Macroeconomic Effects of the Exchange Rate : A Non-linear Analysis

Thesis Submitted for the degree of
Doctor of Philosophy
By

Danny Kaliba

School of Business
Department of Economics, Finance, and Accounting
University of Leicester
United Kingdom
December 2023

Macroeconomic Effects of the Exchange Rate : A Non-linear Analysis

Danny Kaliba

Abstract

The thesis employs non-linear econometric techniques to explore the relationships involving the exchange rate and selected macroeconomic variables, which are subjects of controversy. First, the thesis examines the relationship between globalisation and the exchange rate pass-through to domestic prices, using the panel smooth transition regression model and a sample of 16 African countries. The thesis establishes evidence suggesting a non-linear relationship between globalisation and the pass-through exists, and that globalisation causes a rise in the level of the pass-through. Additional evidence suggests that the influence of globalisation on the pass-through varies with exchange rate regimes, with globalisation causing the pass-through to decrease in fixed regimes and to increase in flexible regimes.

Secondly, the thesis investigates non-linearity, asymmetry, and J-curve effects in the relationship between the exchange rate and the trade balance of Zambia with its 17 trading partners. The thesis uses the logistic vector smooth transition regression model and the non-linear panel autoregressive distributed lag model for estimations. Evidence favouring non-linearity and asymmetry effects is established. However, limited evidence of J-curve is found, especially with individual trading partners. Evidence suggests that currency depreciation cannot be relied on to improve trade balance.

Third, the thesis examines the relationship between the exchange rate and foreign direct investments, taking into account the role of trade openness, natural resources, and institutional quality. Based on the estimation of the dynamic panel threshold model on a sample of 44 African countries, the thesis establishes evidence of non-linear effects. Specifically, the thesis finds that trade openness, natural resources, and institutional quality induce a non-linear response in foreign direct investments to their determinants. Furthermore, the thesis establishes new evidence suggesting that currency depreciation attracts FDI inflows in countries characterised by greater economic openness, abundant natural resources, and weaker institutions.

The findings of the thesis elicit important macroeconomic implications.

Acknowledgements

I would like to express my sincere gratitude to my supervisors, Dr. Don Egginton and Dr. Deborah Gefang, for their unwavering support and encouragement throughout my journey to obtaining my PhD. Their expertise, guidance, and constructive feedback have been invaluable to me. In addition, I am grateful to Dr. Subir Bose and Dr. Sarah G. Mohamed for the PGR sessions.

I owe a debt of gratitude to my employer, the Bank of Zambia, for providing me with the necessary financial assistance to pursue the PhD programme. I extend my sincere gratitude to Dr. Denny H. Kalyalya, Dr. Francis Chipimo, Ms. Rekha C. Mhango, Mr. Isaac Muhanga, Dr. Jonathan M. Chipili, Ms. Mumbi K. Mwila, and Ms. Kombe Soteli for their kind support and encouragement. I also thank the human resources staff, Ms. Mwaka Shimabale, Ms. Febby Mulambia, and Ms. Bendadette Mwiinga, for their consistent support. Furthermore, I wish to express my appreciation to Dr. Grivas S. Chiyaba, Mr. Kafula Longa, Ms. Mary Nketani, Mr. Wachisa Sibale, and Mr. Joseph Simumba for their assistance with data. I am also grateful to my university colleagues, especially Mr. Jawad Mohammad, for their encouragement and support, which made this journey less daunting.

Furthermore, I would like to express my heartfelt appreciation to my wife, Shallety, and my children for their unwavering support in my studies. Their love, encouragement and understanding were critical to helping me complete this journey. I would also like to thank my parents and siblings for their constant support and encouragement throughout my academic journey.

I am grateful to everyone who contributed to my success in completing this PhD programme. Thank you to all.

Danny Kaliba
Leicester, December 7, 2023

Contents

Declaration

The research presented in this thesis was conducted at the University of Leicester, England. This thesis is an original work of the author and has not been submitted elsewhere for any other degree or qualification unless acknowledged explicitly in the text.

List of Figures

List of Tables

Abbreviations

BOP Balance of Payments

DPT Dynamic Panel Threshold

ERPT Exchange Rate Pass-Through

FDI Foreign Direct Investment

GDP Gross Domestic Product

GMM Generalised Method of Moments

KOF Swiss Economic Institute

LVSTR Logistic Vector Smooth Transition Regression

MLC Marshall Lerner condition

NARDL Nonlinear Autoregressive Distributed Lag

OLI Ownership, Location, and Internalization

PARDL Panel Autoregressive Distributed Lag

PSTR Panel Smooth Transition Regression

SADC Southern African Development Community

SSA Sub-Sahara Africa

WAEMU West African Economic and Monetary Union

Chapter 1

Introduction

1.1 Background and Motivation

The exchange rate is a conduit that connects various economic activities within a nation to the larger international economic landscape (Williamson, 2009). It facilitates the comparison of the prices of goods and services in different countries (Krugman et al., 2018). The exchange rate is an important macroeconomic variable, especially when considering comprehensive economic reforms and the overall economic landscape (Obadan, 2006). On the monetary policy front, the exchange rate is one channel or transmission mechanism that influences economic conditions (Mishkin, 2001; Uchendu, 1996; Akram et al., 2015). Similarly, some central banks use the exchange rate as a policy instrument (Hüfner, 2004; Parrado, 2004; Chong Tee, 2013; El Hamiani Khatat et al., 2020). The exchange rate elicits macroeconomic and development impacts in various ways, including resource allocation, external trade balance, inflation, and finance (Frenkel and Taylor, 2006). Motivated by the importance of the exchange rate, the thesis explores the relationships involving the exchange rate and selected macroeconomic variables, which are the subject of controversy. Specifically, it examines the relationship between the exchange rate and domestic prices, with a particular focus on its association with globalisation. It also investigates the relationship of the exchange rate with the trade balance and foreign direct investments.

In its approach to examining the relationships involving the exchange rate, the thesis employs non-linear econometric models. This approach is motivated by the literature suggesting that many macroeconomic variables are non-linearly related (Hubrich and Teräsvirta, 2013). Structural changes are one of the potential sources of non-linearity (Koop and Potter, 2000). The second motivation is that economic theory does not always indicate non-linearity in the relationship between variables, so empirical testing and estimation are necessary to uncover it (Yang, 2012). The third motivation is that where data properties suggest non-linearity, non-linear econometric models are likely to perform better than linear models. Finally, the thesis is motivated by rising advancements in econometric models that account for non-linearity. Despite these advances, the use of non-linear models remains limited, particularly within the domains explored by the thesis.

Concerning the application of non-linear econometric models, the second chapter employs the Panel Smooth Transition Regression (PSTR) model of González et al. (2017) and González et al. (2005). In the third chapter, the Logistic Vector Smooth Transition Regression (LVSTR) model, based on the modelling strategy developed by Teräsvirta and Yang (2014), is employed. Additionally, the non-linear Panel Autoregressive Distributed Lag (PARDL) model is used. Chapter four uses the Dynamic Panel Threshold (DPT) model of Seo and Shin (2016) and Seo et al. (2019). The use of these non-linear models, PSTR, LVSTR and DPT models, in this thesis, is empirically supported by the linearity tests that are conducted. It should be noted that the non-linear PARDL model, which facilitates the assessment of asymmetry effects, does not fall into the class of non-linear models that require linearity testing to provide empirical justification for its use. Instead, its estimation output is subjected to the Wald tests to determine whether there are asymmetry effects. For each chapter, a brief introduction is provided below.

1.1.1 Exchange Rate Pass-Through: Is the influence of globalisation non-linear?

The relationship between the exchange rate and prices (that is, import and domestic prices), known as Exchange Rate Pass-Through (ERPT), has received considerable research attention from academics and policymakers, leading to a vast literature. This is not surprising given the importance attached to ERPT. In particular, ERPT plays a role in the choice of exchange rate policies (Engel, 2000). Fear of floating is related to concerns about higher ERPT (Frankel et al., 2012). ERPT is also important for the conduct of monetary policy (Upper, 2016; Delatte and López-Villavicencio, 2012; Bussière and Peltoven, 2007; Bhattacharya et al., 2008). This is because it allows for accurate inflation projections (Hahn, 2003; Bhattacharya et al., 2008) and facilitates the design of appropriate responses (Yanamandra, 2015). Furthermore, ERPT is important in other aspects, such as understanding the transmission of external shocks, addressing global trade imbalance issues (Delatte and López-Villavicencio, 2012; Bussière and Peltoven, 2007; Nogueira and Leon-Ledesma, 2008; Cheikh and Louhichi, 2016; Brun-Aguerre et al., 2017), and handling macroeconomic stability and capital flows issues (Campa and Goldberg, 2005).

Despite the increasing level of research, the literature presents conflicting findings on the relationship between globalisation and ERPT. As a result, the effect of globalisation on ERPT remains unclear. Some studies suggest that globalisation leads to an increase in ERPT (e.g., Benigno and Faia, 2016; Fandamu et al., 2021), while others document that it causes a decrease in ERPT (e.g., Gust et al., 2010; López-Villavicencio and Mignon, 2018). Understanding the link between globalisation and ERPT is essential, especially for small open economies, such as African countries, that rely on imports for essential products. For example, African countries' food imports are estimated at US$35 billion annually, and this figure is projected to rise to US$110.0 billion by the year 2025 (Viswanathan and Mishra, 2020). Given the faster and more pronounced nature of ERPT in developing countries (Bala et al., 2017), the circumstances in these countries become even more challenging. In view of this, it is critical to examine whether globalisation would worsen the situation by causing ERPT to rise or, better, by lowering the level of ERPT.

Whereas previous studies have explored the relationship between globalisation and ERPT with linear models, the thesis considers a different approach by employing a non-linear econometric model, PSTR model. This approach is novel in addressing the link between globalisation and ERPT. The non-linear model facilitates greater insight and understanding of the relationship between globalisation and ERPT. The question considered is whether globalisation causes non-linear effects on the ERPT. If so, the thesis determines whether higher levels of globalisation are associated with lower or higher levels of ERPT. The thesis extends this analysis to establish whether the results change with different exchange rate regimes. The research is carried out on a sample of 16 African countries, of which 10 have a fixed exchange rate regime, and the remaining 6 have a flexible regime.

1.1.2 The Exchange Rate and Trade Balance Adjustment in Zambia: A Non-linear Analysis

Most recently, the literature led by Bahmani-Oskooee and Fariditavana (2015, 2016) has established evidence suggesting the presence of asymmetry effects in the relationship between the exchange rate and the trade balance. This relationship has a long history of research from the 1930s (see Johnson, 1977). Consistent with this discovery, the accounting of asymmetry effects has improved the relationship between the exchange rate and the trade balance (Bahmani-Oskooee and Saha, 2017). This new evidence motivates the thesis, since previous research has mainly used single non-linear models, mostly the Nonlinear Autoregressive Distributed Lag (NARDL) model. The thesis proposes to use the LVSTR model, a multiple equation model that accounts for the interrelationship between variables. The proposed model allows for regime switching, and the threshold level is established endogenously. To the author's knowledge, this model has not previously been employed to explore the relationship between the exchange rate and the trade balance. Furthermore, the thesis employs the non-linear PARDL model to investigate asymmetry effects.

Before the discovery of asymmetry effects, there was a debate about the influence of the exchange rate on the trade balance. Although the literature suggests that the discovery has reinforced the relationship, the debate remains unsettled. Along these lines, the literature highlights that the body of literature in each country is unique (Bahmani-Oskooee et al., 2019b; Bahmani-Oskooee and Gelan, 2020). This serves as motivation for the thesis. Based on this, the thesis investigates the relationship between the exchange rate and the trade balance using data on bilateral trades between Zambia and its 17 trading partners. Zambia is selected as a case study due to its distinctive trade characteristics, manifested in the fact that a small number of trading partners constitute a significant portion of its trade, and minerals account for a higher share of exports (see subsection 3.4.1 for more details). The other motivation is based on the absence of an exhaustive study involving Zambia that comprehensively examines the relationship between the exchange rate and the trade balance using data at the bilateral trade level. Therefore, the thesis examines non-linearity, asymmetry and J-curve effects in Zambia's exchange rate - trade balance relationship with its 17 trading partners.

1.1.3 Exchange Rate Effect on Foreign Direct Investment: Does trade openness, natural resources, and institutions induce non-linearity?

For more than half a century, the link between the exchange rate and Foreign Direct Investment (FDI) inflows has greatly interested policymakers and researchers. As noted by Jehan and Hamid (2017), Sharifi-Renani and Mirfatah (2012), and Moraghen et al. (2023), the first work that provided a link between the exchange rate and FDI was by Aliber (1970). However, the relationship garnered more interest in the later part of the 1980s and early 1990s due to the unprecedented increase in the level of FDI inflows, particularly into the United States (Blonigen, 1997). Research interest is related to the importance of FDI (for details, refer to Section 4.1).

The effect of the exchange rate on FDI is controversial in the literature. On the one hand, FDI inflows are argued to be driven by the depreciation of the host country's currency. On the other hand, FDI inflows are argued to be driven by appreciation in the currency. There is also a view that the exchange rate does not play a role (See Blonigen, 1997; Chakrabarti and Scholnick, 2002).

Previous research has mainly explored the relationship between the exchange rate and FDI inflows based on the direct relationship and has used linear models. This serves as motivation for the thesis. Unlike previous research, this thesis explores the indirect relationship in a non-linear setting. Specifically, the thesis examines how the relationship is influenced by trade openness, natural resources, and institutional quality in an environment where these factors are allowed to vary from low to higher levels. Therefore, the thesis asks whether trade openness, natural resources, and institutions induce non-linearity in the relationship between the exchange rate and FDI. It also asks whether currency depreciation causes an increase in the level of FDI when the host country is more open, has abundant natural resources, and has stronger institutions.

The research is carried out on a sample comprising 44 African countries. These countries are selected in part on the premise that Africa exhibits unique characteristics, reflected in lower FDI receipts compared to other continents. Furthermore, Africa has higher financing requirements. For example, the infrastructure financing gap for Africa is up to US$100 billion per year (AfDB, 2018).

1.2 Structure of the Thesis

The rest of the thesis is arranged as follows: Chapter 2 delves into the potential non-linear relationship between globalisation and ERPT. It investigates whether higher levels of globalisation lead to an increase or decrease in ERPT and determines the threshold levels of globalisation at which regime changes occur. Additionally, in a non-linear context, the thesis examines whether the relationship between globalisation and ERPT varies depending on the exchange rate regime. The PSTR model is used for the estimations.

Chapter 3 examines the exchange rate and trade balance relationship, accounting for non-linearity and asymmetry effects. The analysis uses bilateral trade data that involve 17 trade partners of Zambia. The chapter seeks to determine whether the relationship exhibits non-linearity and asymmetry effects. In addition, the chapter seeks to test the J-curve hypothesis. Two estimation models are employed, the LVSTR model and the non-linear PARDL model.

Chapter 4 investigates the exchange rate-FDI relationship and seeks to determine whether trade openness, natural resources, and institutions exert a non-linear influence on this relationship. Furthermore, the chapter seeks to determine whether currency depreciation encourages FDI inflows in a host country that is more open, rich in natural resources, and has stronger institutions. The chapter uses a sample of 44 African countries and the DPT model in empirical estimations.

Finally, Chapter 5 presents the conclusion, encapsulating the principal findings and policy implications while identifying prospective avenues for future research.

Chapter 2

Exchange Rate Pass-Through: Is the influence of globalisation non-linear?

2.1 Introduction

Although the literature on ERPT is vast, the relationship between globalisation and ERPT is largely underexplored and is still inconclusive. One strand of the literature postulates that globalisation causes an increase in the level of ERPT (see e.g., Benigno and Faia, 2016). In contrast, another section of the literature holds the view that globalisation leads to a decrease in the degree of ERPT (see e.g., Gust et al., 2010). This lack of consensus complicates the formulation of appropriate policies. Further research is therefore crucial to gain a deeper understanding of the nature of the relationship between globalisation and ERPT.

Both strands of literature agree that globalisation leads to greater competition (see López-Villavicencio and Mignon, 2018). However, competition outcomes diverge between the two strands. With the first strand, competition leads to a shrinkage in foreign firms' mark-ups and an increase in the ERPT, while with the second strand, it leads to an increase in foreign firms' use of complementary price setting and a decrease in the ERPT (see Di Mauro et al., 2008). Based on this, it seems that the level of mark-up plays a significant role in explaining the relationship between globalisation and ERPT. The influence of globalisation on ERPT appears to depend on the level of mark-up. Specifically, globalisation seems to cause ERPT to increase at lower levels of mark-up (i.e., the first strand of literature) and to decrease at higher levels of mark-up (i.e., the second strand of literature). Therefore, it seems there are non-linear effects in the relationship between globalisation and ERPT.

The level of market share also seems cardinal in explaining the relationship between globalisation and ERPT. Based on Dornbusch (1985), a higher share of foreign goods in the domestic economy leads to an increase in the level of ERPT, aligning with the first strand of literature. In the second strand, as indicated by Krugman (1986), foreign firms adopt complementary pricing behaviour for reasons associated with maintaining their market share. In the first strand of the literature, the size of the market share of foreign firms is indicated and is larger relative to that of domestic firms. However, the size of the market share in the second strand is not highlighted; it is likely smaller relative to that of domestic firms and is hence protected through complementary pricing behaviour. In this context, the relationship between globalisation and ERPT seems to depend on the level of market share of foreign firms in the domestic economy. When the level of market share is low, globalisation causes a decrease in the level of ERPT (i.e., the second strand of literature), and when the level of market share is high and exceeds a certain threshold, globalisation causes ERPT to increase (i.e., the first strand of literature). This suggests possible non-linear effects in the relationship between globalisation and ERPT.

The study is directly inspired by that of López-Villavicencio and Mignon (2018), which, among others, explores the possible connection between the level of openness and the degree of ERPT using a linear model. Their study covered three European countries with different levels of trade openness. France exhibited the lowest level of trade openness, followed by Germany, while Belgium had the highest. However, their findings indicated a vague relationship, possibly attributable to the use of a linear model and a small sample size. While previous research has employed linear models, it is important to consider non-linear models and explore the possibility of non-linearity in the globalisation-ERPT relationship.

In connection with the above, the objective of the study is to examine the relationship between globalisation and ERPT. The relationship is examined in a non-linear setting in which regime-switching is allowed based on the level of globalisation. In this line, the study investigates whether the influence of globalisation on the ERPT is non-linear. Specifically, it seeks to establish whether the ERPT varies with the level of globalisation. This approach makes it possible to establish whether globalisation causes the ERPT to rise or to decline. The study also examines whether the influence of globalisation on ERPT varies depending on exchange rate regimes. Estimations are performed using the PSTR model, a regime-switching model that allows thresholds to be endogenously determined. The study uses three globalisation indicators: economic globalisation, trade openness, and import penetration. The study seeks to establish the following:

1. To determine if globalisation's influence on the ERPT is non-linear;
2. To estimate the thresholds of globalisation;
3. To estimate the speed at which transitions takes place between regimes; and
4. To determine whether the globalisation effect on the ERPT in a non-linear setting varies based on exchange rate regimes.

