depreciates (Zakaria & Ahmad, 2009). Thus, a positive relationship is expected to be seen between the domestic nominal exchange rate and relative foreign productivity, ($x_{Tt}^* - x_{Nt}^*$).

3.3 Data Description

Following Bahmani-Oskooee (1992), all data used in the study will be annual data of variables to be analyzed. According to the World Bank, Ghana's top trading partners are; India, China, Germany, The United States, Spain, Netherlands, The United Kingdom, Switzerland, and South Africa (World Bank, 2019). The period for data collection will be from 1983 to 2018, which will yield a total of thirty-five annual observations to test the validity of the model between Ghana and each of her trading partners.

For the study, the exchange rate is the explained (dependent) variable, with domestic and foreign price levels, and average productivity in both the traded and non-traded goods sectors being the explanatory variables. Exchange rate, as will be used in the study, is the units of domestic currency per unit of foreign currency; that is, it is the number of domestic currency units needed to buy a unit of foreign currency. Thus, this study will employ the use of nominal exchange rates.

Following Zakaria and Ahmad (2009), the domestic and foreign price levels will be represented by the growth rates of the consumer price indexes of each country under the study. The sectoral productivity is defined as the ratio of GDP (at constant price) in that sector divided by the total employment in that same sector. That is, the study will make use of average productivity as the sectorial productivity differential in accordance with Zakaria and Ahmad (2009).

As was laid out in section 3.2, the economy will be divided into the traded and non-traded goods sector. Zakaria and Ahmad (2009) used industry (comprising of manufacturing, construction, mining, electricity and gas) as a proxy for the traded goods sector and used other sectors as proxy for the non-traded goods sector.

They, however, excluded agricultural data from their sample. This was because many of the trading partners for Pakistan were industrialized countries whose exports were mainly manufactured goods (Zakaria & Ahmad, 2009).

Their study also cited gaps in data as a reason for their choice of proxies. This study will, however, include agriculture as a component of the traded goods sector due to the importance of cocoa o to Ghana's exports. Thus, the traded goods sector of this study will comprise of industry (comprising of manufacturing, construction, mining, electricity and gas) and agriculture sectors while the remaining sector, services will be used as the proxy for the non-traded goods sector.

Therefore, the sectoral productivity of the traded goods sector will be derived by dividing the ratio of GDP (at constant price USD) which make up the industry and agricultural sectors by the total employment in those two sectors. The same will be done with the non-traded goods sector, where the ratio of GDP (at constant price, USD) which make up the services sector will be divided by the total employment in those sectors.

3.4 Data Analysis

This is a purely quantitative study which will make use of secondary data. Since the study seeks to test the validity of the productivity bias hypothesis between Ghana and its major trading partners, the model in (3) will be estimated for Ghana and each trading partner.

Microsoft Excel will be the primary analysis software because it provides tools which aid in carrying out multiple linear regressions. A multiple linear regression model will be employed because the analysis involves more than one independent variable. For a

successful regression analysis to be carried out, however, the following assumptions have to hold:

1. Random Sampling: that is, the method of data collection must be random
2. Sample variation in the explanatory variables
3. The relationship between the dependent and independent variable(s) is linear.
4. Zero conditional mean; that is the error term has an expected value of zero for any given value of the explanatory variable.
5. No perfect collinearity, that is, there should not be an exact relationship among the independent variables.
6. Homoskedasticity, that is, the data must be free from extreme values.

3.5 Data Cleaning

The World Bank's world development indicators were the primary source of data, with the sole exception being exchange rate, which was obtained from Oanda, an online repository for business data. The state of the data required some manipulation of the data to be done before analysis could be run with it.

The model being employed in this study required the use of productivity levels on the traded and non-traded goods sectors in both the domestic and foreign countries. These data were, however, not available in their raw forms in the data repository. Thus, data on the GDP of each country were collected, as well as the percentage of GDP that corresponds to the industry, agricultural and service sectors, respectively. Multiplying these values gave results that were then used as proxies for the sectors as mentioned earlier. Data on total labor of each question under review was also obtained with the proportion of labor working in the industry, agricultural and service sectors also being collected. The results from

multiplying these two values were used as proxies for total labor in the sectors as mentioned earlier. Dividing the amount of output in a selected sector, by the entire labor in that sector gave the productivity of the sector in question.