Early studies investigating ERPT focused mainly on developed countries, as indicated in a survey by Menon (1995). Recently, there seems to be a growing number of studies that cover developing countries. However, despite this trend, research on ERPT in Africa remains limited. Furthermore, studies that address the relationship between globalisation and ERPT in the African context are particularly scarce. In line with this, the study considers a sample of 16 African countries, in which the exchange rate regime is fixed for 10 countries (hereafter referred to as "fixers") and flexible for 6 countries (hereafter referred to as "floaters"), consistently over the sample period. The guide for this is the de facto classification of the exchange rate regime by the International Monetary Fund, documented in the Annual Reports on Exchange Arrangements and Exchange Restrictions (AREAER)[1].

[1]These reports can be accessed at https://www.imf.org/en/Publications/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions/

The contribution of this study is best reflected in how this study differs from previous research. This study examines the effect of globalisation on ERPT in a non-linear context and uses a non-linear model. On the contrary, existing studies have used linear models and have mainly addressed the topic in a linear context (e.g., Benigno and Faia, 2016; Jiménez-Rodríguez and Morales-Zumaquero, 2016; Fandamu et al., 2021; Ozkan and Erden, 2015; López-Villavicencio and Mignon, 2018). The study also differs in that, in addition to the globalisation indicators used in previous studies, it uses the economic globalisation index that has a wider scope. Economic globalisation, an index published by the Swiss Economic Institute (KOF)[2] that reflects economic openness, has not previously been considered to the author's knowledge. Furthermore, the study examines whether globalisation's non-linear effect on the ERPT depends on exchange rate regimes, which previous research has not explored.

To preview the findings, the study establishes evidence indicating that globalisation's influence on the ERPT is non-linear and that the ERPT increases as globalisation rises beyond a certain threshold. This implies that globalisation causes an increase in ERPT. Based on exchange rate regimes, the results are not comparable using the same globalisation indicators but suggest that globalisation causes the level of ERPT to fall for fixers and to rise for floaters.

The remainder of the chapter is arranged as follows: Section 2.2 reviews the theoretical setting of the ERPT and the trends as well as the developments around the ERPT. It then addresses the theoretical and empirical literature on the relationship between globalisation and ERPT, before presenting a brief review of the relationship between globalisation and inflation. Section 2.3 describes the methodology, while Section 2.4 provides a description of the data. The empirical results are presented in Section 2.5. The conclusion of the study is drawn in Section 2.6.

[2]The Swiss Economic Institute website can be accessed at https://www.kof.ethz.ch/en/

2.2 Literature Review

2.2.1 ERPT - Theory and empirical evidence

This section sets the groundwork for the literature review of the globalisation - ERPT relationship conducted in subsection 2.2.2. In this section, the theoretical framework on which ERPT is determined and estimated is reviewed along with related developments.

2.2.1.1 Derivation of ERPT Equation

The ERPT is theoretically supported by both microeconomic and macroeconomic perspectives. It is, however, the microeconomic perspective that pioneered studies on the ERPT (see Dornbusch, 1985; Mann, 1986; Krugman, 1986). The microeconomic perspective addresses ERPT in the context of industrial organisation models or imperfect competition models, drawing upon aspects of product substitutability, price discrimination, market integration and segmentation, as well as the degree to which foreign firms participate in the market relative to domestic firms (Dornbusch, 1985; Mann, 1986).

Based on the microeconomic perspective, the ERPT equation is derived on the relationship between import prices in the domestic economy and export prices in the foreign country through the exchange rate. The relationship is expressed as follows:

$$p_h = e \times p_f \tag{2.1}$$

Where p_h is the import price in the domestic economy, and e is the exchange rate expressed in the value of the domestic currency per unit of a foreign currency. A rise in the level of the exchange rate reflects the depreciation of the domestic currency. p_f is the export price, expressed in foreign currency or rather the currency of the exporting firms. Equation 2.1 reflects the law of one price as stated in the purchasing power parity (PPP) literature (Dornbusch, 1985; Krugman, 1986; Mann, 1986). Based on the equation, a change in the exchange rate is immediately and fully reflected in the import price. For example, keeping the export price constant, a 10% change in the exchange rate will result in a 10% change in the import price. This reflects a one-to-one variation in the exchange rate and the import price. This is in accordance with the law of one price, which essentially implies that the price of a good in different countries should be equal when expressed in a single currency (Akofio-Sowah, 2009). Therefore, the law of one price and the PPP is valid based on Equation 2.1. However, the empirical literature shows that changes in exchange rates are not fully reflected in import prices, violating the law of one price. The reason for this is found in part in the market structure, specifically in the behaviours of the components that make up the export price. The components include the marginal cost of production (mc_f) and the profit margin or mark-up (mk_f) (Knetter, 1992). To reflect these components of the export price, Equation 2.1 is rewritten as follows:

$$p_h = e \times mc_f \times mk_f \tag{2.2}$$

Applying natural logarithms (logs) and the difference operator (Δ) yields Equation 2.3 expressed as follows:

$$\Delta \log p_h = \Delta \log e + \Delta \log mc_f + \Delta \log mk_f \tag{2.3}$$

The pass-through of the exchange rate to prices is one-to-one (that is, 100% or complete) if the marginal costs are constant and the mark-up is also constant or zero (Adekunle and Tiamiyu, 2018). Keeping $\Delta \log(mc_f)$ and $\Delta \log(mk_f)$ constant in Equation 2.3, the changes in import prices will vary one-to-one with changes in the exchange rate, similar to the case in Equation 2.1 when p_f remains constant. In an imperfect competitive framework, firms enjoy some pricing power, and the mark-up is greater than zero and tends to be variable. According to Krugman (1986), firms tend to vary their mark-ups in response to exchange rate variations to preserve their market share, a phenomenon described as "pricing to market behaviour." The effect of this is that the change in the import price is less than the change in the exchange rate, leading to a less-than-complete ERPT. To illustrate this concept using an example, suppose that the currency of the importing country experiences a depreciation of 10%. The exporter, in response, adjusts the mark-up by absorbing a portion equivalent to 4% of the depreciation. Consequently, the import price would increase by 6%, representing a smaller increase compared to the full extent of the 10% currency depreciation. It is also possible that an exporter can fully absorb a depreciation of 10%, effectively nullifying any increase in import prices and resulting in a pass-through of zero. However, an exporter will likely do so if the mark-up remains positive. Regarding marginal costs, it is essential to note that their fluctuations directly impact the level of mark-ups. When there are productivity improvements or trade cost reductions, such as the removal or reduction of import tariffs, marginal costs tend to decrease (Gust et al., 2010). The decrease in marginal costs translates into increases in mark-ups, which firms use to absorb exchange rate variations and keep import prices relatively stable. In line with this, the mark-up becomes more responsive to exchange rate changes, leading to a fall in sensitivity of the import prices to the exchange rate. When both marginal cost and mark-up are not constant, the effect is an incomplete exchange rate pass-through. The implication is that the "law of one price" may be built around the perfectly competitive framework in which firms are price takers and have zero mark-ups. In such an environment, the pass-through is higher and tends to be complete.

Notably, the imperfect competitive framework not only gives rise to the pricing-to-market mechanism described above but also presents firms with choices on the currency to use to set prices of their goods. The choice of the invoicing currency for goods, though related to pricing-to-market tendencies, forms part of the new open economy macroeconomic models (Obstfeld, 2002; Duarte, 2001; Bacchetta and Van Wincoop, 2003) on which a macroeconomic perspective of ERPT is held. These models are micro-founded, so they focus on firms and their invoicing currency choices. Regarding choices, firms can set their prices in their home country's currency, referred to as "producer currency pricing," or in the importing country's currency, known as "local currency pricing." If a firm decides to use producer currency pricing, import prices will respond one-for-one to variations in the exchange rate, leading to a higher and complete ERPT. As shown above, the law of one price will hold in this case. However, if local currency pricing is used, the import price will not change in response to exchange rate variations, and as such, the pass-through will be zero and the law of one price will not hold. With local currency pricing, firms vary their profit margins one-for-one with exchange rate movements. This is similar to an extreme form of "price-to-market" (Yanamandra, 2015). However, it is highly likely that local currency pricing will be applied in markets characterised by low volatility of the exchange rate and greater macroeconomic stability, without which it may not be a sustainable activity for a long period (Devereux and Engel, 2001). The overall level of ERPT in the country will depend on how widespread one form of currency pricing is relative to the other. This implies that ERPT will be relatively higher if producer currency pricing dominates in use and relatively lower if local currency pricing dominates (Khundrakpam, 2008).

Continuing with Equation 2.3, the marginal cost and the mark-up can be represented by other factors. According to Bailliu and Fujii (2004), marginal cost can change due to variations in the cost of inputs sourced locally in the country of the exporting firms, while mark-up can change as a result of unexpected changes in demand in the importing country. The marginal cost facing firms in exporting countries can, among others, be represented by the cost of oil (oil_f), following Aron et al. (2014). On the other hand, the mark-up can, among others, be represented by the gross domestic product (gdp_h), as indicated by Nogueira and Leon-Ledesma (2008). Reflecting this in Equation 2.3 results in Equation 2.4 below:

$$\Delta \log p_h = \Delta \log e + \Delta \log gdp_h + \Delta \log oil_f \tag{2.4}$$

It should be noted that domestic prices are captured by the consumer price index. Therefore, the impact of exchange rate variations on domestic prices is reflected when the consumer price index is part of the equation. The consumer price index (cpi_h) is made up of non-tradeable sectors (p_{nt}) and tradable sectors (p_t), and can be expressed in equation form as follows:

$$cpi_h = p_{nt}^{\theta} \times p_t^{(1-\theta)} \tag{2.5}$$

Where θ is the parameter, ranging between 0 and 1, that captures the relative weights of the non-tradable sectors and tradable sectors in the consumer price index basket. Taking the logs and applying the difference operator (Δ) to Equation 2.5 yields the following:

$$\Delta \log cpi_h = \theta \Delta \log p_{nt} + (1-\theta) \Delta \log p_t \tag{2.6}$$

The link between the consumer price index and the exchange rate is through the tradable sector. Prices in the tradable sectors are determined as expressed in Equation 2.4, but with the inclusion of past prices (p_{t-1}). Prices in non-tradeable sectors are a function of past prices (p_{nt-1}) as well as aggregate demand, captured by the growth rate in gross domestic product ($\Delta \log gdp_h$) (Nogueira and Leon-Ledesma, 2008). Taking all these aspects into account and reflecting inflation inertia (i.e. changes in past prices) with one lag, results in Equation 2.7 presented in reduced form as follows:

$$\Delta \log cpi_h = \Delta \log cpi_{h-1} + \Delta \log e + \Delta \log gdp_h + \Delta \log oil_f \tag{2.7}$$

Following McCarthy (2007) and Ito and Sato (2008), Money supply (ms_h) is included to account for the effect of monetary policy. Equation 2.7 is therefore adjusted as follows:

$$\Delta \log cpi_h = \Delta \log cpi_{h-1} + \Delta \log e + \Delta \log ms_h + \Delta \log gdp_h + \Delta \log oil_f \tag{2.8}$$

Including coefficients in Equation 2.8 leads to the following specification:

$$\begin{aligned}\Delta \log cpi_{ht} = \beta_1 \Delta \log cpi_{ht-1} + \beta_2 \Delta \log e_t + \beta_3 \Delta \log ms_{ht} + \beta_4 \Delta \log gdp_{ht} \\ + \beta_5 \Delta \log oil_{ft} + \epsilon_t \end{aligned} \tag{2.9}$$

Empirically, ERPT is assessed using Equation 2.9. Previous research that uses this specification includes Ito and Sato (2008), Kassi et al. (2019), Bwire et al. (2013), Fandamu et al. (2021), among others.

2.2.1.2 ERPT trends, developments, and empirical research

ERPT trends

A substantial part of the literature documents that ERPT is low and exhibits a downward trajectory in countries over time (e.g., see McCarthy, 2007; Olivei, 2002; Ihrig et al., 2006; Sekine, 2006; Marazzi and Sheets, 2007; Holmes, 2008; Ghosh, 2013). For example, Gagnon and Ihrig (2004) found a significant decrease in the level of ERPT in the United States of America, the United Kingdom and other advanced countries during the period 1971-2003. Ihrig et al. (2006) found a similar result in their study covering G7 countries[3] and involving two periods, 1975-1989 and 1990-2004. Specifically,

[3] G7 countries include United States, Canada, United Kingdom, France, Germany, Italy and Japan.

they documented that average exchange rate pass through to import prices for G7 countries fell to about 0.04 in the latter period from about 0.07 in the former period. With respect to pass-through to consumer prices, the study reported that average pass-through turned neutral in the period 1990-2004 from about 0.02 in the 1975-1989 period. The results demonstrated statistical significance for pass-through to import prices in three countries and for pass-through to consumer prices in two countries. In developing countries, Frankel et al. (2012) in a sample of 76 countries, which includes only a few developed countries, also finds a declining ERPT level. Holmes (2008) finds a significant drop in the effect of exchange rate variations on import prices in a study involving 19 African countries, including Burkina Faso, Cote d'lvoire, Gabon, Ghana, Madagascar, Mauritius, Senegal, South Africa, and Togo.

The low-level and downtrend trend of the ERPT is now considered a stylised fact. The trend exhibited by ERPT is the result of a combination of factors. Some of these factors have already been highlighted in subsubsection 2.2.1.1 and include price-setting behaviour by firms through pricing to market arrangement and choice of invoicing currency. Other factors documented as contributing to the fall in ERPT levels include the low inflationary environment (Taylor, 2000; Choudhri and Hakura, 2006; Ca'Zorzi et al., 2007), the implementation of credible monetary policy frameworks (Gagnon and Ihrig, 2004; Coulibaly and Kempf, 2010), the improvement of macroeconomic stability and trends (Mwase, 2006; Razafimahefa, 2012), as well as increased trade integration and global spread of multinational corporations (Bailliu et al., 2010). Although ERPT has been declining in level, it remains relatively high in developing countries compared to advanced countries (María-Dolores, 2009), and one of the reasons for this is that developing countries are associated with relatively higher inflation rates and underdeveloped financial markets that limit hedging opportunities (Ca'Zorzi et al., 2007). Less credible monetary policy frameworks may be another reason. However, some studies, such as Frankel et al. (2012), establish evidence that points to a narrowing of differences in ERPT levels between developed and developing countries.

Another stylised fact is that the ERPT decreases along the pricing chain, which implies that the effect of exchange rate variations is higher on import prices and lower on consumer prices (Ca'Zorzi et al., 2007; Donayre and Panovska, 2016). One factor that accounts for the difference in level between pass-through to import prices and pass-through to consumer prices is the distribution costs (Bacchetta and Van Wincoop, 2003; Burstein et al., 2003).

ERPT and exchange rate regimes

The relationship between ERPT and exchange rate regimes has been explored. ERPT is argued to have an influence on the type of exchange rate regime adopted by a country (Frankel et al., 2012). In this context, the fear of floating by countries is linked to concerns about a higher ERPT. This suggests that countries with a higher level of ERPT are likely to adopt fixed regimes. Empirically, some studies establish results that indicate that fixed regimes are associated with higher ERPT than floating regimes (e.g., see Kassi et al., 2019; Razafimahefa, 2012; Kara and Öğünç, 2008). One reason for this is that exchange rate movements are considered permanent in fixed regimes (El bejaoui, 2013). However, despite this, some studies document a lower ERPT with fixed regimes compared to floating regimes (e.g., see Ghartey, 2019).

Non-linear models on exchange rate pass-through

Several non-linear models have been utilised in previous research to investigate ERPT. One such model is the Non-linear Autoregressive Distributed Lag (NARDL) model, mainly used to examine asymmetry effects in ERPT[4]. In a study involving Nigeria, Adekunle and Tiamiyu (2018) employed this model and established evidence of asymmetry effects in the short term, with consumer prices responding more to currency appreciation than depreciation. Similarly, based on the same econometric model, Delatte and López-Villavicencio (2012) investigated asymmetry in ERPT in four developed countries. The results indicated that ERPT behaved differently in response to currency appreciation and depreciation in the long run. Evidence also suggested that the impact of currency depreciation on ERPT was greater compared to that of appreciation. Baharumshah et al. (2017) used the NARDL model to analyse asymmetric effects in ERPT for Sudan and established evidence suggesting asymmetry, with ERPT responding more to currency depreciation than appreciation. In a study by El bejaoui (2013), the ERPT asymmetry was

[4]Asymmetry effects implies that currency depreciations and appreciations are not passed on in equal proportions to prices. This implies that prices respond more strongly to currency depreciation than to appreciation, or to currency appreciation than to depreciation. The reasons for the asymmetry in ERPT are price rigidities (Delatte and López-Villavicencio, 2012), pricing-to-market, and binding constraints (Pollard and Coughlin, 2004).

investigated for four advanced countries, Germany, France, Japan, and the United States. The findings indicated that export and import prices exhibited asymmetry in response to currency depreciation and appreciation. Specifically, evidence indicated that these prices were more responsive to currency appreciation than to depreciation.

Non-linear models within the framework of smooth transition regressions have also been employed by existing research to explore not only asymmetry in ERPT, as with NARDL models, but also the relationships of ERPT with macroeconomic variables. Nogueira and Leon-Ledesma (2008), utilising the smooth transition regression model, examined the relationships of ERPT with inflation, output growth, size of exchange rate changes, and macroeconomic instability in six countries: South Africa, Brazil, Mexico, the Czech Republic, Canada and the United Kingdom. The study found that ERPT is non-linearly influenced by these factors. Specifically, evidence suggested that the level of ERPT was positively associated with inflation, output growth, and macroeconomic instability, with ERPT increasing when these factors increase. Cheikh (2012a) using the same model investigated ERPT asymmetry in 12 European countries, and the findings suggested asymmetry effects. This was with respect to the varying degrees of response of domestic inflation to currency depreciation and appreciation, as well as to small and large exchange rate movements. In a different study, Cheikh (2012b) using the same model explored the relationship between ERPT and inflation in 12 European countries. The study established evidence suggesting that ERPT and inflation are positively correlated, with ERPT increasing at higher inflation levels. Junttila and Korhonen (2012) used the same model in a similar study involving nine OECD countries[5]. The study also found that the level of ERPT depended on the level of inflation and tended to be higher in a higher inflation environment. Shintani et al. (2013) also conducted a similar study using the same model but using the United States as a case study. Similar results were obtained as those found by Cheikh (2012b) and Junttila and Korhonen (2012). In a more recent study, Balcilar et al. (2021) used the multivariate version of the model, the smooth transition vector autoregressive regression model, and established evidence suggesting the asymmetric influence of small and large exchange rate shocks. Using the vector smooth transition regression model,

[5]OECD refer to the Organisation for Economic Cooperation and Development.

the study by Cheikh et al. (2018) involving countries in the euro area established that ERPT is more pronounced during economic expansions compared to recessions for some countries, while the opposite holds true for others.

Using panel data, the above class of non-linear models have also been used in research. Cheikh and Zaied (2020) used the panel smooth transition regression model to investigate the role of inflation, exchange rate volatility, and output growth in a study involving 10 European countries. The study established inconclusive evidence on the relationship between output growth and the ERPT, and no evidence of non-linearity supporting the use of exchange rate volatility as a threshold variable in the model. However, the study found that ERPT was higher in higher inflation episodes, similar to the results found by some studies reviewed above.

Threshold models have also been used in the existing literature. Aleem and Lahiani (2014), using the threshold vector autoregression model, investigated non-linear effects in the relationship between ERPT and the inflation rate in Mexico. The study established that ERPT is significant above the inflation threshold, but insignificant below it. Donayre and Panovska (2016) used a similar model in the Bayesian version in a study involving Canada and Mexico. The study examined the relationship between ERPT and economic activity and established evidence suggesting that ERPT depends on the level of economic activity. Specifically, ERPT was found to be higher when the economy was expanding and lower when the economy was contracting. In a different study focusing on Brazil, Correa and Minella (2010) explored the influence of business cycles, the volatility of the exchange rate, and the size of changes in the exchange rate on ERPT. The results suggested that ERPT tended to increase with expansion in economic activity, greater depreciation of the exchange rate, and lower volatility of the exchange rate. Doğan (2013), in a study involving Turkey and using threshold regression models, explored the influence of exchange rate volatility, the size of exchange rate changes, and demanding conditions on the relationship between exchange rate and industry prices in the manufacturing sector. The study findings were that ERPT was higher in the face of expanding economic activities, but no evidence of the asymmetric influence of the other factors was established.

Similarly, Przystupa and Wróbel (2011), in a study involving Poland, used threshold models to examine the relationship of ERPT with inflation, the output gap, and exchange rate volatility. The study found evidence suggesting that ERPT was not non-linearly influenced by inflation. However, the study found evidence of non-linear influence with respect to the output gap and the volatility of the exchange rate. Specifically, the study established that ERPT increased with expansion of economic activity and decreased with economic contraction. Furthermore, ERPT was found to increase with low exchange rate volatility and decrease as the exchange rate volatility increased.

This review indicates that the use of non-linear econometric models in the ERPT literature is not new. Several relationships between ERPT and macroeconomic variables have been explored using these models. Concerning the relationship between ERPT and globalisation, to the best knowledge of the author, no existing studies have employed a non-linear model. Therefore, this study makes a novel contribution in this regard.

2.2.2 Globalisation and ERPT

The theoretical link between globalisation and ERPT is divided as regards the effect of globalisation on the ERPT. In the first strand of literature, which contends that globalisation causes an increase in ERPT, the theoretical perspective is drawn from the work of Dornbusch (1985), which contributed significantly along with the work of Krugman (1986) to establish the theoretical foundation for early studies of ERPT. The work of Dornbusch (1985) employed industrial organisation literature models, specifically the Cournot model. In the model, the key elements included the relative market shares of domestic and foreign firms, the degree of market concentration, and the level of substitutability of the product. The model demonstrated that a larger presence of foreign firms in the market, indicated by a higher market share of foreign firms compared to domestic ones and heightened competition, was strongly correlated with a high level of pass-through. The larger market share held by foreign firms in the model signifies an elevated level of import share in the domestic economy, which, in turn, reflects a high degree of openness. The implication is that openness and ERPT are positively correlated, meaning that higher levels of openness are associated with a high degree of pass-through. Although higher imports into the domestic economy imply a higher ERPT, as indicated in this piece of literature, the research findings of

Campa and Goldberg (2005) suggest that this may be the case only if imports are mainly composed of commodities. If imports are dominated by manufactured goods, which tend to be associated with lower ERPT, the result may not hold (Aron et al., 2014).

Still in the first strand, Di Mauro et al. (2008) indicates that globalisation can lead to higher ERPT if greater competition erodes the mark-ups of some of the foreign firms participating in the domestic economy. As mark-up decreases, firms cannot deploy pricing to market strategies and are forced to pass exchange rate movements into prices, leading to an increase in the ERPT.

The other strand of literature postulates that globalisation leads to a decline in ERPT. Gust et al. (2010) develops a framework that supports this strand by using the dynamic stochastic general equilibrium model. The framework shows increased complementary price settings by firms due to increased competition emanating from increased trade integration associated with reduced trade costs, increases in foreign productivity levels, or a combination of both. It is further shown that a reduction in trade costs, an increase in productivity, or a combination of both reduces the marginal costs facing foreign firms and translates to higher mark-ups. With larger mark-ups, firms become more responsive to pricing by other firms and engage in pricing-to-market behaviour by absorbing exchange rate variations. The implication is that prices on the market are more inclined to remain constant or to fall than to rise. The framework further shows that while falling trade costs and increased productivity levels each result in a decline in the pass-through, their combined effect leads to an even steeper decline in the level of the pass-through. This outcome is consistent with the argument of Bacchetta and van Wincoop (2005) that increased competition caused by the entry of foreign firms into the market can result in lower pass-through.

Regarding the reduction in trading costs, Di Mauro et al. (2008) presents a divergent view, suggesting that this may not necessarily lead to a lower ERPT. This is because lower trading costs allow for easy market entry and exit and ultimately can lead to higher ERPT, as some firms, in times of higher exchange rate volatility, can temporarily opt out of the market instead of defending their market share. However, a temporary exit from the market carries the risk of a permanent loss of market share. As Delatte and López-Villavicencio (2012) pointed out, evidence of hysteresis effects established by

Froot and Klemperer (1988) suggests that market share may be permanently lost if temporarily lost. Taking this evidence into account, firms may be reluctant to exit the market due to the potential long-term implications.

As in the theoretical literature, empirical studies on the effect of globalisation on ERPT are divided. Some studies report a negative influence of globalisation on ERPT, while others document a positive relationship between globalisation and ERPT. Benigno and Faia (2016) extends the work of Dornbusch (1985) and investigates the effect of globalisation on ERPT in the United States of America. Globalisation is measured as the increase in the share of foreign goods in the domestic economy. Similar to Dornbusch (1985), the study establishes that the ERPT level is closely related to the share of foreign goods on the domestic market and the degree of market concentration. The study finds a positive relationship between the share of foreign goods and the exchange rate pass-through, indicating that globalisation causes an increase in the level of pass-through.

Along the same lines as above, Fandamu et al. (2021) investigates the impact of globalisation on ERPT in Zambia using monthly data for the period 2006-2017 and the vector error correction model. They use three indicators of globalisation that include the ratio of imports from China to total imports, the ratio of imports from Southern African Development Community (SADC) to total imports, and the sum of exports and imports over Gross Domestic Product (GDP). The study finds evidence suggesting that ERPT is positively affected by globalisation measured in terms of imports from China and the share of exports and imports in GDP. However, the study finds that ERPT is negatively influenced by globalisation measured in terms of imports from SADC.

Similarly, Barhoumi (2006) conducted a study involving 24 developing countries, using tariff barriers to gauge the openness of a country. Lower tariff rates imply greater openness and, of course, higher levels of globalisation within the context of this study. Using the sample median tariff barrier rate for each year, the author categorised the countries into groups of low-tariff and high-tariff. Countries with tariff rates above the median for more than half of the sample period are categorised as high-tariff, while those with rates lower than the median are classified as low-tariff. The study finds that ERPT is higher for low-tariff countries than for high-tariff countries, suggesting that globalisation causes higher ERPT.

Unlike the studies mentioned above, other studies report opposing results. López-Villavicencio and Mignon (2018) investigated the effect of globalisation on ERPT in three countries in the euro area - Belgium, Germany, and France - with varying levels of openness. Three indicators of globalisation were used: the ratio of imports from China to total imports, the import penetration rate (measured as the ratio of imports to GDP), and tariff rates. The effect of globalisation was captured in the model through an interaction term computed as a product of the exchange rate and an indicator of globalisation. The authors found evidence suggesting that an increase in trade openness and a reduction in tariff rates, representing a rising level of globalisation, contributed to a low pass-through of the exchange rate into import prices. They also found evidence that imports from China had not led to a reduction in the level of ERPT. Furthermore, the study findings did not show a clear link between the level of openness and the degree of ERPT.

Likewise, a study by Ozkan and Erden (2015), covering 88 countries and using the Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model, established that the pass-through to consumer prices is negatively impacted by trade openness. This finding was also established in all sub-samples: developing, less developed, and developed countries. Kohlscheen (2010) also found a similar result. Using simple and spearman correlations, the author found that trade openness and ERPT were negatively correlated.

Mixed results are reported by Jiménez-Rodríguez and Morales-Zumaquero (2016) in a study involving the G-7 countries. Trade openness, measured as the sum of exports and imports over GDP, is found to cause a decrease in the ERPT level in Canada and Japan, but an increase in Germany and Italy. Insignificant and inconsistent results are obtained by Choudhri and Hakura (2006) and Ca'Zorzi et al. (2007). In a study that involved 71 countries, Choudhri and Hakura (2006) using a panel regression model found that the import-to-GDP ratio has an insignificant and negative effect when it is the only regressor in the model. When other regressors, such as inflation, inflation volatility, and exchange rate variability, are included in the model, the import-to-GDP ratio has a positive but insignificant effect on ERPT. Ca'Zorzi et al. (2007), in a study covering 12 emerging market countries, uses the Pearson and Spearman correlation to investigate the link between openness, measured as the ratio of imports to GDP, and ERPT. The authors find evidence of an insignificant correlation between ERPT and openness, which is negative without controlling for inflation, and positive after controlling for inflation. A study by María-Dolores (2009), involving 11 countries from central and eastern Europe, established results that suggest that there is no clear link between openness and ERPT.

As noted in previous studies, the effect of globalisation on ERPT is mixed. This study deviates from existing studies in that it examines the effect of globalisation on ERPT in a non-linear setting, whereas previous studies used linear models. Specifically, the study uses a regime-switching model to determine whether low and high levels of globalisation impact ERPT differently. It is noteworthy that the study by López-Villavicencio and Mignon (2018), although it used a linear model, is closer to the focus of this study in that it sought to establish whether there is a link between the level of openness and the degree of ERPT. The other difference between this study and previous research is that it also considers whether the effect of globalisation on ERPT varies depending on exchange rate regimes. Furthermore, the study considers a new variable, economic globalisation, as an indicator of globalisation.

However, it is important to note that it is difficult to conclusively establish the causality between globalisation and ERPT. Globalisation has no universally agreed upon definition; hence, it has many definitions and several indicators or proxies (see Dreher et al., 2008; Talani, 2019). The implication is that the indicators might not effectively measure globalisation. It is also possible that the relationship between the indicator and globalisation can change rapidly. The proxy for other variables in the model can also be incorrect. This makes it difficult to model causation even if an attempt was made to control for these other effects.

2.2.3 Globalisation and Inflation

Literature establishes a connection between globalisation and inflation, which is controversial because both theoretical support and empirical evidence are mixed. Romer (1993) established that openness and inflation are negatively related, implying that the more open the economy, the lower the level of inflation. This finding, also known as the "Romer hypothesis," is based on the monetary authorities' decision to refrain from the implementation of surprise monetary expansion when the economy is relatively more open. The study also established evidence showing a one-way causality from openness to inflation. Some studies also found similar results suggesting a negative relationship between openness and inflation (e.g., Lane, 1997; Rogoff, 2003; Gruben and McLeod, 2004). On the contrary, other studies established opposing results (e.g., Zombe et al., 2017; Evans, 2012; Alfaro, 2005).

With the generally rising levels of globalisation, the debate has been extended to what is referred to as the "global hypothesis". The global hypothesis posits that globalisation has altered the inflation process such that inflation is increasingly responsive to global slack and decreasingly responsive to domestic slack. This implies a reduced sensitivity of inflation to domestic factors and increased sensitivity to global factors as globalisation increases (Ihrig et al., 2010; Benigno and Faia, 2016). Globalisation affects inflation directly and indirectly: directly by influencing the cost of imports and indirectly by increasing competition in the markets for goods, services, and labour (López-Villavicencio and Saglio, 2014). The hypothesis is tested mainly using the Phillips curve and incorporating global factors such as the foreign output gap (e.g., see Tootell, 1998; Gamber and Hung, 2001; Borio and Filardo, 2007). In a model setting, evidence of the global hypothesis is reflected when the coefficient of the global factor is greater than the coefficient of the domestic factor and when the coefficient of the global factor shows an increase over time, while the coefficient of the domestic factor reduces with time (Bianchi and Civelli, 2015).

Benigno and Faia (2016) incorporates the global hypothesis in the analysis of the effect of globalisation on ERPT. The share of imports, a proxy for the number of foreign products, is used to capture globalisation. The study shows that increases in import share strengthen the link between domestic prices and foreign marginal costs, which are connected to foreign output gaps. At the same time, the relationship between domestic marginal costs and domestic prices is shown to weaken as the level of imports increases. This reflects that domestic prices are largely determined by foreign slack, not domestic slack, confirming the global hypothesis. The study also shows that globalisation has a positive influence on ERPT, which means that increases in globalisation lead to increases in the level of pass-through. Similar to Benigno and Faia (2016), some studies find support for the globalisation hypothesis (e.g., Borio and Filardo, 2007; Zhang et al., 2015; Manopimoke, 2015). However, other studies report evidence against the globalisation hypothesis (e.g., Tatom, 2017; Tootell, 1998; López-Villavicencio and Saglio, 2014; Ihrig et al., 2010; Bianchi and Civelli, 2015).

The globalisation hypothesis has been a subject of interest for many central banks. This is because it implies that the setting of monetary policy to achieve the target goals becomes challenging (Carney, 2017). This is in the context that, while monetary policy may continue to influence domestic factors, its effects on inflation developments may be negligible given the increasingly weak link between domestic factors and inflation.

Based on the review, it is clear that there is a connection between globalisation and inflation, although it is ambiguous. To account for this, a globalisation indicator (gb) is incorporated into Equation 2.9, which is now written as follows:

$$\Delta \log cpi_{ht} = \beta_1 \Delta \log cpi_{ht-1} + \beta_2 \Delta \log e_t + \beta_3 \Delta \log ms_{ht} + \beta_4 \Delta \log gdp_{ht} + \beta_5 \Delta \log oil_{ft} + \beta_6 \Delta \log gb_{ht} + \epsilon_t \quad (2.10)$$

This specification is consistent with the one used by Fandamu et al. (2021).

2.3 Methodology

2.3.1 Overview of the PSTR Model

The study employs the Panel Smooth Transition Regression (PSTR) model to examine the non-linear relationship between globalisation and ERPT. The PSTR model has several characteristics that make its application to this study advantageous. First, it is a regime-switching model that facilitates the determination of extreme regimes of globalisation and their effects on ERPT. Second, the model endogenously determines the globalisation threshold that defines extreme regimes. Third, the countries in the sample are allowed to switch between regimes during the sample period depending on whether the level of globalisation is below or above the threshold.

The PSTR model is effective in handling heterogeneous panels (González et al., 2005), and its use by researchers underscores its appeal to capture heterogeneity (González et al., 2017). Heterogeneity is reflected in the regression coefficients, which vary for cross-sectional units over the sample period. The cross-sectional units are placed in different groups or regimes according to the threshold level and are allowed to switch between groups at each time period (Colletaz and Hurlin, 2006; Fouquau et al., 2008; González et al., 2017). Since cross-sectional units can switch between groups during the sample period, Colletaz and Hurlin (2006) suggest that the PSTR model performs better than the sample splitting technique, which does not allow the shifting of cross-sectional units between groups throughout the sample period.

Although the PSTR model is believed to allow cross-sectional units to shift between groups or regimes throughout the sample period, there may be limitations. In the presence of heterogeneity, where some cross-sectional units predominantly exhibit smaller or higher values in relation to the threshold level, switching by these units over the sample period may not be possible. Consequently, it might be possible that the threshold level established by the model may not be common to all cross-sectional units. Another limitation of the PSTR model is that it does not account for cross-sectional dependence. This implies that the parameter estimates may be inefficient and biased.

A linear panel model, based on Equation 2.10, can be specified in the following way:

$$y_{it} = \alpha_i + \beta' x_{it} + \epsilon_{it} \tag{2.11}$$

Where y_{it} is a vector of the dependent variable and represents the domestic prices of the country i = 1,....., N and the period t = 1,...., T. x_{it} is a vector of k dimensions of explanatory variables that include lagged domestic prices, exchange rates, money supply, gross domestic product, crude oil prices and globalisation. The dependent variable and the explanatory variables are all expressed in growth rates, consistent with Equation 2.10. ϵ_{it} is a vector of error terms. α_i reflect individual country fixed effects, while β represents the coefficients of the explanatory variables. Introducing the transition function $g(s_{it} : \gamma, c)$ to Equation 2.11 yields the PSTR model of González et al. (2017), specified in Equation 2.12 below as follows:

$$y_{it} = \alpha_i + \beta' x_{it} + \beta^{*'} x_{it} g(s_{it} : \gamma, c) + \epsilon_{it} \tag{2.12}$$

In the transition function $g(s_{it} : \gamma, c)$, s_{it} denotes the transition or threshold variable and, in this study, represents globalisation. γ is the slope parameter reflecting the transition speed between regimes. c is the location or threshold parameter and is essentially the value of the transition variable, which triggers switches between regimes when the transition variable rises above and falls below it. The transition function is a continuous function, and its value falls in the range of zero to one. It is specified as follows:

$$g(s_{it} : \gamma, c) = [1 + exp(-\gamma \prod_{z=1}^{m} (s_{it} - c_z))]^{-1} \tag{2.13}$$

Where $\gamma > 0$, $c_1 \leq ... \leq c_m$ and c is an m-dimensional vector of location parameters. The PSTR model presented in Equation 2.12 comprises linear and non-linear components. The linear component is associated with the coefficient β, and the non-linear component with the coefficient β^*, linked to the transition function described in Equation 2.13. If the transition function tends to zero, the PSTR model in Equation 2.12 collapses to the linear panel model in Equation 2.11. In this situation, γ will be closer to zero. On the other hand, if the transition function tends to one, γ will be very large, possibly tending to infinite. In this case, the PSTR model collapses into a panel threshold regression model of Hansen (1999), in which the switch between regimes is not smooth but sudden.

The interaction between the values of the transition variable and the location parameter provides an indication of the value of the transition function as well as the applicable extreme regime. The transition function tends to zero when the transition variable takes values that are significantly lower than the location parameter. The situation in which the transition variable takes a value below the location parameter is classified by the model as the lower regime. When the transition variable is associated with values far greater than the location parameter, the transition function value gravitates toward one, and the model classifies this as the higher regime. The lower regime coefficient is β, while the higher regime coefficient is the sum of β and β^*. However, this applies only if the transition function takes the value of 1. The transition function can also take different values that fall between 0 and 1. In connection to this, the PSTR model nests several regimes, where in each of them the transition function has a value that is unique. Based on this, the higher regime coefficient is a weighted average of β and β^* for values of the transition function between 0 and 1. In view of this, the interpretation of the model coefficients is based on their sign (Colletaz and Hurlin, 2006). The implication is that the coefficients are not read as elasticities. Regarding the interpretation based on coefficient signs, a positive sign implies a greater effect of the regressor on the regressand, while a negative sign denotes a lesser effect (see Fouquau et al., 2008).

2.3.2 PSTR Model Estimation Procedure

This study follows the estimation procedure for the PSTR model suggested by González et al. (2017), which consists of three important steps: specification, estimation, and evaluation.