In line with Zakaria and Ahmad (2009), the final data used in the function was obtained by taking the natural logarithm of the data. This was to standardize the form of the data in the function, so as to ensure uniformity in output.

3.6 Analysis of Data

This section deals with the analysis procedure used in this study. Tests for multicollinearity and stationarity were run to test the validity of the data to be used for regression analysis. The stationarity test was run using the Augmented Dicky-Fuller model was run and will be described in this section while the Variance Inflation Factor (VIF) technique was used to test for multicollinearity. To test for the robustness of the model, the Breusch-Pagan test for heteroskedasticity was employed.

Per Ahmad and Zakaria (2009), an endogeneity problem crops up due to the fact that the relative price of the two trading partners appearing on the right-hand side of the equation is already affected by the nominal exchange rate employed on the left-hand side of the equation.

This is due to the effect of the prices of foreign goods on domestic currency. This leads to a situation where a case of imported inflation occurs and thus contributes to the general inflation in the country (Zakaria & Ahmad, 2009). Also, the productivity variable may be affected by the changes in exchange rates because of the potential real effects of variations in the exchange rate. To tackle this endogeneity problem, the Generalized

Method of Moments (GMM) estimation technique was adopted and applied using the lagged values as input data.

3.6.1 Test for Multicollinearity

One of the major underlying assumptions of the multiple linear regression technique is the assumption of no perfect multicollinearity between the variables. This implies that the independent variables employed in a multiple linear regression should not have a perfect relationship with each other.

From research, the problem of perfect multicollinearity arises from the inaccurate use of dummy variables, the repetition of the same variable in the study, and the inclusion of a variable obtained by other variables included in the study. Although the existence of multicollinearity may not reduce the explanatory power of a model, it does however, reduce the significance of the independent variables.

To carry out this test, the Variance Inflation Factor (VIF) technique was employed using Microsoft Excel. The VIF measures multicollinearity among independent variables being used in a multiple linear regression model. The VIF values generated in this study, were calculated manually in Excel by applying the mathematical rule below:

$$\text{VIF} = \frac{SE^2 * (n-1) * SD^2}{OSE^2}$$

Where "SE" refers to the estimated standard errors of each individual independent variable obtained from the regression output, "n-1" refers to the sample size (n) minus 1, "SD" refers to the standard deviation of each independent variable and "OSE" is the overall standard error of the model.

The VIF is applied to only the independent variable because, mathematically, the VIF of a specific regression model is the ratio of the overall model variance to the variance of a model that includes only a selected independent variable. A large VIF value means that the specific independent variable is highly correlated with the other variables in the model.

3.6.2 Test for Stationarity of Data.

In time series data analysis, it is imperative that the data used is stationary. A stationary data series is one that has its statistical properties such as mean, variance, etc., to be constant over time. An advantage of a stationary dataset is that it prevents the occurrence of spurious results in a regression analysis. That is, a nonstationary time series data may indicate the existence of a relationship between variables when such relationships do not exist.

To test for the stationarity of the time series data employed in this study, unit root tests were conducted. More specifically, the Augmented Dicky-Fuller (ADF) test was applied to the datasets to determine whether they were appropriate for use. The ADF test employs the use of three model specifications. However, the specification employed for use in this study is one which has the intercept only and is outlined below:

$$\Delta z_t = \alpha_0 + \delta z_{t-1} + \alpha_1 \Delta z_{t-2} + \ldots + \alpha_p \Delta z_{t-p} + \alpha_t \quad (4)$$

In equation (4), Δz_t is the difference in the dependent variable (variable being tested), α_0 is the intercept, δ is the parameter being estimated for the lag of the dependent variable and α_1 is the estimated parameter of the lag of the difference of the dependent variable.