2.3.2.1 Specification

In this step, the PSTR model is specified as in Equation 2.12, and the linearity test, also known as the homogeneity test, is carried out to determine the appropriateness of the application of the model. It should be noted that the estimation of the PSTR model requires the empirical support provided by the linearity test. The test's null hypothesis favours the estimation of a linear panel model presented in Equation 2.11, while the alternative hypothesis supports the use of the PSTR model, specified in Equation 2.12. As highlighted earlier, the PSTR model collapses into a linear panel model when the value of the transition function is zero. On the basis of the specification of the PSTR model, the value of the transition function is zero in two cases. The first case is when the slope parameter,γ, is equal to zero, and the second one is when the coefficients, β^*, in the non-linear part of the model, are equal to zero. In connection with this, the test null hypothesis is stated as $H_0 : \gamma = 0$ or $H_0 : \beta^* = 0$. However, this creates an identification problem, since the alternative hypothesis identifies the PSTR model and not the null hypothesis. This is because the parameters γ and β^* in the null hypothesis are not part of the linear panel model presented in Equation 2.11 but Equation 2.12 for the PSTR model, and as such they are termed nuisance parameters. This identification issue makes the linearity test non-standard. To address this issue, González et al. (2017) substitute the transition function for its first-order

Taylor approximation of Luukkonen et al. (1988), around $\gamma = 0$, resulting in the following auxiliary regression:

$$y_{it} = \alpha_i + \beta^{'} x_{it} + \beta_1^{*'} x_{it} s_{it} + \beta_2^{*'} x_{it} s_{it^2} + ... + \beta_m^{*'} x_{it} s_{it^m} + \epsilon_{it} \tag{2.14}$$

Here, the parameter vectors $\beta_1^*, ..., \beta_m^*$ are multiples of γ. With the auxiliary regression in Equation 2.14, which is a linear model, the null hypothesis, $H_0 : \gamma = 0$ or $H_0 : \beta_1^* = ... = \beta_m^* = 0$ can be tested. Following Colletaz and Hurlin (2006), three types of linearity tests are carried out, and these include Wald Lagrange multiplier (LM_W), Fischer Lagrange multiplier (LM_F) and Likelihood Ratio (LR), defined as follows:

$$LM_w = T \times N(SSR_0 - SSR_1)/(SSR_0) \tag{2.15}$$

$$LM_F = \frac{T \times N(SSR_0 - SSR_1)/Km}{SSR_0/(T \times N(SSR_0 - SSR_1)/Km)} \tag{2.16}$$

$$LR = -2(\log SRR_1 - \log SSR_0) \tag{2.17}$$

Where T and N reflect the sample time period and number of observations, respectively. SSR_0 is the summative value of the squared residuals for the linear panel model in Equation 2.11 under the null hypothesis, while SSR_1 is the summative value of the squared residuals and relates to the auxiliary regression in Equation 2.14, which falls under the alternative hypothesis and reflects the PSTR model. The LM_w and LR have a $(m \times K)$ degree of freedom, where m is the number of location parameters and K is the number of regressors in the model. The LM_F has an approximate F distribution with degrees of freedom $(m \times K, T \times N - N - m \times K)$. For each test above, a statistically significant statistic, reflected by a p-value of at most 0.10 (i.e., 10% significance level), implies rejecting the null hypothesis and adopting the PSTR under the alternative hypothesis. The specification step reaches its conclusion by evaluating the results of the linearity test, and the next step is to estimate the PSTR model if the null hypothesis is rejected.

2.3.2.2 Estimation

The estimation stage comprises a two-step process. The initial step is to remove the fixed effects (α_i), from the PSTR model in Equation 2.12 by deducting the mean of each variable, resulting in the modified PSTR model below:

$$\hat{y}_{it} = \beta \hat{x}_{it} + \beta^* x_{it} g(\widehat{s_{it} : \gamma, c}) + \hat{\epsilon}_{it} \tag{2.18}$$

Where $\hat{y}_{it} = y_{it} - \bar{y}_i$, $\hat{x}_{it} = x_{it} - \bar{x}_i$, $x_{it} g(\widehat{s_{it} : \gamma, c}) = x_{it} g(s_{it} : \gamma, c) -$ $\overline{x_{it} g(s_{it} : \gamma, c)}$, $\hat{\epsilon}_{it} = \epsilon_{it} - \bar{\epsilon}_i$, $\bar{y}_i = \frac{1}{T_i} \sum_{t=1}^{T_i} y_{it}$, $\bar{x}_i = \frac{1}{T_i} \sum_{t=1}^{T_i} x_{it}$, $\overline{x_{it} g(s_{it} : \gamma, c)} =$ $\frac{1}{T_i} \sum_{t=1}^{T_i} x_{it} g(s_{it} : \gamma, c)$, and $\bar{\epsilon}_i = \frac{1}{T_i} \sum_{t=1}^{T_i} \epsilon_{it}$.

In the second step, the non-linear least squares is applied on Equation 2.18 to estimate the parameter values that correspond to the sum of squared errors that are smallest. This takes the form specified below:

$$\hat{\epsilon}' \hat{\epsilon} = \sum_{t=1}^{N} \sum_{t=1}^{T} (\hat{y}_{it} - \beta \hat{x}_{it} - \beta^* x_{it} g(\widehat{s_{it} : \gamma, c}))^2 \tag{2.19}$$

2.3.2.3 Evaluation

In this step, the test of no remaining non-linearity, also known as misspecification tests, is performed to rule out the presence of residual non-linearity. This test seeks to establish the optimal number of transition functions or extreme regimes of the model. The test is inextricably linked to the linearity tests performed in the specification step. In linearity tests, the null hypothesis is stated as $H_0 : \gamma = 0$, which is essentially equivalent to $H_0 : r = 0$, where "r" refers to the number of transition functions. The alternative hypothesis, expressed as $H_1 : \gamma \geq 0$ in the linearity tests, can also be stated as $H_1 : r \geq 1$. Following the adoption of the PSTR model based on the outcome of the linearity tests, the test for no residual non-linearity is performed to determine if the model contains only one or more transition functions. The null hypothesis ($H_0 : r = 1$) posits that there exists only a single transition function, whereas the alternative hypothesis ($H_1 : r \geq 2$) suggests that there are two or more transition functions. The PSTR model with two transition functions is specified below:

$$y_{it} = \alpha_i + \beta' x_{it} + \beta^{*'} x_{it} g_1(s_{it}^{(1)} : \gamma_1, c_1) + \beta^{**'} x_{it} g_2(s_{it}^{(2)} : \gamma_2, c_2) + \epsilon_{it} \tag{2.20}$$

Where the part, $\beta^{*'} x_{it} g_1(s_{it}^{(1)} : \gamma_1, c_1)$, reflects the first transition function and the component , $\beta^{**'} x_{it} g_2(s_{it}^{(2)} : \gamma_2, c_2)$, represents the second transition function. According to Equation 2.20, the null hypothesis of a single transition function (that is, $r = 1$) is equivalent to the hypothesis that $\gamma_2 = 0$ or $\beta^{**} = 0$. As was the case with linearity tests, there is an issue of identification. The second transition function is identified in the alternative hypothesis, not in the null hypothesis. To address this problem, an approach similar to that conducted with linearity tests is employed. The Taylor first-order approximation around $\gamma_2 = 0$ is used in place of the second transition function to generate the auxiliary regression needed to perform the test. The auxiliary regression is represented below.

$$y_{it} = \alpha_i + \beta' x_{it} + \beta^{*'} x_{it} g_1(s_{it}^{(1)} : \hat{\gamma_1}, \hat{c_1}) + \beta_1^{**'} x_{it} s_{it}^{(2(1))} + \beta_2^{**'} x_{it} s_{it}^{(2(2))} + \\ ... + \beta_m^{**'} x_{it} s_{it}^{(2(m))} + \epsilon_{it} \quad (2.21)$$

The coefficients β_j^{**} for $j = 1, \dots, m$ are multiples of γ_2. The test for no remaining non-linearity is carried out with the null hypothesis, $H_0 : \beta_1^{**} = ...\beta_m^{**} = 0$. The same linearity tests are used, Wald Lagrange multiplier (LM_w), Fischer Lagrange multiplier (LM_F), and likelihood ratio (LR). The test results suggesting non-rejection of the null hypothesis imply that the PSTR model with a single transition function should be adopted and that no further testing is required. On the other hand, if the results suggest rejection of the null hypothesis, the implication is that the suitable model has at least two transition functions and more testing is necessary to determine whether the appropriate model contains two or more transition functions. Therefore, the next test will consider the null hypothesis of two transition functions (i.e., $r = 2$) against the alternative hypothesis of three transition functions (i.e.,$r = 3$). If the test results again suggest rejection of the null hypothesis, further tests are conducted. The null hypothesis of three transition functions (i.e., $r = 3$) will be tested against the alternative hypothesis of four transition functions (i.e., $r = 4$). Testing progresses sequentially and stops when the null hypothesis cannot be rejected (Colletaz and Hurlin, 2006).

2.3.2.4 PSTR and Endogenity

Endogeneity is a potential problem for the PSTR model. To deal with this problem, González et al. (2005) estimated the model with the transition variable and the explanatory variables expressed in their first lags. In a later study, González et al. (2017) indicated that the PSTR model could be extended to a dynamic model by including the lag of the dependent variable as an explanatory variable. However, this could lead to endogeneity due to a possible correlation between the first lag of the dependent variable and the error term. To address this potential problem, Anderson and Hsiao (1981) suggested instrumenting the first lag of the dependent variable with the second lag. In line with this, the lagged dependent variable enters the model in its second lag, while all other explanatory variables do so in their first lag. The transition variable enters the model in its second lag.

2.4 Data

2.4.1 Data description

The study uses a sample of 16 African countries, strictly selected based on consistent adherence to fixed or flexible exchange rate regimes for the entire sample period. This enables a comparison of the relationship between globalisation and ERPT based on the exchange rate regime, an aspect that existing studies have not explored. The classification of exchange rate regimes is de facto based, as documented in the IMF's Annual Reports on Exchange Arrangements and Exchange Restrictions for the period covered by the sample. The availability of data also determines the selection of countries for the sample. In the sample, 10 countries are fixers[6], and their respective currencies are pegged to the euro. Each of these countries belongs to the economic region grouping, which is either the Economic and Monetary Community of Central Africa (CEMAC) or West African Economic and Monetary Union (WAEMU). Six countries in the sample are floaters. Table 2.1 shows that the countries that make up the sample.

[6] As defined earlier, "fixers" refer to countries with fixed exchange rate regimes, while "floaters" refer to countries with flexible exchange rate regimes.

Table 2.1: List of countries in the sample

	Fixers		Floaters
1	Benin	1	Ghana
2	Burkina Faso	2	Madagascar
3	Central African Rep.	3	Mauritius
4	Chad	4	South Africa
5	Côte d'Ivoire	5	Uganda
6	Gabon	6	Zambia
7	Mali		
8	Niger		
9	Senegal		
10	Togo		

Balanced panel data is used with annual data from 1994 to 2019. The start date of the data coincides with the adoption of the fixed exchange rate regime by the fixers. The variables used in the study include domestic price, exchange rate, money supply, gross domestic product, and crude oil price index, as well as some indicators of globalisation, including the economic globalisation index, trade openness, and import penetration. Below, a concise overview of the variables is provided, including their source.

Domestic price is represented by the Consumer Price Index (CPI), defined as a standardised index that reflects the level of domestic or consumer prices in a country. The CPI is calculated as the price of a weighted average basket of products that represent typical household consumption. The percentage changes in the CPI denote changes in domestic prices or inflation rates. The source for the CPI data is the World Bank Group Databank for World Development Indicators[7].

Exchange rate is used to capture ERPT and is the variable of interest. The nominal effective exchange rate (NEER) is preferred to the nominal bilateral exchange rate, especially when dealing with countries with fixed exchange rate regimes, as in this study. The preference for NEER is that it facilitates the variability of the exchange rate since it considers all currencies used in the trading activities between a country and its trading partners (Akofio-Sowah, 2009). The data on NEER is taken from Bruegel datasets[8], where it

[7]The World Bank Group Databank for World Development Indicators can be accessed at https://databank.worldbank.org/source/world-development-indicators

[8]The Bruegel datasets can be accessed at https://www.bruegel.org/publications/datasets/real-effective-exchange-rates-for-178-countries-a-new-database

is available for all countries in the sample. The construction of the NEER index is based on the work of Darvas (2021) and Darvas (2012). The NEER used is based on basket of 170 currencies of trading partners. In this study, the NEER data is transformed by taking its reciprocal so that an increase in the level of NEER reflects a depreciation of the domestic currency against a basket of foreign currencies.

Money supply is represented by broad money and reflects the central bank's reaction to inflationary concerns. Broad money refers to the aggregation of forms of money that include cash outside the banking system; non-central-government demand deposits; non-central-government time, savings, and foreign currency deposits; bank and traveller's cheques; and certificates of deposit, commercial paper, and other similar securities. Broad money is taken from the World Bank Group Databank for World Development Indicators.

GDP is a standardised measure that reflects the total economic output of the country and is used in this study to represent the demand conditions for imported goods and services in the domestic economy. Real GDP data is used and is taken from the World Bank Group Databank for World Development Indicators.

Crude oil price index (2016=100) is constructed as the simple average of the spot prices for three different types of crude oil: Brent, West Texas, and Dubai. The crude oil price index represents the marginal cost conditions facing producers of goods in the exporting country. The data is obtained from the Primary Commodity database of the International Monetary Fund.

Economic globalisation is an index published by the Swiss Economic Institute (KOF). It is a component of the globalisation index and denotes economic openness. The economic globalisation index ranges from 1 and 100, with a higher value indicating greater globalisation. The index comprises the trade globalisation index and the financial globalisation index. The trade globalisation index comprises several factors, such as trade in goods and services, trade diversity, trade regulations, trade taxes, trade tariffs, and trade agreements. The financial globalisation index takes into account foreign direct investment, portfolio investment, international debt, international reserves, international income payments, capital account openness, international investment agreements, and investment restrictions (Potrafke, 2015).

Trade openness is measured as the ratio of exports and imports of goods and services to GDP. A rise in the level of trade openness implies greater openness of a country and reflects an increase in globalisation. The data used to construct this indicator is obtained from the World Bank Group Databank for World Development Indicators.

Import penetration is defined as the ratio of imports of goods and services to GDP. A higher level of this indicator reflects higher imports in the domestic economy and points to higher levels of globalisation. As with trade openness, this indicator is constructed using data from the World Bank Group Databank for World Development Indicators.

2.4.2 Unit Root Tests

The variables used for estimation are tested for the presence of unit roots. Three unit root tests are used: Levin-Lin-Chu (LLC) of Levin et al. (2002), Fisher-Augmented Dickey-Fuller (ADF), and Cross-sectionally Augmented Im, Pesaran and Shin (CIPS) unit root tests. LLC and ADF tests assume cross-sectional independence in the variables, while the CIPS test assumes that the variables are cross-sectionally dependent (Baltagi, 2013). The null hypothesis for all tests is that the variable has unit roots. The alternative hypothesis states that there is no unit root. For the LLC and IPS unit root tests, the decision to reject the null hypothesis is informed by the p-values. If the p-values are less than 0.01, 0.05, or 0.1, the null hypothesis is rejected. In the case of the CIPS unit root test, the decision is guided by critical values. If the absolute value of the CIPS statistic exceeds the critical value[9], then the null hypothesis is rejected.

The results are reported in Table 2.2 for the whole sample and in Table 2.3 and Table 2.4 for the sub-samples (i.e., fixers and floaters). For the whole sample, the LLC unit root test results indicate that all variables in levels have p-values less than 0.1. This suggests rejecting the null hypothesis at the 10% significance level, implying no presence of unit roots in the variables. Notably, certain variables such as domestic prices (DP_{it}), the nominal effective exchange rate ($NEER170_{it}$), money supply (MS_{it}), and economic globalisa-

[9]The critical values for the test are presented in the notes below the tables reporting the unit root test results.

tion (EG_{it}) are associated with p-values less than 0.01, indicating rejection of the null hypothesis at the 1% significance level. Regarding the Fischer ADF unit root test, the results suggest rejection of the null hypothesis only for EG_{it} and at the 5% significance level. The CIPS unit root test results suggest rejecting the null hypothesis of unit roots for $NEER170_{it}$ and crude oil (Oil_t) at the 10% significance level. In the first difference of the variables, the results of all unit root tests show that all variables are stationary. The LLC and ADF unit root tests reveal p-values of zero for all variables, suggesting rejection of the null hypothesis at the 1% level of significance. Concerning the results of the CIPS unit root test, it is shown that the test statistics for all variables are greater than 2.38 in absolute terms. This indicates that the null hypothesis should be rejected at the 1% significance level.

Table 2.2: Unit Root Test Results - Whole Sample

Variables	Level			First Difference		
	LLC	ADF	CIPS	LLC	ADF	CIPS
DP_{it}	0.000	0.187	-1.847	0.000	0.000	-4.311
$NEER170_{it}$	0.000	0.972	-2.411	0.000	0.000	-4.595
MS_{it}	0.000	0.942	-1.792	0.000	0.000	-4.520
GDP_{it}	0.074	0.991	-1.324	0.000	0.000	-3.832
Oil_t	0.001	0.809	2.610	0.000	0.000	2.600
EG_{it}	0.004	0.023	-2.095	0.000	0.000	-5.144
TOP_{it}	0.069	0.635	-1.920	0.000	0.000	-4.810
IMP_{it}	0.005	0.452	-1.892	0.000	0.000	-4.842

The figures under LLC and ADF Fisher are p-values while those under CIPS are test statistics. The critical values of CIPS are -2.11, -2.20, and -2.38 at the 10%, 5%, and 1% levels of significance, respectively. "DP_{it}" = domestic prices, "$NEER170_{it}$" = the nominal effective exchange rate, "MS_{it}" = Money supply, represented by broad money, "GDP_{it}" = Gross Domestic Product, "EG_{it}" = economic globalisation, "TOP_{it}" = trade openness, "IMP_{it}" = import penetration.

For the sub-samples, the results of the unit root tests for fixers in Table 2.3 and floaters in Table 2.4 show mixed outcomes across test types for variables in their levels. However, in the first differences of the variables, the results of all unit root tests suggest that all variables are stationary. Specifically, the LLC and ADF unit root tests are associated with p-values of zero for all variables, while the CIPS unit root test has statistics greater than 2.57 in absolute terms for all variables. As a result, the null hypothesis of a unit root is rejected for all variables in all sub-samples by all unit root tests at the 1% significance level. Based on these results and the representation in

Equation 2.10, all the regressors in the PSTR model are expressed in their first difference.

Table 2.3: Unit Root Test Results - Fixers

Variables	Level			First Difference		
	LLC	ADF	CIPS	LLC	ADF	CIPS
DP_{it}	0.000	0.423	-1.814	0.000	0.000	-5.117
$NEER170_{it}$	0.000	0.967	-0.892	0.000	0.000	-3.618
MS_{it}	0.935	1.000	-2.362	0.000	0.000	-4.847
GDP_{it}	0.842	0.999	-1.387	0.000	0.000	-3.834
Oil_t	0.008	0.743	2.600	0.000	0.000	2.610
EG_{it}	0.460	0.237	-1.803	0.000	0.000	-5.321
TOP_{it}	0.146	0.785	-1.854	0.000	0.000	-4.978
IMP_{it}	0.237	0.519	-1.790	0.000	0.000	-4.865

The figures under LLC and ADF Fisher are p-values while those under CIPS are test statistics. The critical values of CIPS are -2.21, -2.33, and -2.57 at the 10%, 5%, and 1% levels of significance, respectively. See the notes under Table 2.3 for the definitions of variables.

Table 2.4: Unit Root Test Results - Floaters

Variables	Level			First Difference		
	LLC	ADF	CIPS	LLC	ADF	CIPS
DP_{it}	0.000	0.106	-1.904	0.000	0.000	-3.644
$NEER170_{it}$	0.001	0.747	-2.498	0.000	0.000	-4.869
MS_{it}	0.000	0.090	-2.169	0.000	0.000	-4.596
GDP_{it}	0.002	0.861	-1.986	0.000	0.000	-3.571
Oil_t	0.031	0.673	2.600	0.000	0.000	2.610
EG_{it}	0.002	0.002	-2.441	0.000	0.000	-5.312
TOP_{it}	0.017	0.312	-1.917	0.000	0.000	-4.860
IMP_{it}	0.009	0.209	-2.190	0.000	0.000	-4.931

Note: The figures under LLC and ADF Fisher are p-values while those under CIPS are test statistics. The critical values of CIPS are -2.21, -2.33, and -2.57 at the 10%, 5%, and 1% levels of significance, respectively.

2.4.3 Descriptive statistics and preliminary analysis

Descriptive statistics of the data for the sample, fixers, and floaters are presented in Table 2.5. For the sample, the changes in domestic prices, which reflect the inflation rate, over the study period are shown to average 5.26%, with the highest annual change of 46.66% recorded by Ghana in 1995 and the lowest domestic price change of -9.40% recorded by Chad in 2007. The exchange rate variations in the sample have a mean of 1.61%. The largest annual depreciation is 63.08%, which occurred in Ghana in 2000, and the greatest annual appreciation is 23.74%, recorded in 2003 by South Africa. The growth of the money supply has a mean of 11.90% in the sample, with the highest annual growth of 55.25% in Zambia in 2000 and the lowest growth of -32.41% in Cote d'Ivoire in 2003. The average growth rate of the gross domestic product of 4.19% in the sample is shown, highest at 28.99% in Chad in 2004 and lowest at -45.24% in the Central African Republic in 2013. The oil price index shows average changes of 5.54% over the period with variability over the period, measured by standard deviation, of 24.49%. The oil index price experienced its most substantial annual increase of 48.83% in 2000, and the most significant annual decline occurred in 2015, with a drop of 55.41%.

Turning focus to fixers and floaters, it is shown that fixers have a lower inflation rate, averaging 2.60% during the study period compared to the average of 9.71% recorded by floaters. It is also shown that the average exchange rate variation for fixers reflects a domestic currency appreciation of 1.27%, while the average exchange rate variation for floaters exhibits a depreciation of 6.41%. It is further shown that the variability for inflation and the exchange rate is lower for the fixers than for the floaters. Regarding the growth of the money supply, it is lower for fixers than floaters, averaging 9.21% compared to 16.39%. Concerning the globalisation indicators, it is shown that the level of globalisation is higher for floaters than fixers.

For further insight, the averages of the variables above in various periods of the study period are presented in Table 2.6. This helps to understand the trend of variables during the study period. Changes in domestic prices, or rather inflation rate, show a downward trend during the study period, falling from 8.04% in the period 1995–1999 to 3.06% in the period 2015-2019. As with domestic price changes, exchange rate variations show a declining trend, falling to 3.83% in the period 2015-2019 from 6.39% in the period 1995-1999. The declining trend of domestic price changes and exchange rate variations suggests improved macroeconomic stability and a decrease in ERPT level. The trend of money supply growth is similar to that of domestic price and exchange rate variations, although it had an upward trend until 2005–2009. Money supply growth decreased to 9.22% in the period 2015–2019 from 10.56% in the period 1995–1999. Economic growth generally remained relatively steady, around 4.00% during the review period. Globalisation indicators, economic globalisation, trade openness, and import penetration, generally show a rise in globalisation. However, a marked decline in the level of globalisation is observed in the 2010-2014 to 2015-2019 periods, especially for trade openness and import penetration.

Table 2.5: Descriptive Statistics

Variable	Mean	Maximum	Minimum	Std. Dev.	Observations
Whole Sample					
ΔDP_{it}	5.26	46.66	-9.40	6.66	400.00
$\Delta NEER170_{it}$	1.61	63.08	-23.74	8.17	400.00
ΔMS_{it}	11.90	55.25	-32.41	11.24	400.00
ΔGDP_{it}	4.19	28.99	-45.24	4.25	400.00
ΔOil_{t}	5.54	48.83	-55.41	24.49	400.00
EG_{it}	43.27	85.00	21.00	11.50	400.00
TOP_{it}	62.20	132.20	30.04	22.42	400.00
IMP_{it}	34.20	113.66	18.00	11.98	400.00
Fixers					
ΔDP_{it}	2.60	17.55	-9.40	3.57	250.00
$\Delta NEER170_{it}$	-1.27	6.55	-9.92	3.31	250.00
ΔMS_{it}	9.21	52.52	-32.41	11.32	250.00
ΔGDP_{it}	4.03	28.99	-45.24	4.91	250.00
EG_{it}	38.12	58.00	21.00	8.02	250.00
TOP_{it}	58.94	126.35	30.37	18.41	250.00
IMP_{it}	32.46	113.66	18.00	9.98	250.00
Floaters					
ΔDP_{it}	9.71	46.66	-1.72	8.11	150.00
$\Delta NEER170_{it}$	6.41	63.08	-23.74	11.11	150.00
ΔMS_{it}	16.39	55.25	-5.87	9.59	150.00
ΔGDP_{it}	4.46	13.14	-13.25	2.82	150.00
EG_{it}	51.85	85.00	30.00	11.32	150.00
TOP_{it}	67.62	132.20	30.04	27.06	150.00
IMP_{it}	37.11	68.62	18.78	14.30	150.00

Notes: All variables are in log-differences and multiplied by 100, except for globalisation indicators, which are in their levels. Source: Author compilations.

Table 2.6: Globalisation and macroeconomic trends - Whole Sample

Indicator	Year				
	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
ΔDP_{it}	8.04	5.28	6.01	3.92	3.06
$\Delta NEER170_{it}$	6.39	7.35	3.97	4.01	3.83
ΔMS_{it}	10.56	12.32	14.54	12.88	9.22
ΔGDP_{it}	4.34	3.86	4.28	4.34	4.13
EG_{it}	39.78	42.26	43.14	45.59	45.56
TOP_{it}	58.74	60.81	62.98	66.67	61.81
IMP_{it}	32.20	33.97	34.51	36.53	33.80

Notes: For $NEER_{it}$, the percentage changes are in absolute terms. Source: Author compilations.

The statistics for fixers and floaters are presented in Table 2.7 and Table 2.8, respectively. It is shown that inflation, as reflected by domestic price changes, is higher for floaters than for fixers, and generally, floaters have a history of higher inflation. It is also shown that the exchange rate variations are higher for floaters compared to fixers. One aspect common to both floaters and fixers regarding inflation and exchange rate variations is the downward trend over the review period. This is consistent with the trend observed in the whole sample and could suggest a decrease in the level of ERPT over time. However, as the exchange rate variability falls over time, it is possible that the ERPT has remained the same or that the actual magnitude of the exchange rate changes that affect prices has become smaller. With respect to globalisation indicators, the floaters are associated with greater globalisation levels and a higher rate of increase in globalisation compared to the fixers. As in the sample, a decline in globalisation is observed for both fixers and floaters between the periods 2010–2014 and 2015–2019.

Table 2.7: Globalisation and macroeconomic trends - Fixers

Indicator	Year				
	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
ΔDP_{it}	4.20	1.85	3.84	2.11	0.97
$\Delta NEER170_{it}$	3.83	4.21	1.39	2.58	2.24
ΔMS_{it}	5.42	7.88	12.98	12.22	7.53
ΔGDP_{it}	4.39	3.57	3.58	4.15	4.48
EG_{it}	37.72	36.84	37.18	39.68	39.16
TOP_{it}	56.03	55.94	58.87	64.81	59.07
IMP_{it}	30.81	31.59	31.71	35.42	32.75

Notes: For $NEER_{it}$, the percentage changes are in absolute terms. Source: Author compilations.

Table 2.8: Globalisation and macroeconomic trends - Floaters

Indicator	Year				
	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
ΔDP_{it}	14.44	10.99	9.63	6.94	6.55
$\Delta NEER170_{it}$	10.65	12.57	8.27	6.39	6.47
ΔMS_{it}	19.14	19.71	17.13	13.97	12.02
ΔGDP_{it}	4.25	4.36	5.46	4.67	3.56
EG_{it}	43.20	51.30	53.07	55.43	56.23
TOP_{it}	63.26	68.92	69.81	69.76	66.37
IMP_{it}	34.50	37.93	39.17	38.38	35.55

Notes: For $NEER_{it}$, the percentage changes are in absolute terms. Source: Author compilations.

2.5 Empirical estimation and results

In this section, the PSTR model, as specified in Equation 2.12, is estimated to establish whether the impact of globalisation on ERPT is non-linear. Three globalisation indicators, economic globalisation, trade openness, and import penetration, are candidate transition variables. The PSTR model estimation procedure discussed in subsection 2.3.2 is followed. The Matlab code by Colletaz and Hurlin (2006) and Fouquau et al. (2008) is used to estimate the PSTR model, and the maximum number of transition functions is set at 3 in this study, consistent with Zhang et al. (2019). As highlighted in subsubsection 2.3.2.4, the lag of the dependent variable enters the model in its second lag, whereas all other explanatory variables do so in their first lag. The transition variable enters the model in its second lag.

The estimation is first conducted for the whole sample and then extended to fixers and floaters. As a starting point for the estimation with the sample, the linearity test is conducted. The null hypothesis of the linearity test suggests that the linear panel model is appropriate, while the alternative hypothesis indicates that the PSTR model is appropriate. Linearity tests are carried out for each candidate transition variable, and the results are reported in Table 2.9. The results suggest rejecting the null hypothesis in favour of the alternative hypothesis, as the p-values are less than 0.1. This implies that the data reflect non-linearity and that the PSTR model appropriately fits the data. The established result, therefore, justifies the use of the PSTR model.

Among the transition variables, it should be noted that import penetration is associated with the greatest rejection of linearity.

Table 2.9: Linearity Tests - Whole Sample

Transition variables	Wald Tests (LM)	Fisher Tests (LM)	LR Tests (LR)
Economic Globalisation	13.752	2.239	14.016
	(0.033)	(0.039)	(0.029)
Trade Openness	11.876	1.923	12.072
	(0.065)	(0.076)	(0.060)
Import Penetration	17.094	2.809	17.504
	(0.009)	(0.011)	(0.008)

Figures in parenthesis are p-values.

The tests of no remaining non-linearity are carried out on all transition variables to avoid misspecifications and to determine the appropriate number of transition functions to be incorporated into the model. The null hypothesis posits a single transition function, whereas the alternative hypothesis asserts that there are two or more transition functions. The results of the tests for no remaining non-linearity are presented in Table 2.10, and they indicate no further non-linearity for all transition variables. These results suggest that estimating the PSTR model with a single transition function is appropriate.

Table 2.10: Tests of no remaining non-linearity - Whole Sample

Transition variables	Wald Tests (LM)	Fisher Tests (LM)	LR Tests (LR)
Economic Globalisation	4.432	0.679	4.458
	(0.618)	(0.667)	(0.615)
Trade Openness	8.273	1.280	8.367
	(0.219)	(0.266)	(0.212)
Import Penetration	9.977	1.551	10.115
	(0.126)	(0.161)	(0.120)

Figures in parenthesis are p-values.

In line with the results of the linearity tests and the tests of no remaining non-linearity, the PSTR model is estimated. The PSTR estimation output is presented in Table 2.11. The threshold or location parameters are 40.6 for economic globalisation, 80.5% for trade openness, and 36.5% for import penetration. The values below these figures reflect the lower regime, while the values above represent the higher regime. The implication is that the relationship between domestic price changes and their determinants is different when the globalisation indicators are below and above the determined thresholds. The speed of regime shifts, as indicated by the slope parameter, is 3.7 when the transition variable is economic globalisation, 504 for trade openness, and 843.2 for import penetration. This suggests that transitions between the lower and higher regimes are faster when import penetration is a threshold variable, as it is associated with a larger slope parameter than other threshold variables. The transitions are next faster when the threshold variable is trade openness and the least faster or rather slower when the transition variable is economic globalisation.

In interpreting the remaining results, it is noteworthy that the lower regime relates to coefficients in the linear part of the model, while the higher regime corresponds to the sum or weighted average of the coefficients in the linear and non-linear parts of the model. The sum of the coefficients in the linear and non-linear parts of the model occurs only when the transition function takes the value of unity. If the transition function takes a value that is greater than zero but less than unity, then a weighted average of the coefficients in the linear and non-linear parts of the model applies. However, it is difficult to know the exact value of the transition function. In line with this, the model's coefficients are interpreted on the basis of their sign, not their elasticities, as suggested by Fouquau et al. (2008).

The exchange rate, the variable of primary interest representing the ERPT, is positive and significant in the lower regime (i.e., linear part) for all models. In the higher regime (i.e., linear and non-linear parts), the exchange rate variable is positive in all models but is only significant in models where the transition variables are trade openness and import penetration. These results imply that when the level of globalisation is low, as captured by the indicator, the impact of exchange rate variations on inflation (or domestic prices) is positive. This impact increases as the level of globalisation surpasses a certain threshold. This finding suggests that globalisation induces non-linear effects in the ERPT, indicating that ERPT behaves differently at varying levels of globalisation. Furthermore, the results suggest a positive relationship between globalisation and the ERPT, with ERPT rising as the level of globalisation increases. In relation to existing literature, this finding aligns with the results of Dornbusch (1985) and Fandamu et al. (2021), supporting the notion in literature that globalisation leads to an increase in the ERPT. The results also suggest that the positive impact of oil prices on inflation increases with the level of globalisation.

Table 2.11: PSTR Estimation Output - Whole Sample

$$y_{it} = \alpha_i + \beta x_{it} + \beta^* x_{it} g(s_{it} : \gamma, c) + \epsilon_{it}$$

Transition variable	Economic Globalisation	Trade Openness	Import Penetration
Slope parameter	3.659	503.993	843.186
Threshold parameter	40.607	80.520	36.524
linear part (β)			
ΔDP_{it-2}	-0.048	0.102**	0.142***
	(0.044)	(0.050)	(0.052)
$\Delta NEER170_{it-1}$	0.160***	0.175***	0.165***
	(0.044)	(0.029)	(0.032)
ΔMS_{it-1}	0.046	0.053***	0.045**
	(0.029)	(0.018)	(0.019)
ΔGDP_{it-1}	-0.076	-0.144**	-0.112
	(0.097)	(0.065)	(0.077)
ΔOil_{t-1}	0.034***	0.025***	0.023***
	(0.008)	(0.006)	(0.006)
Δgb_{it-1}	-0.029	-0.024	-0.011
	(0.035)	(0.029)	(0.064)
non-linear part (β^*)			
ΔDP_{it-2}	0.235***	-0.018	-0.182**
	(0.067)	(0.136)	(0.083)
$\Delta NEER170_{it-1}$	0.054	0.208***	0.143***
	(0.061)	(0.070)	(0.053)
ΔMS_{it-1}	-0.010	-0.129	-0.034
	(0.041)	(0.088)	(0.059)
ΔGDP_{it-1}	-0.030	0.311***	0.109
	(0.133)	(0.113)	(0.131)
ΔOil_{t-1}	-0.014	0.042**	0.024*
	(0.011)	(0.020)	(0.012)
Δgb_{it-1}	0.086*	0.026	0.011
	(0.050)	(0.058)	(0.076)

Figures in parenthesis are standard errors, corrected for heteroskedasticity. The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

The plots of the transition function of the transition variables are depicted in Figure 2.1, Figure 2.2, and Figure 2.3. All plots exhibit non-linearity patterns as the transition functions take a lower value, approximately equal to zero, when the globalisation indicator is below the threshold level. When the globalisation level rises above the threshold, the transition function shifts and approaches the value of 1.

Figure 2.1: Transition function plot of Economic globalisation index - Whole Sample

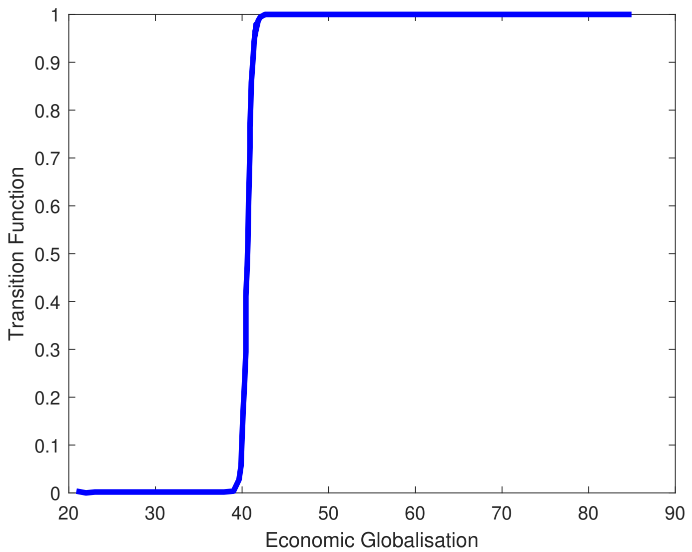


Figure 2.2: Transition function plot of trade openness - Whole Sample

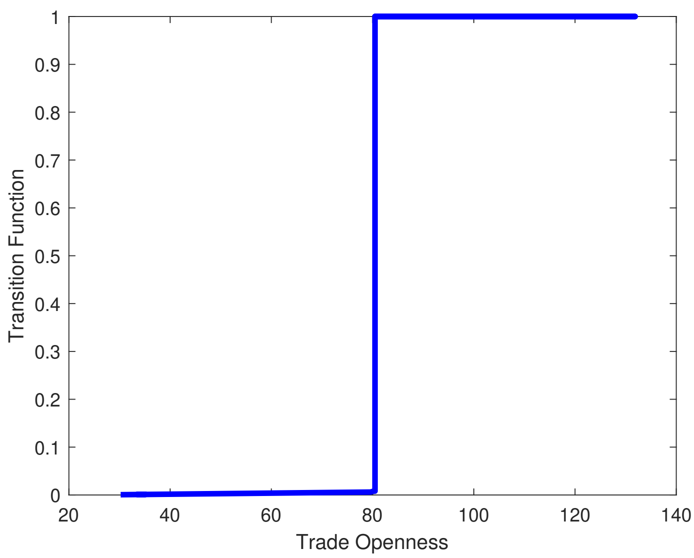
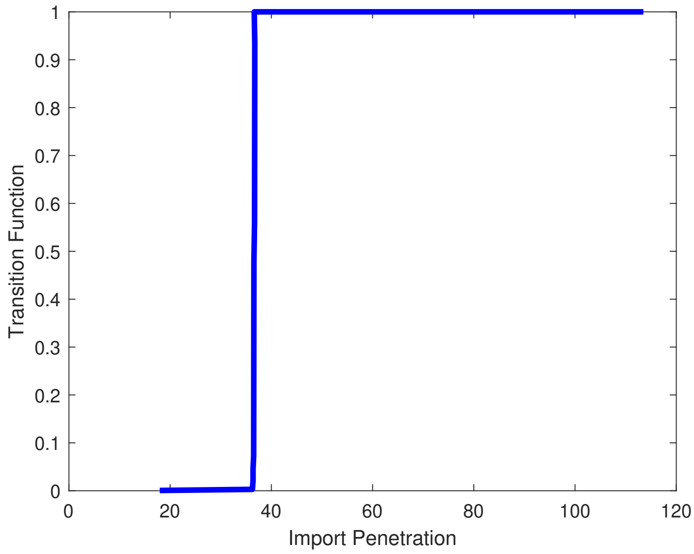


Figure 2.3: Transition function plot of import penetration - Whole Sample



The analysis is now extended to fixers and floaters to gain insights into whether the effect of globalisation on ERPT varies with the exchange rate regime based on the non-linear setting considered for the whole sample. The linearity tests are conducted for the fixers and the floaters using the same transition variables considered earlier. The results of the linearity tests are depicted in Table 2.12. The top panel shows the results for the fixers, while the bottom panel shows the results for the floaters. For fixers, the results suggest that the null hypothesis favoring a linear panel model cannot be rejected when economic globalisation is a candidate transition variable. This is because the p-values associated with the test are larger and greater than 0.1. However, when the candidate transition variables are trade openness and import penetration, the results suggest the null hypothesis should be rejected at the significance level of 5%. These results imply that the PSTR model is only appropriate when the transition variables are trade openness and import penetration. For floaters, the results show support for rejecting the null hypothesis of a linear model for all the transition variables considered at the significance level of 10%. This suggests that the PSTR model better fits the data for all three candidate transition variables. The implication of these results for both floaters and fixers is that domestic inflation or prices respond non-linearly to exchange rate variations and other exogenous variables in the model at lower and higher levels of globalisation.