The null and alternate hypotheses of the ADF test are given below:

H_0: $\delta=0$

H_1: $\delta<0$

The study will employ the use of estimated ADF statistics, for the 95% confidence interval. Thus, the t-statistic of the results will be compared to 1.633, which is the estimated ADF statistic. If the computed t-value is less than 1.633, we shall fail to reject the null hypothesis, and the variable will have to be differenced further. If the t-value is greater than 1.633, we shall reject the null hypothesis, meaning the data is stationary. A point of note here is that, in comparing the t-statistic and ADF estimations, only absolute values are considered, meaning any negative sign is ignored. The results of the ADF tests carried out in the study are discussed in the results section below.

3.6.3 Test for Robustness (Breusch-Pagan Test for Heteroskedasticity)

In carrying out a multiple linear regression, one crucial assumption is that there should be no heteroskedasticity in the data being employed. The concept of heteroskedasticity assumes that the variance of the error terms is constant. Mathematically, this is defined as, $\boldsymbol{Var\ (\varepsilon i)=\sigma 2.}$ This study employed the use of the residual plot method to test for heteroskedasticity. The Breusch-Pagan test was used to confirm whether the output from the residual plot was heteroskedastic.

To carry out the heteroskedastic test, the following hypotheses were followed:

H_0: The data is not heteroskedastic

H_1: The data is heteroskedastic

Excel was the analysis tool of choice to generate the p-value. The generated value, p-value, was then compared with the critical value of 0.05, which is the critical value at 95% confidence interval. If the generated p-value is greater than the critical value, we shall fail to reject the null hypothesis, and the conclusion will be the nonexistence of heteroskedasticity on the data.

To correct for heteroskedasticity, if present, the Weighted Least Squares (WLS) approach was employed. The WLS approach is an estimation technique that involves the involves the use of weights obtained from observations which are proportional to the variance of that observation. To carry out the WLS regression, the author followed procedures laid down by Pennsylvania State University's online statistics course platform.

Per Pennsylvania State University (2020), the weight of a given variable given by the formula below:

$$W=\frac{1}{\delta^2}$$

Where "w" is weight and "δ" is an estimate of the fitted value of the residual against the OLS predictors.

To obtain "δ," the author performed a general OLS regression to obtain the residuals and fitted values of the heteroscedastic data in Excel. Following Pennsylvania State University (2020), the author analyzed the shape of the residual plot against the predictors to determine whether they exhibited a megaphone shape. If they did, a further regression of the absolute values of the residuals, the absolute residuals, is run against the independent variables. The fitted values generated as an output of the final regression are estimates of "δ" (Pennsylvania State University, 2020). The fitted value was then plugged

into the equation above and the weight is generated and applied to the model containing the heteroskedastic data. the weighted data was then used to create a new model free from heteroskedasticity.

3.7 Limitations of the Study

Some challenges were faced over the course of conducting and writing the thesis. These challenges, the author believes, may have played varying roles in impacting the outcome of the study. This section will outline these challenges and make a case for further research.

The first issue the author faced was the unavailability of data for the study, more specifically, exchange rate data between Ghana and some of its trading partners. The absence of the data worked to reduce the sample size of some of the scenarios. The major reason for the absence of the data was that majority of the data was hidden behind a paywall, requiring a significant cost that the author could not bear. Thus, data accessibility for the period the author required was hindered.

The second issue had to do with possible endogeneity problems among the variables. There was the possibility of a factor (possibly unobserved) which affected some independent variables and the dependent variable simultaneously. However, that factor was not captured in the initial model as the data for the study was not panel data, so panel data techniques like fixed effects and random effects could not be applied to remove possible unobserved time invariant endogeneity. The independent variables which were possibly endogenous in this study were price and domestic output. Failure to resolve the endogeneity issue may lead to bias and inconsistent estimates. The paper this thesis was based on employed the use of the Generalized Methods of Moments (GMM) approach to

account for the endogeneity problem. However, the relevant statistical packages needed to carry out the GMM regression (Stata, Eviews and similar software) were not available to the author at the time of the study. Even if they were available, the author was not exposed enough to these software to competently execute the GMM estimations; thus the GMM approach could not be employed. As discussed already, the fixed and random effects could not be used as they are exclusive to panel data regressions.

The final approach considered to account for endogeneity was the Two-stage least squares approach (2SLS) which is a type of Instrumental Variable (IV) estimation. This approach uses instrumental variables correlated to the independent variable but not to the dependent variable to control the effect of endogeneity. This approach was abandoned because an appropriate instrument that was sufficiently strong and exogenous and that was supported by the literature could not be identified.