Table 2.12: Linearity Tests - Fixers and Floaters

Transition variables	Wald Tests (LM)	Fisher Tests (LM)	LR Tests (LR)
		Fixers	
Economic globalisation	6.895	1.102	7.001
	(0.331)	(0.362)	(0.321)
Trade Openness	17.000	2.847	17.661
	(0.009)	(0.011)	(0.007)
Import penetration	16.889	2.827	17.541
	(0.010)	(0.011)	(0.007)
		Floaters	
Economic globalisation	11.385	1.888	11.882
	(0.077)	(0.088)	(0.065)
Trade Openness	11.132	1.843	11.607
	(0.084)	(0.096)	(0.071)
Import penetration	11.318	1.876	11.810
	(0.079)	(0.090)	(0.066)

Figures in parenthesis are p-values.

Following the results of the linearity tests above, the tests of no remaining non-linearity are conducted and the estimation output is presented in Table 2.13. The results for fixers are presented on the top panel of the table, while the results for floaters are displayed on the bottom panel. For fixers, only two transition variables—trade openness and import penetration—are considered for the tests following the outcome of the linearity tests. The results show no indication of further non-linearity with respect to trade openness as a transition variable. For import penetration, the p-values are smaller, which suggests that there could be further non-linearity. However, the model with a maximum number of regimes set at three (3) still selects a two-regime model as appropriate. Therefore, this implies that the failure to reject the null hypothesis occurs at the 1% level of significance. For floaters, the results also suggest failure to reject the null hypothesis. As with the fixers, the significance level for failure to reject the null hypothesis is low, specifically for trade openness and import penetration.

Table 2.13: Tests of no remaining non-linearity - Fixers and Floaters

Transition variables	Wald Tests (LM)	Fisher Tests (LM)	LR Tests (LR)
		Fixers	
Trade Openness	6.071	0.913	6.152
	(0.415)	(0.487)	(0.406)
Import penetration	15.459	2.426	16.003
	(0.017)	(0.028)	(0.014)
		Floaters	
Economic globalisation	6.282	0.906	6.430
	(0.392)	(0.493)	(0.377)
Trade Openness	13.053	1.985	13.713
	(0.042)	(0.073)	(0.033)
Import penetration	13.510	2.062	14.217
	(0.036)	(0.063)	(0.027)

Figures in parenthesis are p-values.

Based on the results of the linearity tests and the tests for no remaining non-linearity, the PSTR model is estimated for the fixers and floaters, and the estimation output is displayed in Table 2.14. While all three transition variables are employed in the case of floaters, only two are used for fixers, as economic globalisation is excluded due to the unfavourable results obtained from the linearity tests.

The estimation output reported in Table 2.14 shows that when economic globalisation is the transition variable (i.e., pertaining to floaters), the exchange rate variable is not statistically significant in both the lower and higher regimes. When the transition variable is trade openness, the results for fixers suggest that increases in the level of globalisation lead to a fall in the level of the ERPT. The results for floaters are not significant in both regimes. When import penetration is the transition variable, the results show that floaters experience a higher level of ERPT as globalisation increases. For fixers, the results are significant in the lower regime but insignificant in the higher regime. Due to the issue of the insignificant exchange rate variable, the results for fixers and floaters are not comparable using the same globalisation indicator. However, the results show that increases in trade openness cause a decline in the level of ERPT for fixers, while increasing levels of import penetration lead to an increase in the degree of ERPT for floaters.

Table 2.14: PSTR Estimation Output - Fixers and Floaters

$$y_{it} = \alpha_i + \beta x_{it} + \beta^* x_{it} g(s_{it} : \gamma, c) + \epsilon_{it}$$

Transition variable	Economic Globalisation	Trade Openness		Import Penetration	
	Floaters	Fixers	Floaters	Fixers	Floaters
Slope parameter	82.077	10.354	1.757	27.128	4.514
Threshold parameter	42.450	64.776	53.3593	22.374	39.028
linear part (β)					
ΔDP_{it-2}	-0.155**	-0.096*	-0.030	0.181	0.216***
	(0.066)	(0.054)	(0.073)	(0.188)	(0.076)
$\Delta NEER170_{it-1}$	0.108	0.214***	0.082	0.340*	0.144***
	(0.069)	(0.058)	(0.054)	(0.198)	(0.038)
ΔMS_{it-1}	0.276**	0.030*	0.148*	0.014	0.124**
	(0.118)	(0.018)	(0.084)	(0.033)	(0.049)
ΔGDP_{it-1}	0.537***	-0.222***	0.625***	-0.187***	0.281
	(0.080)	(0.035)	(0.112)	(0.025)	(0.181)
ΔOil_{t-1}	-0.029	0.017***	-0.010	0.004	-0.013
	(0.025)	(0.006)	(0.015)	(0.028)	(0.013)
Δgb_{it-1}	-0.248***	-0.030	-0.023	1.088***	0.075
	(0.074)	(0.022)	(0.106)	(0.239)	(0.116)
non-linear part (β^*)					
ΔDP_{it-2}	0.366***	-0.079	0.198**	-0.300	-0.088
	(0.098)	(0.147)	(0.092)	(0.193)	(0.116)
$\Delta NEER170_{it-1}$	0.111	-0.240**	0.151**	-0.216	0.243***
	(0.081)	(0.111)	(0.071)	(0.207)	(0.063)
ΔMS_{it-1}	-0.136	-0.093	-0.033	-0.003	-0.034
	(0.121)	(0.061)	(0.095)	(0.043)	(0.098)
ΔGDP_{it-1}	-0.678***	0.303***	-1.000***	0.151*	-0.297
	(0.216)	(0.076)	(0.207)	(0.072)	(0.307)
ΔOil_{t-1}	0.059**	0.021	0.049**	0.021	0.103***
	(0.027)	(0.015)	(0.023)	(0.028)	(0.030)
Δgb_{it-1}	0.274***	0.010*	0.045	-1.089***	-0.183
	(0.087)	(0.058)	(0.120)	(0.244)	(0.155)

Figures in parenthesis are standard errors, corrected for heteroskedasticity. The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

The plots of the transition function of the transition variables for fixers and floaters are presented below. As with the plots for the whole sample, the plots for fixers and floaters depict non-linear movements in the transition function of the transition variables.

Figure 2.4: Transition function plot of Economic globalisation index - Floaters

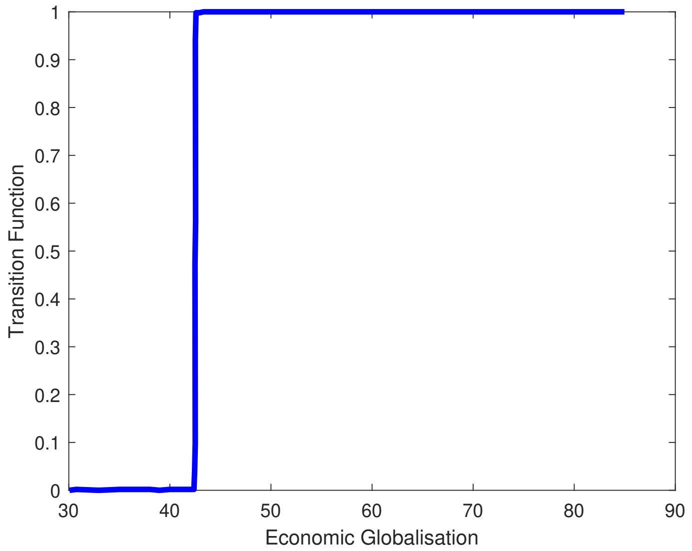


Figure 2.5: Transition function plot of trade openness - Fixers

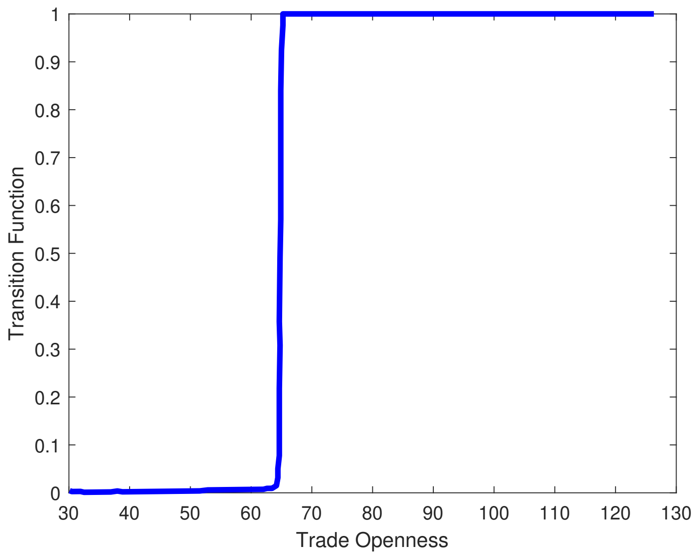


Figure 2.6: Transition function plot of trade openness - Floaters

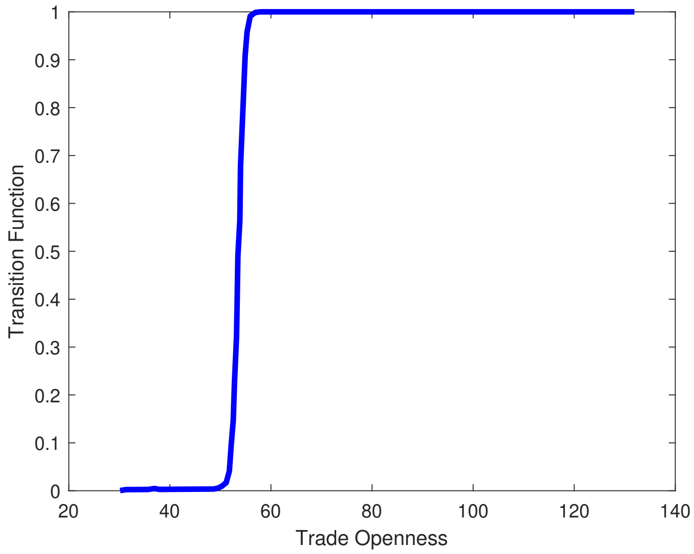


Figure 2.7: Transition function plot of import penetration - Fixers

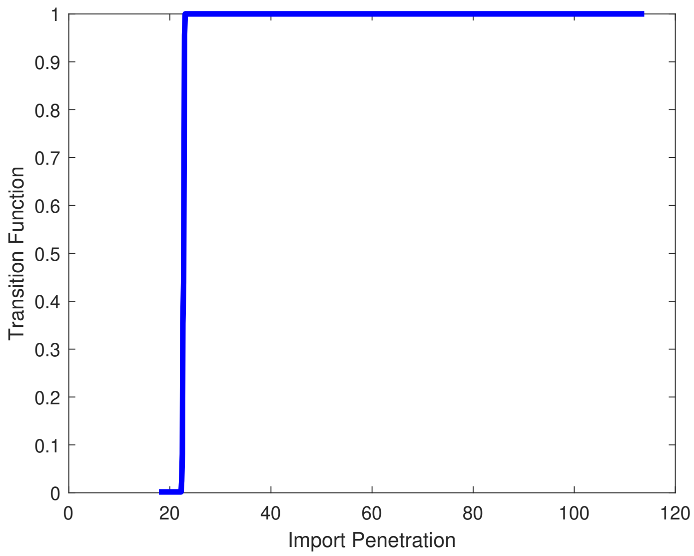
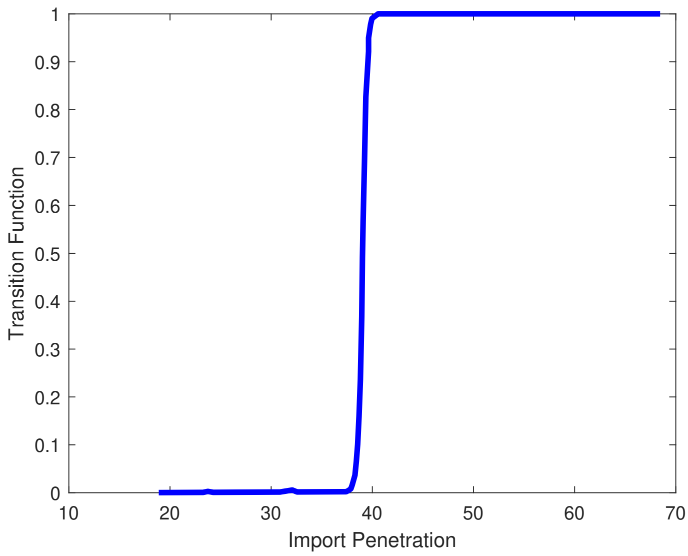


Figure 2.8: Transition function plot of import penetration - Floaters



Robustness check

As part of a check for the robustness of the results, an alternate exchange rate is used. The alternate exchange rate used is the nominal effective exchange rate index based on a basket of 65 currencies of trading partners, $NEER65_{it}$[10]. This index is narrower in scope compared to $NEER170_{it}$ used in earlier estimations. The results of the linearity tests for the entire sample are presented in Table 2.15. The findings support the rejection of the null hypothesis of a linear panel model for all candidate threshold variables, as indicated by p-values less than 0.10. Specifically, the results indicate the rejection of the null hypothesis at the level of significance of 5% for economic globalisation (as the threshold variable), 10% for trade openness, and 1% for import penetration. These results support the estimation of the PSTR model with each of the threshold variables considered.

The results of the tests of no remaining non-linearity for the whole sample are presented in Table 2.16, and indicate that the null hypothesis of a single transition regression cannot be rejected at the 5% level of significance. This result implies that there is no evidence of remaining non-linearity. Therefore, the results imply estimating the PSTR model with a single transition function.

[10]The data for $NEER65_{it}$ is obtained from the same source as $NEER170_{it}$, which is bruegel dataset (see footnote 8). The results of the unit root test for $NEER65_{it}$ are available in Appendix A in Table A.1.

It is noteworthy that the results of the linearity tests and tests of no remaining non-linearity generally align with earlier results reported in Table 2.9 and Table 2.10.

Table 2.15: Linearity Tests for the Whole Sample - alternate exchange rate

Transition variables	Wald Tests (LM)	Fisher Tests (LM)	LR Tests (LR)
Economic globalisation	13.956	2.273	14.228
	(0.030)	(0.036)	(0.027)
Trade Openness	12.248	1.985	12.457
	(0.057)	(0.067)	(0.053)
Import penetration	17.63	2.902	18.067
	(0.007)	(0.009)	(0.006)

Figures in parenthesis are p-values.

Table 2.16: Tests of no remaining non-linearity for the whole sample - alternate exchange rate

Transition variables	Wald Tests (LM)	Fisher Tests (LM)	LR Tests (LR)
Economic globalisation	5.093	0.781	5.128
	(0.532)	(0.585)	(0.527)
Trade Openness	8.447	1.308	8.545
	(0.207)	(0.253)	(0.201)
Import penetration	10.128	1.575	10.27
	(0.119)	(0.153)	(0.114)

Figures in parenthesis are p-values.

The estimation output of the PSTR model is shown in Table 2.17. The results show threshold levels of 40.6 for economic globalisation, 80.5% for trade openness, and 36.8% for import penetration. These thresholds are closely aligned with those found with the previous model estimation and reported in Table 2.11. The slope parameters are also similar except for the import penetration estimated at 257.3, less than 843.2 estimated in the previous model. The results also demonstrate significant effects of the exchange rate for all threshold variables in the linear part of the estimation output. In the non-linear part, the exchange rate is only significant for threshold variables of trade openness and import penetration. These results are similar to those obtained earlier and suggest that a rise in globalisation is associated with an increase in the level of the pass-through of the exchange rate. This suggests that the choice of the nominal effective exchange rate does not influence the results.

Table 2.17: PSTR Estimation Output for Whole Sample - alternate exchange rate

$$y_{it} = \alpha_i + \beta x_{it} + \beta^* x_{it} g(s_{it} : \gamma, c) + \epsilon_{it}$$

Transition variable	Economic Globalisation	Trade Openness	Import Penetration
Slope parameter	3.025	531.589	257.330
Threshold parameter	40.661	80.522	36.845
linear part (β)			
ΔDP_{it-2}	-0.049	0.102**	0.131**
	(0.044)	(0.050)	(0.052)
$\Delta NEER65_{it-1}$	0.161***	0.171***	0.157***
	(0.044)	(0.028)	(0.031)
ΔMS_{it-1}	0.046	0.053***	0.047**
	(0.029)	(0.018)	(0.019)
ΔGDP_{it-1}	-0.075	-0.142**	-0.119
	(0.098)	(0.065)	(0.075)
ΔOil_{t-1}	0.033***	0.024***	0.020***
	(0.008)	(0.006)	(0.006)
Δgb_{it-1}	-0.027	-0.023	0.013
	(0.035)	(0.030)	(0.064)
non-linear part (β^*)			
ΔDP_{it-2}	0.235***	-0.023	-0.142*
	(0.067)	(0.135)	(0.086)
$\Delta NEER65_{it-1}$	0.049	0.217***	0.170***
	(0.062)	(0.070)	(0.053)
ΔMS_{it-1}	-0.007	-0.129	-0.041
	(0.041)	(0.088)	(0.060)
ΔGDP_{it-1}	-0.029	0.311***	0.145
	(0.133)	(0.113)	(0.129)
ΔOil_{t-1}	-0.014	0.043**	0.033**
	(0.011)	(0.020)	(0.013)
Δgb_{it-1}	0.086*	0.024	-0.016
	(0.050)	(0.058)	(0.076)

Figures in parenthesis are standard errors, corrected for heteroskedasticity. The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

As with the whole sample, a similar analysis is conducted on sub-samples, fixers, and floaters. The results of the linearity tests and the tests of no remaining non-linearity are presented in Table 2.18 and Table 2.19, respectively. The results favour the estimation of the PSTR model and align broadly with those reported in Table 2.12 and Table 2.13.

Table 2.18: Linearity Tests for Fixers and Floaters - alternate exchange rate

Transition variables	Wald Tests (LM)	Fisher Tests (LM)	LR Tests (LR)
		Fixers	
Economic Globalisation	6.834	1.092	6.937
	(0.336)	(0.368)	(0.327)
Trade Openness	16.544	2.764	17.169
	(0.011)	(0.013)	(0.009)
Import penetration	16.611	2.776	17.241
	(0.011)	(0.013)	(0.008)
		Floaters	
Economic Globalisation	11.411	1.893	11.91
	(0.076)	(0.087)	(0.064)
Trade Openness	11.526	1.914	12.036
	(0.073)	(0.083)	(0.061)
Import penetration	11.737	1.952	12.267
	(0.068)	(0.077)	(0.056)

Figures in parenthesis are p-values.