The author, therefore, calls for further research into this topic. Results generated with GMM estimation and Instrumental Variable estimation can be compared to the results presented by this thesis to ensure that the output generated, and conclusions drawn are consistent.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter lays out the results obtained from the tests and analyses carried out in the study. With the use of tables and graphs, the output generated will be presented and discussed. The data used in this study was secondary in nature and primarily sourced from the World Bank's WDI. Analysis of the data was carried out using the appropriate econometric techniques.

To ensure that the results were sound and could be modelled using the multiple regression analysis approach, three tests were run on the data. these were; the multicollinearity test, the heteroskedasticity test and the unit root test. An OLS multiple linear regression was run on the data to generate the required estimates. The analysis carried out contributed to achieving the study's objective of validating the PBH between Ghana and its major trading partners. Thus, this chapter answered the following research questions:

1. Will increasing the productivity of the Ghanaian economy be an effective strategy in stabilizing the cedi exchange rate?
2. Does the Productivity Bias Hypothesis hold in Ghana?
3. Is the nominal exchange rate in Ghana affected by domestic price levels?
4. Is the nominal exchange rate in Ghana affected by national productivity levels?

4.2 Descriptive Statistics

Due to the nature of the study, where the analysis will have to be run between Ghana and each trading partner, the descriptive statistics will have to be run on multiple datasets. What will be discussed in this section, however, is the descriptive statistics of data between

Ghana and the United States of America. For information on the descriptive statistics on the other countries in question, kindly view the appendix.

Basing the argument on a confidence interval of 95%, it can be observed that the mean values for the exchange rate, price, domestic sector and foreign sector are 0.075097, -1.03327, 0.74168 and 0.53639 respectively. The median values -0.06694, -0.91702 and 0.94792 which represent the variables exchange rate, price and domestic sector, are somewhat far from their means, suggesting a normal distribution. The median for the foreign sector, 0.54912, appears to be close to its mean, which indicates a deviation from the normal distribution.

The kurtosis values for the variables exchange rate, domestic sector, and foreign sector, are significantly lower than the standard normal distribution kurtosis value of 3 (Lewis-Beck, Bryman & Liao, 2003), thus distorting the assumption of normal distribution. However, these values fall between the range of +2 and -2, the interval for a normally distributed dataset (Lewis-Beck, Bryman & Liao, 2003). The kurtosis value for price is 2.059, which is well within the given range for a normal distribution.

Thus, it can be concluded that GHC/USD exchange rate, price, domestic sector, and foreign sector variables are normally distributed. This conclusion satisfies one of the assumptions of as multiple regression analysis that the values of the independent variables follow a random probability distribution.

Table 1.

Descriptive Statistics Ghana-USA Data

Item	**GHC/ USD Rate**	**Price**	**Domestic Sector**	**Foreign Sector**
Mean	0.075097475	-1.033273727	0.741685714	0.53639
Standard Error	0.188547234	0.229759003	0.065447535	0.022516
Median	-0.066943709	-0.917027105	0.947926215	0.549125
Mode	0.00	0.00	0.00	0.00
Standard Deviation	0.86403197	1.052888021	0.299918283	0.103182
Sample Variance	0.746551246	1.108573185	0.089950976	0.010647
Kurtosis	-0.204379799	2.05977975	-1.445707075	-0.30498
Skewness	-0.28419378	-0.36111723	-0.699679358	-0.46345
Range	3.056085889	4.990802559	0.751261756	0.384862
Minimum	-1.58573956	-3.63789161	0.241666178	0.338345
Maximum	1.470346329	1.35291095	0.992927934	0.723207
Sum	1.577046968	-21.69874826	15.57539999	11.26419
Count	21	21	21	21

Source: Author's Calculation from World Bank Data

4.3 Tests for Multicollinearity

The Variance Inflation Factor (VIF) was used to test for multicollinearity in this study. A general rule of thumb when inferring multicollinearity from VIF values is that:

VIF = 1 (no correlation)

1<VIF<5 (moderately correlated)

5<VIF (highly correlated)

From the Table 2 below, it is observed that majority of the variables under consideration in this study have VIF values greater than 1, except for the case of Ghana-South Africa, whose VIF is approximately 1. Thus, the independent variables employed in the study are moderately correlated in all cases, except for Ghana-South Africa, for which it is not correlated. Thus, the data employed in the study are relatively significant.