Table 2.19: Tests of no remaining non-linearity for Fixers and Floaters - alternate exchange rate

Transition variables	Wald Tests (LM)	Fisher Tests (LM)	LR Tests (LR)
		Fixers	
Trade Openness	5.931	0.891	6.009
	(0.431)	(0.502)	(0.422)
Import penetration	15.343	2.406	15.878
	(0.018)	(0.029)	(0.014)
		Floaters	
Economic Globalisation	6.866	0.995	7.043
	(0.333)	(0.432)	(0.317)
Trade Openness	14.885	2.297	15.75
	(0.021)	(0.039)	(0.015)
Import penetration	11.172	1.674	11.65
	(0.083)	(0.134)	(0.070)

Figures in parenthesis are p-values.

Table 2.20: PSTR Estimation Output for Fixers and Floaters - alternate exchange rate

$$y_{it} = \alpha_i + \beta x_{it} + \beta^* x_{it} g(s_{it} : \gamma, c) + \epsilon_{it}$$

Transition variable	Economic Globalisation	Trade Openness		Import Penetration	
	Floaters	Fixers	Floaters	Fixers	Floaters
Slope parameter	80.014	10.587	80.499	30.907	1,941.900
Threshold parameter	42.516	64.770	67.426	22.421	36.650
linear part (β)					
ΔDP_{it-2}	-0.153**	-0.101*	0.183***	0.194	0.236***
	(0.065)	(0.055)	(0.070)	(0.183)	(0.078)
$\Delta NEER65_{it-1}$	0.108	0.215***	0.138***	0.432**	0.153***
	(0.066)	(0.063)	(0.042)	(0.218)	(0.036)
ΔMS_{it-1}	0.274**	0.030	0.103*	0.015	0.117**
	(0.117)	(0.019)	(0.057)	(0.031)	(0.055)
ΔGDP_{it-1}	0.538***	-0.220***	0.341**	-0.190***	0.355**
	(0.079)	(0.036)	(0.164)	(0.024)	(0.155)
ΔOil_{t-1}	-0.029	0.017***	-0.001	-0.007	-0.008
	(0.025)	(0.006)	(0.014)	(0.030)	(0.014)
Δgb_{it-1}	-0.242***	-0.027	-0.008	1.125***	0.037
	(0.074)	(0.022)	(0.076)	(0.225)	(0.079)
non-linear part (β^*)					
ΔDP_{it-2}	0.364***	0.071	0.130	-0.317*	-0.267**
	(0.098)	(0.147)	(0.099)	(0.188)	(0.134)
$\Delta NEER_{it-1}$	0.107	-0.240**	0.231***	-0.309	0.113**
	(0.079)	(0.114)	(0.056)	(0.228)	(0.049)
ΔMS_{it-1}	-0.133	-0.093	-0.020	-0.001	0.001
	(0.121)	(0.061)	(0.088)	(0.043)	(0.083)
ΔGDP_{it-1}	-0.678***	0.303***	-0.664**	0.155**	-0.612**
	(0.214)	(0.076)	(0.303)	(0.072)	(0.298)
ΔOil_{t-1}	0.058**	0.022	0.070***	0.031	0.067***
	(0.027)	(0.015)	(0.026)	(0.030)	(0.025)
Δgb_{it-1}	0.269***	0.095	-0.053	-1.126***	0.100*
	(0.087)	(0.058)	(0.087)	(0.229)	(0.060)

Figures in parenthesis are standard errors, corrected for heteroskedasticity. The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

The estimation output of the PSTR model is reported in Table 2.20. The results indicate that the coefficient of the exchange rate variable is positive in the lower regimes but only significant in models where the transition variables are trade openness and import penetration for both fixers and floaters. In the higher regime, the impact of the exchange rate variable turns negative and significant when the threshold variable is trade openness for fixers. With floaters, the sign of the coefficient of the exchange rate variable remains positive and significant in the higher regimes for the models with the transition variables of trade openness and import penetration. This finding suggests that an increasing level of globalisation is associated with a decline in ERPT for fixers and a rise in ERPT for floaters. This finding generally aligns with the results reported earlier in Table 2.14 and confirms the robustness of the results.

2.6 Conclusion

The chapter examines the relationship between globalisation and the ERPT, which is a subject of debate regarding the nature of the relationship. One side of the literature asserts that globalisation causes an increase in the level of ERPT, while another indicates that globalisation causes a decrease in ERPT. This lack of consensus complicates the formulation of appropriate policies. This motivates the chapter to carry out this research.

While research addresses the relationship using linear econometric models, the chapter explores it in a non-linear setting in which the level of globalisation induces regime-switching. Specifically, the chapter uses the PSTR model. The chapter asks whether the influence of globalisation on ERPT is non-linear, and if so, whether ERPT varies with the level of globalisation. This approach enables the determination of whether globalisation causes ERPT to rise or decline. Estimations are conducted on a sample of 16 African countries selected based on their consistent adherence to fixed or flexible exchange rate regimes for the entire sample period, 1994–2019. Of the 16 countries in the sample, 10 are fixers, while 6 are floaters.

Globalisation is measured by three indicators: the economic globalisation index, trade openness, and import penetration, which are also used as potential transition variables in the model. The chapter establishes evidence suggesting that globalisation influence on ERPT is non-linear. In line with this, the ERPT is established to vary with the level of globalisation. At low levels of globalisation, the ERPT is low, but increases as globalisation rises in level beyond a certain threshold. This result is established when globalisation is measured by trade openness and import penetration. It should be noted that when globalisation is measured by economic globalisation, ERPT is positive and significant at lower levels of globalisation, as is the case with other globalisation indicators. However, the effect becomes insignificant at higher levels of economic globalisation. Concerning the question of whether globalisation causes ERPT to increase or decline, these findings suggest that globalisation causes ERPT to increase. These findings support Benigno and Faia (2016) and Barhoumi (2006), who find empirical support that indicates that globalisation causes an increase in the ERPT level.

The analysis is extended to exchange rate regimes, particularly to determine whether the globalisation-ERPT relationship behaves differently in the presence of different exchange rate regimes. In view of this, the PSTR model is estimated on sub-samples of fixers and floaters. The results show that increases in trade openness lead to a decrease in the ERPT level for fixers, while increases in import penetration cause an increase in the level of ERPT for floaters. Based on these results, it is inferred that increases in the level of globalisation cause the ERPT to decline for countries with fixed exchange rate regimes and to rise for countries with flexible exchange rate regimes. The difference in results between fixers and floaters appears to be due to the fact that fixers are associated with lower levels of globalisation compared to floaters. The robustness check outcomes support these results.

Significant implications emerge from the chapter's findings, suggesting that rising levels of globalisation present an upside risk to ERPT. Therefore, formulating and implementing policies that promote macroeconomic stability could help reduce susceptibility to external shocks. Specifically, these policies can aim to maintain low and stable price levels, promote robust financial regulation and supervision, and maintain prudent fiscal management.

Chapter 3

The Exchange Rate and Trade Balance Adjustment in Zambia: A Non-linear Analysis

3.1 Introduction

The relationship between the exchange rate and the trade balance has been a subject of study and interest for many decades, dating back to the 1930s and 1940s (see Johnson, 1977). Historically, a driving factor for this sustained interest, which remains equally relevant to present-day research, has been the quest to discern the circumstances under which the exchange rate would potentially enhance the trade balance and, by extension, the balance of payments[11]. The quest to understand the relationship between the exchange rate and the trade balance became paramount, especially in the 1930s after the collapse of the gold standard system. This system provided an automatic mechanism for addressing imbalances in the balance of payments. But with its dissolution, the responsibility of rectifying these imbalances shifted to governments, turning it into a significant policy challenge (Johnson, 1972, 1977). By the mid-1940s, when the International Monetary Fund (IMF) was inaugurated, several member countries, still reeling from the economic after

[11] The Balance of Payment is a statistical record of transactions between the residents of a country and non-residents over a particular period, according to the definition provided by the IMF in the 6th edition Balance of Payments and International Investment Position Manual (BPM6) (IMF, 2009).

effects of World War II and their resulting increased import needs, were facing pronounced balance of payment deficits (De Vries, 1987). Consequently, many member countries approached the IMF for credit assistance to offset their unmanageable deficits (Polak, 1998; De Vries, 1987). In the search for solutions to this persistent problem, the exchange rate, particularly the devaluation of the currency, was recognised as a potential tool. As a result, the IMF's structural reform initiatives prominently featured currency devaluation as a tool to address balance of payments deficits (De Vries, 1987; Edwards, 1986).

The devaluation of the currency as part of the solution to the problem of balance of payments deficits was aimed at encouraging the expansion of exports and restricting the demand for imports (Musila, 2002; Yiheyis and Musila, 2018; Kwalingana et al., 2012). With currency devaluation or depreciation, imports become expensive for domestic consumers, while exports become cheaper for foreign buyers (Anju and Uma, 1999; Kaya, 2021). Currency depreciation therefore changes the relative prices of exports and imports, which consequently affect the levels of exports and imports. As a result of currency depreciation, exports gain competitiveness in international markets, as they become cheaper. This is expected to lead to greater foreign demand and an increase in the level of exports. On the other hand, the domestic demand for imports is expected to fall as imports become expensive with currency depreciation. This potentially leads to a decrease in the level of imports (Lal and Lowinger, 2002; Musila and Newark, 2003). The implication is that an increase in the level of exports and a decrease in the level of imports will improve the trade balance and, ultimately, the balance of payments.

Whether or not currency devaluation produces the expected outcomes is controversial and may also be an element that has attracted research interest. The Marshall learner condition[12] partly provides a theoretical basis through which the exchange rate improves the trade balance (see Ardalan, 2009). However, currency devaluations in some countries have not been accompanied by an improved trade balance. For example, the British government devalued its currency in 1967, but no corresponding improvement in the BOP followed (Johnson, 1972). Similarly, the United States devalued its currency in 1971 by 15%, but the existing trade balance of US$2.7 billion deficit instead of

[12]The Marshall learner condition is covered in greater detail in subsection 3.2.2.

narrowing expanded to US$6.8 billion in 1972 (Bahmani-Oskooee and Ratha, 2004). However, research has developed theoretical arguments that highlight that currency devaluation does not cause immediate improvements in trade balance. The concept of a J-curve, developed by Magee (1973), explains that the trade balance initially worsens before it starts to improve. Several studies have tested the presence of the J-curve in the relationship between the exchange rate and the trade balance. However, Bahmani-Oskooee et al. (2018) notes that the supporting evidence for the "J-Curve" is inconsistent and inconclusive.

Most recently, evidence has emerged supporting asymmetric effects in the link between the exchange rate and the trade balance. Bahmani-Oskooee and Fariditavana (2015) first established this evidence in a study involving Canada, China, the United Kingdom, and the United States that investigated the possibility of an asymmetry effect in the relationship between the real effective exchange rate and the trade balance. In a subsequent study involving bilateral trade between the United States and its six major trading partners, Bahmani-Oskooee and Fariditavana (2016) established similar evidence supporting asymmetric effects. The asymmetry finding suggests that the trade balance does not react uniformly to currency appreciation and depreciation. Thus, it reacts more to one direction of the exchange rate (i.e., appreciation or depreciation) than to the other. These studies attribute this finding to the varying responses and behaviours of exporters and importers to currency appreciation and depreciation. According to Bahmani-Oskooee and Kanitpong (2017), this finding may also be due to the asymmetric response of import prices to exchange rate variations documented by Bussière (2013).

The above-mentioned finding implies that not accounting for asymmetry effects in the relationship of the exchange rate and the trade balance can lead to incorrect policy decisions. Therefore, this raises questions about the accuracy of the findings of previous studies that used the assumption of symmetric effects in their analysis. This is more so as, according to Bahmani-Oskooee and Fariditavana (2015), the assumption of symmetric effects implied that "...if depreciation improves the trade balance, appreciation hurts it." Furthermore, the literature shows a stronger exchange rate-trade balance relationship in studies that account for asymmetrical effects, as also noted by Bahmani-Oskooee et al. (2019b). For example, Nusair (2017) finds evidence of a significant effect of the exchange rate on the trade balance only when asymmetry effects are considered. Along these lines, Bahmani-Oskooee and Saha (2017) documents more evidence of the significant effect of the exchange rate on the trade balance after the asymmetry effect is taken into account.

The growing body of literature that accounts for asymmetry effects motivates this study. This is partly because existing studies have addressed this subject with single-equation models, which ignore the interrelationship between variables. Unlike previous studies, this study proposes to employ a multiple equation model, the LVSTR model, which to the knowledge of the author has not been previously used. Furthermore, the study proposes to complement this methodology with the non-linear PARDL model.

The other motivation, as noted by Bahmani-Oskooee et al. (2019b) and Bahmani-Oskooee and Gelan (2020), is that the literature on each country is unique to its specific context, in line with the survey findings of Bahmani-Oskooee and Ratha (2004) and Bahmani-Oskooee and Hegerty (2010). This implies that the exchange rate-trade balance relationships vary between countries, and, by extension, generalising the findings from one country to another may not be beneficial. The absence of universal evidence regarding the J-curve may be due to the unique circumstances and characteristics of individual countries.

In connection with the above, this study considers Zambia due to its trade patterns that may be unique. First, Zambia's exports are dominated by minerals, which represent 70% of the export proceeds (Chipili, 2016). Second, trade is dominated by a few trading partners. The trade statistics for 2019 shows that the five largest trading partners represented 88% of total exports, while on the import side, the top five trading partners represented 63% of total imports (Bank of Zambia, 2019). The distinctive characteristics of Zambia motivate the study, especially that no previous studies have examined the relationship of exchange rate and trade balance with several trading partners using data on the bilateral trade level.

The objective of the study is to investigate the asymmetry relationship between the exchange rate and the trade balance between Zambia and its 17 trading partners. Specifically, the study seeks to establish whether currency depreciation and currency appreciation exert a similar level of impact on trade balance. In addition, the study seeks to establish whether there is evidence of the J-curve in a non-linear environment. To achieve this, the questions the study seeks to answer are the following.

1. Is there evidence of non-linearity in the trade balance relationship with the exchange rate and other determinants?;
2. What are the threshold levels at which the exchange rate induces non-linear trade balance adjustments in models with each of the trading partners?;
3. What is the speed at which switches between regimes take place in each of the models?;
4. Is the trade balance affected significantly negative in lower lags and positive in the higher lags in the higher regime of each model?;
5. Is the impact of currency depreciation on the trade balance significantly different to that of currency appreciation?;
6. Is the trade balance impacted negatively or insignificantly in the short-run and significantly positive in the long-run by either currency depreciation or appreciation?

To address the questions raised, the study, as previously highlighted, employs the LVSTR (Logistic Vector Smooth Transition Regression) model and the non-linear PARDL (Panel Autoregressive Distributed Lag) model. The LVSTR model provides a regime-switching environment in which the possibility of non-linearity between the exchange rate and the trade balance with each of Zambia's trading partners is examined. The model also enables the determination of threshold levels, endogenously, that separate the regimes. The non-linear PARDL model facilitates the analyses of asymmetry effects by permitting the splitting of the exchange rate variable into two components, depreciation and appreciation. This enables determining whether the impact of currency depreciation and appreciation on the trade balance is significantly different. In light of this, the LVSTR model addresses the first four questions, while the non-linear PARDL model provides responses to the remaining questions.

The study makes several contributions. First, the study conducts an empirical analysis based on data at the bilateral trade level for Zambia and its 17 trading partners. No previous studies have conducted such an extensive analysis, which is so important given the unique trade patterns of Zambia. Second, the study addresses the effects of asymmetry effects, which have not been addressed based on bilateral-level data involving several trading partners of Zambia. The study by Bahmani-Oskooee and Arize (2019) is the closest in that it includes Zambia in the analysis of the exchange rate and trade balance that involve the United States and its 20 African trading partners. Third, the analysis in this study covers the period when the exchange rate management system supports a floating exchange rate. Previous studies such as Bahmani-Oskooee and Arize (2020) and Bahmani-Oskooee and Arize (2019), use sample periods involving multiple exchange rate regimes[13]. The selected sample period ensures that the results are relevant to the current economic setting. Fourth, the study employs two different non-linear methodologies: the LVSTR model and the non-linear PARDL model. The use of the two models ensures that the analysis is comprehensive. Additionally, previous research has mostly employed single equation models to account for non-linear effects. The LVSTR model, a multi-equation model, proposed for use in this study has not previously been employed, and therefore its use serves as novel contribution.

The study's empirical findings indicate the presence of non-linearity and asymmetry effects in the relationship between the exchange rate and the trade balance. These results are in line with recent evidence of asymmetry effects in the literature. Evidence of the J-curve is found to be limited with respect to individual trading partners. However, there is support for the presence of a J-curve when the analysis involves all trading partners as a group, but based on currency appreciation and not depreciation. The findings suggest that, while the relationship between the exchange rate and the trade balance is believed to have improved with the support of asymmetry effects, currency depreciation on its own may not be adequate to improve the trade balance.

The remainder of the chapter is organised as follows: Section 3.2 addresses the

[13]Bahmani-Oskooee and Arize (2020) uses data for the period 1988Q2-2015Q3 while Bahmani-Oskooee and Arize (2019) uses data for the period 1987Q4-2015Q4. The exchange rate regime has been floating since 1992, whereas before it tended to be fixed (see subsection 3.4.1 for details).

theoretical and empirical literature on the relationship between the exchange rate and the trade balance. Section 3.3 describes the methodology and data. The empirical results are presented in Section 3.5, and the conclusion is drawn in Section 3.6.

3.2 Literature Review

3.2.1 Approaches to the Balance of Payment

Before the 1930s, there were no theories about the Balance of Payments (BOP), including those related to devaluations and balance of payment policy. The gold system that provided automatic adjustments for imbalances existed at the time (Johnson, 1977). However, one of the problems associated with the gold system was that maintaining the stability of currency took precedence over addressing unemployment issues, and in the 1930s, a period of the Great Depression, the gold system collapsed. With its collapse, countries adopted independent measures that led to instability in exchange rates, competitive depreciations in currency values, stringent controls on currency exchange, and restrictions on cross-border capital movement and imports. These measures did not solve the problem of balance of payments deficits. This development, coupled with the problems associated with the gold system, led to the establishment of the International Monetary Fund, which reflected the introduction of an entirely novel system to handle adjustments of balance of payments[14] (see De Vries, 1987). According to Johnson (1972), the collapse of the gold system in the 1930s and the rise of widespread unemployment partly led to the establishment of theories of balance of payments.

There are three main approaches to the balance of payments and these include the elasticity, absorption, and monetary approaches (Ardalan, 2009; Mushendami et al., 2017; Johnson, 1977). The trade balance, which is the specific focus of this study, is a component of the current account of the balance of payments. The trade balance reflects the net value of a country's international trade activities. The connection between the trade balance and the balance of payments is that developments in the trade balance impact the

[14]One of the motives was to have a system that would not constrain the implementation of domestic policies to achieve full employment and economic advancement (De Vries, 1987).

current account and ultimately the balance of payments position. In addition to the current account, the balance of payments is composed of other accounts that include capital and financial accounts. Elasticity and absorption approaches focus primarily on the current account, while the monetary approach considers the current and capital accounts of the balance of payments (Mushendami et al., 2017).