Table 2.

Multicollinearity Test for Ghana-USA Data

	GH-USA	GH-UK	GH-Swiss	GH-China	GH-India	GH-NED	GH-SA
Price	1.78	1.34	1.25	1.6	1.37	1.01	0.78
Domestic Output	1.26	1.51	1.25	1.17	1.27	1.09	0.84
Foreign Output	1.	1.15	1.05	1.71	1.12	1.08	0.83

Source: Author's calculation from World Bank data

4.4 Stationarity Test

The tests for stationarity was carried out using the ADF tests, with a 95% confidence interval. This implies that the ADF estimate which will be compared to the computed estimates is 1.633. Thus, the rule adopted was, if the t-statistic of the coefficient of the lag of the variable being tested was less than 1.633, the null hypothesis is not rejected, and if with was greater than 1.633, the null hypothesis is rejected. The null and alternate hypotheses are laid out below:

H_0: $\delta=0$

H_1: $\delta<0$

From the tests carried out in Excel, it was determined that all the variables were stationary, albeit at varying orders. The table below gives a summary of the various orders that each variable in each case was stationary:

Table 3.

Table Showing the Orders at which Variables Attained Stationarity

Variable	**GH-USA**	**GH-UK**	**GH-SWISS**	**GH-China**	**GH-India**	**GH-NED**	**GH-SA**
Exchange Rate	Second Order	Second Order	Second Order	Second Order	Second Order	First Order	Second Order
Price	First Order	First Order	First Order	First Order	First Order	First Order	First Order
Domestic Output	Second Order	First Order	First Order	First Order	First Order	First Order	First Order
Foreign Output	First Order	First Order	Second Order	First Order	First Order	Second Order	Second Order

Source: Author's analysis of data in Excel.

4.5 Test for Robustness

The Breusch-Pagan test was used to test for the robustness of the model employed. The critical value used was 0.05, which represents a 95% confidence interval. The table below gives a summary of the output generated in Excel:

Table 4.

Results of the Breusch-Pagan Test for Heteroskedasticity

USA-GH	UK-GH	SWISS-GH	CHINA-GH	INDIA-GH	NED-GH	SA-GH
0.1188	0.0936	0.5019	0.00641	0.0754	0.3296	0.1171

Source: Author's analysis of data in Excel

From Table 4 above, it can be observed that the p-values of all the case scenarios are less than the critical value 0.05, except for China. This implies that we can fail to reject the null hypothesis that the independent variables have no effect on the variation of the error term in all cases except for the Ghana-China case scenario. This implied that the models for all situations were robust, except for Ghana-China. This prompted the author to carry out a WLS regression to correct the heteroskedasticity. The author was successful in

doing this, in the process generated a WLS model for the Ghana-China scenario with no heteroskedasticity issues.

4.6 Regression Output

As the stationarity condition has been satisfied, a regression analysis was run on the available data sets. This study was carried out to answer relevant research questions. These questions were:

1. Will increasing the productivity of the Ghanaian economy be an effective strategy in stabilizing the cedi exchange rate?
2. Does the Productivity Bias Hypothesis hold in Ghana?
3. Is the nominal exchange rate in Ghana affected by domestic price levels?
4. Is the nominal exchange rate in Ghana affected by national productivity levels?

Thus, the results from the regression analysis will be discussed to determine whether they provide satisfactory answers to the questions laid down above. The regression output is given in Table 4 below:

Table 5.

Empirical Findings of Productivity Bias Model of Nominal Exchange Rate Determined with Major Trading Partner of Ghana

	Constant	**Price**	**Domestic Output**	**Foreign Output**	**R^2**	**Adjusted-R^2**
USA	-13.1974 (-2.8325)	-0.4360 (-2.5361)	-0.43615 (-0.857)	4.2529 (3.223)	0.57989	0.505748
UK	-2.6256 (-1.3957)	0.31102 (0.931)	-0.8163 (-0.8780)	7.6432 (2.0167)	0.2205	0.1092
Switzerland	-5.7746 (-2.7798)	-0.0244 (-0.1212)	-0.4076 (-0.4776)	15.8636 (3.271893)	0.36179	0.2706
Netherlands	-5.77526 (-4.0523)	-0.23325 (-1.2386)	-0.51536 (-1.166)	8.767789 (4.3186)	0.5644	0.4827
China	0.4834 (0.9911)	0.1277 (0.5859)	-1.455 (-1.446)	-6.702 (-1.792)	0.1633	0.0437
India	-3.29728 (-39.685)	-0.14678 (-3.0825)	-0.34897 (-3.1914)	-7.59098 (-31.4671)	0.981	0.9783
South Africa	-2.98171 (-3.1514)	-0.04049 (-0.134)	-0.47501 (-0.8639)	2.541198 (1.8607)	0.2202	0.1088

Source: Author's Computation from Excel

Table 5 above provides the estimated results for the productivity bias model of exchange rate determination. The values without the parentheses are estimates, while those within the brackets are the t-statistic values. The critical value to be compared in this study is 2.262, which represents a 95% confidence interval.

Per the results obtained in Table 5, most of the parameters had the expected theoretical signs mentioned in the methodology section. That is, most of the estimators for price across all countries were negative save for UK and China, the estimator for domestic

output was also negative, while just two (China and India) did not have the expected sign (positive) for their estimators of foreign output.

Using a t-critical value of 2.262 corresponding to a significance level of 95%, majority of the variables were concluded to be significant to the study, with the exceptions of China and the UK, which had none of their values being significant. The R^2 values for the majority of the countries were above 30%, indicating that the model fits the data quite well in those cases.

However, the R^2 values for the UK and China were approximately 22% and 10% respectively, indicating that the model may not fit the data in those countries well. A reason for that may be that the sample size may have been too small to provide a more robust result.

It can further be observed from Table 5 above that, coefficients of the relative price variable have the expected negative sign and are significant in all but two of the regression scenarios. This implies that an increase in foreign price levels relative to Ghana's domestic price leads to an appreciation of the bilateral exchange rate of the Ghanaian Cedi with the respective trading partners. This is achieved through improved current account positions. Thus, it is true that the nominal exchange rate in Ghana is influenced by domestic price levels.

From Table 4, it can be observed that the coefficients of the domestic and foreign sectors have negative and positive signs, respectively in almost all cases. What a negative sign means for the domestic sector is that increases in the relative productivity in this sector

will lead to an appreciation of the Ghanaian Cedi, in nominal terms, against the currencies all of its trading partners.

This occurs through an improved balance of payments (Zakaria & Ahmad, 2009) and is significant in all the cases. Meanwhile, a positive sign for the coefficient of the foreign sector implies that increased productivity in traded goods abroad, relatively, leads to a depreciation of the Ghanaian Cedi against the respective trading partners. These results can be explained via the productivity bias model, which argues that the changes in the productivity of the traded goods sector affect nominal exchange rate, irrespective of the direction the productivity moves. (Zakaria & Ahmad, 2009)

What the analysis in the preceding paragraph suggests is that, Ghana can experience both real and nominal exchange rate appreciations if the country embarks on a sustainable growth trajectory. Thus, according to the results of this study the PBH holds in Ghana in the long run.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This is the concluding chapter of the study. This chapter presents a summary of the purpose of the research, the research problem, the research questions, the methodology and the results. It will end by providing some recommendations for policymakers.

5.2 Conclusion

The aim of the study was to determine the impact of increased productivity on Ghana's exchange rate. Thus, the study sought to validate the existence of the Productivity Bias Hypothesis in Ghana. The motivation for this study was the author's interest in the persistent depreciation spiral the Ghanaian Cedi seemed to be in. This was further buttressed by speech by the current Vice President of Ghana, Dr. Bawumia, where he mentioned that the Ghanaian Cedi had never experienced a net appreciation.

Thus, this study was to test whether Ghana had the capacity to experience an appreciation in its exchange rate, based on the PBH. To carry out this test the following questions were asked:

1. Will increasing the productivity of the Ghanaian economy be an effective strategy in stabilizing the cedi exchange rate?
2. Does the Productivity Bias Hypothesis hold in Ghana?
3. Is the nominal exchange rate in Ghana affected by domestic price levels?
4. Is the nominal exchange rate in Ghana affected by national productivity levels?

To answer the questions, the study employed a simple two-country model, with a traded and non-traded goods sector to examine the impact of increased productivity on the

aforementioned sectors on the Ghanaian Cedi exchange rate. This test was conducted between Ghana and its major trading partners, USA, UK, China, India, Switzerland, Netherlands and South Africa. The variables under consideration were; nominal exchange rates, growth in price levels (proxied by inflation), domestic and foreign productivity differentials. The data for analysis was obtained from the World Bank and Oanda Business solution, both online databanks. Tests for stationarity and multicollinearity were run on the data and OLS estimation was used to estimate the coefficients.

The results of the study indicate that, nominal exchange rate, relative price differentials, and relative domestic and foreign productivity differentials enjoy a close relationship. Firstly, it appears that relative price levels explain, to an extent, the long-run movement of the Ghanaian Cedi. This answered the third research question about whether exchange rate was influenced by the domestic price levels. Secondly, increases in domestic relative productivity of traded goods leads to an appreciation of the nominal exchange rate. This corroborates Balassa (1964), who concluded that a country experiences a real appreciation in its exchange rate as it experiences increase in its productivity differentials. Thus, the PBH holds in Ghana.

5.3 Recommendations

One aim of this study was to provide recommendations to relevant policymakers and stakeholders. I believe the conclusion that the PBH holds in Ghana holds important policy implications for Ghana.

What it means is that, the country has the potential to experience real appreciations in bilateral exchange rates with its major trading partners if it is able to increase productivity. The caveat here, however, is that, the productivity must be increased in the

traded goods sector. This advice is also consistent with voiding the Dutch Disease and the Resource curse for Ghana a primary commodity export dependent country. Thus, a takeaway for policymakers is that, to ensure the long-term appreciation of the Ghanaian Cedi, they need to institute plans to sustainably grow Ghana's traded goods sector.

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APPENDICES

APPENDIX 1: Descriptive Statistic Ghana-UK Data

Item	GHC/ GPB Rate	Price	Domestic Sector	Foreign Sector
Mean	-0.059113718	-2.170884904	0.809855	0.510611
Standard Error	0.222359096	0.148256957	0.056669	0.012143
Median	-0.081426999	-2.206055511	0.951654	0.524685
Mode	0.00	0.00	0.00	0.00
Standard Deviation	1.111795482	0.741284786	0.283344	0.060713
Sample Variance	1.236089195	0.549503134	0.080284	0.003686
Kurtosis	-0.593941055	-0.404004028	-0.19047	1.617275
Skewness	-0.389842967	-0.223695145	-1.14172	-1.09549
Range	3.873574462	3.024798022	0.907845	0.273995
Minimum	-2.285727976	-3.841541455	0.241666	0.354182
Maximum	1.587846486	-0.816743433	1.149512	0.628177
Sum	-1.477842961	-54.2721226	20.24637	12.76527
Count	25	25	25	25

APPENDIX 2: Descriptive Statistics for Ghana-Switzerland Data

Item	GHC/CHF Rate	Price	Domestic Sector	Foreign Sector
Mean	-0.213358757	-3.40342	0.809855	0.366136
Standard Error	0.248607952	0.241116	0.056669	0.009152
Median	-0.252443637	-3.14317	0.951654	0.379192
Mode	0.00	0.00	0.00	0.00
Standard Deviation	1.243039762	1.205579	0.283344	0.04576
Sample Variance	1.545147851	1.453421	0.080284	0.002094
Kurtosis	-0.960561919	4.420845	-0.19047	0.621592
Skewness	-0.258051315	-1.97574	-1.14172	-0.78866
Range	4.142749483	5.147064	0.907845	0.191011
Minimum	-2.547207676	-7.0655	0.241666	0.245585

Maximum	1.595541807	-1.91844	1.149512	0.436596
Sum	-5.333968933	-85.0856	20.24637	9.153395
Count	25	25	25	25

APPENDIX 3: Descriptive Statistics for Ghana-China Data

Item	**GHC/Yuan Rate**	**Price**	**Domestic Sector**	**Foreign Sector**
Mean	-2.056707444	-1.98163	0.809855	0.398161
Standard Error	0.240976898	0.207558	0.056669	0.011281
Median	-2.137918471	-2.04972	0.951654	0.415136
Mode	#N/A	#N/A	#N/A	#N/A
Standard Deviation	1.20488449	1.037789	0.283344	0.056404
Sample Variance	1.451746635	1.077006	0.080284	0.003181
Kurtosis	-0.765239423	-0.1277	-0.19047	-0.85499
Skewness	-0.339399564	-0.33752	-1.14172	-0.37108
Range	4.063829018	4.257717	0.907845	0.204907
Minimum	-4.406319327	-4.28268	0.241666	0.284278
Maximum	-0.342490309	-0.02497	1.149512	0.489185
Sum	-51.41768611	-49.5408	20.24637	9.954023
Count	25	25	25	25

APPENDIX 4: Descriptive Statistics for Ghana-India Data

Item	**GHC/Rupee Rate**	**Price**	**Domestic Sector**	**Foreign Sector**
Mean	-3.921349129	-0.96029	0.809855	0.06355
Standard Error	0.182676484	0.135198	0.056669	0.02406
Median	-3.877621579	-0.97727	0.951654	0.059988
Mode	-3.483492624	#N/A	#N/A	#N/A
Standard Deviation	0.913382421	0.67599	0.283344	0.120301
Sample Variance	0.834267447	0.456963	0.080284	0.014472
Kurtosis	-0.672971801	-0.78345	-0.19047	-0.59871
Skewness	-0.53489543	0.137972	-1.14172	0.594307
Range	3.05884933	2.431653	0.907845	0.38923
Minimum	-5.713832811	-2.1641	0.241666	-0.09781
Maximum	-2.65498348	0.267553	1.149512	0.291423
Sum	-98.03372822	-24.0071	20.24637	1.588758

Count	25	25	25	25

APPENDIX 5: Descriptive Statistics for Ghana-Netherlands Data

Item	**GHC/Euro Rate**	**Price**	**Domestic Sector**	**Foreign Sector**
Mean	0.545999883	-2.1858	0.768875	0.708009
Standard Error	0.174737542	0.154119	0.068002	0.014757
Median	0.576330656	-2.16002	0.927656	0.693163
Mode	#N/A	#N/A	#N/A	#N/A
Standard Deviation	0.781450046	0.68924	0.304112	0.065994
Sample Variance	0.610664174	0.475052	0.092484	0.004355
Kurtosis	-0.652660844	1.517427	-0.96694	0.615682
Skewness	-0.216175595	-0.93753	-0.78781	0.53458
Range	2.77923761	2.944061	0.907845	0.274264
Minimum	-1.07031642	-4.00951	0.241666	0.595644
Maximum	1.708921191	-1.06545	1.149512	0.869907
Sum	10.91999765	-43.716	15.3775	14.16018
Count	20	20	20	20

APPENDIX 6: Descriptive Statistics for Ghana-South Africa Data

Item	**GHC/Rand Rate**	**Price**	**Domestic Sector**	**Foreign Sector**
Mean	-2.099202546	-1.13427	0.809855	0.480587
Standard Error	0.152469541	0.121757	0.056669	0.025709
Median	-1.952632695	-0.97335	0.951654	0.477968
Mode	#N/A	#N/A	#N/A	#N/A
Standard Deviation	0.762347703	0.608784	0.283344	0.128543
Sample Variance	0.58117402	0.370618	0.080284	0.016523
Kurtosis	-1.008282007	1.496013	-0.19047	-1.50852
Skewness	-0.471424625	-1.08947	-1.14172	-0.20006
Range	2.463344797	2.68463	0.907845	0.379418
Minimum	-3.530167763	-2.90377	0.241666	0.255689
Maximum	-1.066822966	-0.21914	1.149512	0.635107

Sum	-52.48006365	-28.3568	20.24637	12.01469
Count	25	25	25	25