The elasticity approach is the oldest of the three approaches, with its initial work dating back to the 1930s (Johnson, 1977). This approach views the trade balance as the difference between a country's exports and imports. According to this approach, the adjustment of the trade balance depends on the relative prices of exports and imports, which are influenced by the real exchange rate. This assumption is crucial for the analysis of the approach (Ardalan, 2009). Mathematically, the trade balance is defined as follows:

$$TB_t = X_t - M_t \tag{3.1}$$

Where TB_t denotes the trade balance, X_t represents exports, and M_t represents imports. A change in the real exchange rate affects the relative prices of exports and imports, thus impacting price competitiveness and, ultimately, the trade balance. More directly, a country's currency depreciation decreases the price of exports in foreign currency terms, making them more affordable to foreign buyers, thereby increasing foreign demand and, in turn, the level of exports. In contrast, currency depreciation increases import prices in domestic currency terms, making them more expensive and reducing their demand. Consequently, the outcome of currency depreciation is a rise in exports and a decline in imports, leading to a favourable adjustment in the trade balance. Therefore, according to the elasticity approach, currency depreciation is associated with an improved trade balance. However, the exchange rate–trade balance relationship is examined in terms of elasticities to determine the extent of the impact (for more details, see subsection 3.2.2). One of the limitations of the elasticity approach is that it assumes that there is idle capacity (Ardalan, 2009; Johnson, 1977). The implication is that, in the absence of unused capacity, currency depreciation might not lead to expanded export production and, ultimately, to the improvement in the trade balance.

The absorption approach, introduced by Alexander (1952), addresses the trade balance using an identity based on national income accounting. The trade balance under this approach is defined as the difference between national income, representing goods and services produced, and absorption, representing goods and services consumed. Mathematically, the definition of the trade balance is specified in the following manner:

$$TB_t = Y_t - A_t \tag{3.2}$$

Where TB_t reflects the trade balance, Y_t represents national income, and A_t represents absorption (that is, expenditure on goods and services consumed). The relationship is derived from the equation for national income Y_t specified as follows:

$$Y_t = C_t + I_t + G_t + (X_t - M_t) \tag{3.3}$$

Where C_t represents consumption, I_t reflects investment, and G_t represents government expenditure. $(X_t - M_t)$ is the trade balance, as in Equation 3.1. In Equation 3.3, absorption, A_t, is equal to $C_t + I_t + G_t$. Rewriting the equation yields Equation 3.4 below, which is equivalent to Equation 3.2.

$$Y_t = A_t + (X_t - M_t) \tag{3.4}$$

According to Equation 3.2, the depreciation of a country's currency causes the trade balance to improve if it leads to a greater increase in Y_t relative to A_t. The increase in Y_t follows an expansion in export production due to the price competitiveness resulting from the depreciation of the currency. A slower growth in Y_t relative to A_t implies a deterioration in the trade balance. As with the elasticity approach, the absorption approach assumes the existence of idle resources, which is important in supporting the expansion of production. This means that Y_t cannot be increased in the absence of idle capacity, and the only way that currency devaluation can cause an improvement in the trade balance is by reducing A_t. However, unlike the elasticity approach, this approach notes this limitation and addresses it by recommending the implementation of expenditure-switching and expenditure-reduction policies to reduce A_t (Johnson, 1977).

The monetary approach, developed based on the work of Johnson (1972) and others, views the BOP as a monetary phenomenon. Broadly, the BOP is defined as follows:

$$BOP_t = \Delta H_t - \Delta D_t \tag{3.5}$$

Where BOP_t represents the balance of payment, H_t is the amount of money demanded and D_t is the creation of credit. As reflected in Equation 3.5, an increase in the demand for money, H_t, relative to the domestic money supply, leads to a BOP surplus. An increase in the demand for money implies that residents opt to retain their money within the domestic economy instead of spending it on imports or foreign investments. The implication is that more funds may flow into the country from foreign sources than flow out, thus leading to a BOP surplus. On the other hand, an expansion in the money supply implies increased domestic spending, which can result in higher imports or capital outflows, leading to more funds flowing out of the country than flowing in, thus supporting a BOP deficit (Ardalan, 2009; Duasa, 2007). Currency devaluation in this approach is viewed as equivalent to a reduction in the supply of real money (Chen, 1975).

With respect to the approaches presented above, empirical literature does not present unanimous agreement on which approach best explains the BOP adjustments. As a result, the empirical issue is determining the approach that is appropriate for a particular country or region (Bošnjak et al., 2018). However, the elasticity approach is commonly used, as noted by Boyd et al. (2001) and Rose (1991), in the analysis of the nexus of the exchange rate and the trade balance. This approach does not have any exceptional features that make it preferable over other approaches. However, it is still used because of its extensive use in the literature, which has become standard. Therefore, the use of this approach enables the comparability of the results with those of existing studies (Rose, 1990). In line with this, the study uses the elasticity approach in its analysis.

3.2.2 Theoretical framework

The elasticity approach in analysing the trade balance considers the impact of exchange rate movements using various elasticities. There are four elasticities; two are related to exports, and the other two are related to imports. The elasticity of demand for exports and the elasticity of supply of exports are considered for exports, while the elasticity of demand for imports and the elasticity of supply of imports are considered for imports. This approach makes two key assumptions. The first is that the supply elasticities of exports and imports are infinite, meaning that price changes have an immediate and proportional effect on the quantity supplied, and the second is that the trade balance is equal to zero, implying that exports equal imports. These assumptions give rise to a special case known as the Marshall Lerner condition (MLC). According to this condition, currency depreciation improves the trade balance when the absolute sum of the demand elasticities of exports and imports exceeds unity (greater than one). In other words, when the demand for exports and imports is relatively elastic, currency depreciation can positively impact the trade balance (Ardalan, 2009).

The theoretical relationship between the exchange rate and trade balance based on the elasticity approach is presented in this section. Following Boyd et al. (2001), the trade balance can be defined as a ratio of nominal exports (X_t) to nominal imports (M_t) and can be represented as follows:

$$X_t/M_t = (P_t Qx_t)/(P_t^* E_t Qm_t) \tag{3.6}$$

Where $X_t = (P_t Qx_t)$ and $M_t = (P_t^* E_t Qm_t)$. P_t and P_t^* represent domestic and foreign prices, respectively. Qx_t reflects export volumes, while Qm_t represents import volumes. E_t is the nominal exchange rate and reflects the value of the domestic currency per unit of a foreign currency. An increase in E_t represents a depreciation of the domestic currency against the foreign currency.

Applying logs to Equation 3.6 leads to the following representation.

$$\begin{aligned} ln(X_t/M_t) &= lnP_t + lnQx_t - lnP_t^* - lnE_t - lnQm_t \\ &= lnQx_t - lnQm_t - lnE_t + lnP_t - lnP_t^* \\ &= lnQx_t - lnQm_t - lnRER_t \end{aligned} \tag{3.7}$$

where $RER_t = [lnE_t - lnP_t + lnP_t^*]$ and represents the real exchange rate. Following Matesanz and Fugarolas (2009) and Kaya (2021), the export and import demand functions can be written as follows:

$$Qx_t = (P/(P^* E))_t^n (Y_t^f)^\theta \tag{3.8}$$

$$Qm_t = ((P^* E)/P)_t^\lambda (Y_t^d)^\delta \tag{3.9}$$

Where Qx_t stands for the export volumes and Qm_t represents the import volumes, as already defined. $(P/(P^* E))$ and $((P^* E)/P)$ reflect the real exchange rate, E is the nominal exchange rate, P is the domestic price level, and P^* is the foreign price level. Y_t^d and Y_t^f reflect real domestic income and real foreign income, respectively. The elasticities of exports and imports to the real exchange rate are captured by n and λ, respectively. θ and δ are the elasticities of exports and imports to real foreign income and real domestic income, respectively.

Applying logs to Equation 3.8 and Equation 3.9 yields:

$$\begin{aligned} lnQx_t &= n[lnP_t - lnP_t^* - lnE_t] + \theta lnY_t^f \\ &= nlnRER_t + \theta lnY_t^f \end{aligned} \tag{3.10}$$

$$\begin{aligned} lnQm_t &= \lambda[lnP_t^* + lnE_t - lnP_t] + \delta lnY_t^d \\ &= -\lambda lnRER_t + \delta lnY_t^d \end{aligned} \tag{3.11}$$

Incorporating Equation 3.10 and Equation 3.11 into Equation 3.7 yields the following:

$$\begin{aligned} ln(X_t/M_t) &= nlnRER_t + \theta lnY_t^f - (-\lambda lnRER_t + \delta lnY_t^d) - lnRER_t \\ &= (n + \lambda - 1)lnRER_t - \delta lnY_t^d + \theta lnY_t^f \\ &= \kappa lnRER_t - \delta lnY_t^d + \theta lnY_t^f \end{aligned} \tag{3.12}$$

Where $k = (n + \lambda - 1)$ and represents the real exchange rate elasticity for the trade balance. As already highlighted, $ln(X_t/M_t)$ represents the trade balance, expressed as the ratio of nominal exports to nominal imports. Using a ratio to measure trade balance is considered a reliable and consistent approach, as the ratio avoids problems associated with units of measurement[15] (Bahmani-Oskooee, 1991). Having presented the derivation of the trade balance equation, it is now opportune to indicate each variable's expected effect. Real domestic income (lnY_t^d) positively affects imports, as shown in Equation 3.11 and is therefore expected to negatively affect the trade balance. With real foreign income (lnY_t^f), it positively impacts exports, as shown in Equation 3.10 and, as a result, is expected to positively affect the trade balance. In this sense, the expected signs of δ and θ are negative and positive, respectively. The real exchange rate ($lnRER_t$) is defined as the amount of

[15] The implication is that trade balance as a ratio can be expressed in either real terms or nominal terms. This is because, as a ratio, it is unit-free (Bahmani-Oskooee and Halicioglu, 2017).

the domestic currency per unit of a foreign currency such that a rise denotes a depreciation of the domestic currency. A positive κ, which implies $n + \lambda > 1$, indicates that a currency depreciation should improve the trade balance.

As highlighted previously, MLC (Marshall Leaner Condition) sets the circumstance in which currency depreciation leads to an improvement in the trade balance, that is, when the absolute sum of n and λ is greater than unity (that is, $n+\lambda > 1$). When the sum of the elasticities is below unity, the depreciation of the currency does not improve the trade balance. The validity of MLC has been controversial in the empirical literature. Even in the presence of ample evidence that the MLC conditions are satisfied, there have been situations in which currency devaluations have not produced expected results (Bahmani-Oskooee, 1985). However, estimates of n and λ have generally been found to be low, suggesting that the MLC does not hold. Historically, this situation led to a shift to the absorption approach. Despite this, it is generally believed that the depreciation of the real exchange rate leads to an improvement in the trade balance, although not immediately (see Boyd et al., 2001). This is because the MLC is believed to hold in the long-run, as that is when the elasticities rise in level.

Despite the indication above that the MLC holds in the long-run, concerns about low elasticities persist. Ndlela and Ndlela (2002) notes that the elasticities are low in the primary commodities that make up a greater part of the exports of developing countries, such as those of the SADC region. Low elasticities also prevail on the import side in products with few substitutes, such as petroleum and intermediate inputs. Similarly, Oladipupo (2011) notes in the case of Nigeria that low elasticities prevail as prices for crude oil and agricultural products are predetermined on the world markets. It should be noted that these concerns apply to Zambia, as minerals make up a larger share of exports and their prices are predetermined on international markets.

With respect to empirical studies, some studies find evidence of MLC, while others do not. For example, Rose (1991) in a study involving five member countries of the Organization for Economic Cooperation and Development (OECD), found no evidence of MLC. A similar result was obtained by Dongfack and Ouyang (2019) in a study covering Cameroon. Similarly, Yol and Baharumshah (2007) found no evidence in a study involving the US and 10 African trading partners. However, evidence of MLC is reported in the studies by Noland (1989) for Japan, Eita (2013) for Namibia, and Caporale et al. (2015) for Kenya.

3.2.3 Asymmetry effects

Recently, there has been a move in the literature to account for asymmetric effects in the analysis of the relationship between the exchange rate and the trade balance. This development follows the work of Bahmani-Oskooee and Fariditavana (2015, 2016), in which evidence of asymmetry effects was uncovered. The first study considered a sample of four countries: Canada, China, Japan and the USA, and used aggregate level data along with the NARDL model for estimation. The second study used the same estimation methodology, but now differently considered bilateral trade data between the United States of America (USA) and each of its six trading partners to investigate the possibility of effects of asymmetry in the relationship between the exchange rate and the trade balance. Evidence of the effects of asymmetry found in these studies implies that the effect of the exchange rate on the trade balance varies depending on whether the exchange rate is appreciating or depreciating. This further implies that currency appreciation and depreciation of the same size do not affect the trade balance by the same magnitude. The trade balance thus reacts differently to currency depreciation and appreciation; it reacts stronger in one direction of the exchange rate and less in the other direction. This new body of literature suggests that the accuracy of the findings of previous research using the symmetry assumption may be questionable.

The relationship between the exchange rate and the trade balance is closely related to the relationship between the exchange rate and the trade prices (i.e., the exchange rate pass-through). According to Magee (1973), the pass-through of the exchange rate to import prices is part of the adjustment process of the trade balance following a currency devaluation. Along the same lines, Bussière (2007) points out that the pass-through of the exchange rate to the trade prices influences the way the trade quantities respond to the exchange rate. This implies that the reaction of the trade balance to currency depreciation and appreciation depends on the pass-through of the exchange rate. Similarly Cheikh and Louhichi (2016) and Goldberg and Tille (2006) argue that a greater pass-through of the exchange rate to import prices is required for adjustments in the trade balance to take place through expenditure-switching effects. The implication of this is that there is a link between the exchange rate pass-through and the trade balance that becomes stronger when the level of the exchange rate pass-through is higher.

The literature on exchange rate pass-through has long uncovered evidence of asymmetry effects, implying that import prices responses to currency appreciation and depreciation are disproportionate. Given that the exchange rate pass-through influences the relationship between the exchange rate and the trade balance, the factors underlying asymmetry effects in the exchange rate pass-through may also be relevant to the relationship between the exchange rate and the trade balance. Factors that underlie the effects of asymmetry in the pass-through of the exchange rate to import prices include pricing-to-market, downward price rigidity, and market binding constraints (Cheikh, 2012a; Pollard and Coughlin, 2004; Bussière, 2007; El bejaoui, 2013; Karoro et al., 2009; Yanamandra, 2015). One characterisation of these factors is that they involve exporting firms adjusting their prices in response to exchange rate movements. This departs from the standard theoretical model on the relationship between the exchange rate and the trade balance. According to Yol and Baharumshah (2007) and Leonard and Stockman (2002), the standard theoretical model does not assume the presence of pricing-to-market. It is assumed that domestic and foreign prices do not change in response to changes in exchange rates. Consistent with this, the change in relative prices of exports and imports is influenced only by changes in the nominal exchange rate (Yol and Baharumshah, 2007). This could explain why earlier research may not have accounted for asymmetry effects in the relationship between the exchange rate and the trade balance.

The reason for the presence of asymmetry effects in the relationship between the exchange rate and the trade balance as given by Bahmani-Oskooee and Fariditavana (2015) is that exporters and importers exhibit behaviours and reactions to currency depreciation that differ from those to currency appreciation. This reason is related to the factors that account for asymmetry effects in the exchange rate pass-through. These factors are discussed in detail below in terms of how they can potentially influence the effects of asymmetry on the exchange rate and the trade balance relationship.

Pricing to market, a concept introduced by Krugman (1986), may explain the effects of asymmetry in the relationship between the exchange rate and the trade balance, as also noted by Arize et al. (2017). Pricing to market reflects a strategy employed by exporting firms with the objective of maintaining market share in international markets. On the basis of this strategy, exporting firms strive to keep their prices in international markets stable by ensuring that they are not adversely affected by exchange rate movements. It follows that, in line with this strategy, exporting firms adjust their prices in response to exchange rate changes. When the currency of the exporting firm appreciates, the implication is that the price of the goods in foreign currency terms becomes expensive and, as such, loses competitiveness in international markets. In response to this currency movement, exporting firms reduce the mark-up on their goods to absorb part of the appreciation and keep the prices facing foreign buyers relatively unchanged. The limitation to this practise is that exporting firms can only absorb the appreciation to the extent that the mark-up can accommodate it. If the appreciation is greater than the mark-up, exporting firms may not be able to fully absorb the appreciation, as doing so may imply making losses (Arize et al., 2017).

For the scenario where the currency of the exporting firms depreciates, it should be noted that the objective of maintaining market share in international markets is not adversely affected for these firms. This is because depreciation leads to a gain in price competitiveness as exported goods become cheaper in foreign currency terms. In view of this, exporting firms do not need to alter the prices of their goods. The possible implication of the use of the pricing-to-market strategy by exporting firms is that the response of export sales to currency depreciation and appreciation is different. The increase in export sales after currency depreciation is likely more significant than the decrease due to appreciation. Applying this idea on the import side, it is likely that the fall in imports following a domestic currency depreciation may be less than the increase in imports due to currency appreciation. The general result of these events is that the trade balance response to currency depreciation and appreciation may be asymmetric.

The downward price rigidity is another factor that can account for the effects of asymmetry. This factor is related to the fact that the increase in price occurs more quickly than a decrease based on the work of Peltzman (2000), as noted by Arize et al. (2017). This is reflected in the pricing behaviour of exporting firms in response to exchange rate movements. When the currency of the importing country appreciates (i.e., implying depreciation of the exporter's currency), the exporter responds to this movement in the exchange rate by increasing the price of their goods to keep them unchanged in foreign currency terms. However, when the importing country's currency depreciates, the exporting firms do not adjust the price downward and instead leave it unchanged, thereby leading to price increases in foreign currency terms. The possible implication of this is that currency appreciation in the importing country may induce negligible demand for imports, and as such the import level remains largely unchanged. However, with currency depreciation, the price of imports increases, and the effect may be a reduction in the level of imports. Overall, this kind of pricing behaviour by exporting firms can lead to the trade balance responding differently to currency depreciation and appreciation.

The other factor that could underlie the effects of asymmetry is the market-binding or trade constraints. These constraints, which can be in the form of a quota, capacity, or limit, are faced by exporting firms and restrict the quantities of goods that can be exported to a foreign market. The effects of asymmetry are reflected in the manner in which exporting firms respond to movements in the exchange rate. When the currency of the importing country is depreciating (i.e., appreciation of the exporter's currency), the exporting firm does not alter the price of the goods exported. However, when the currency of the importing country appreciates, the exporting firms respond by raising the price. This is due to the increase in demand from the importing country that cannot be met due to constraints (Pollard and Coughlin, 2004). Currency appreciation is generally associated with an increase in imports. However, in the context of this factor, currency appreciation in the importing country cannot lead to an increase in the level of imports beyond the limit faced by exporting firms, and as such the potential for an increase in imports is limited. Therefore, this situation can cause currency depreciation and appreciation to exhibit different effects on the trade balance.

The factors reviewed above relate to the effects of asymmetry, specifically on how currency appreciation and depreciation can lead to unequal effects on the trade balance. The overall effect on the relationship between the exchange rate and the trade balance is largely dependent on how pronounced these factors are and how they interact with each other at an industry, bilateral, and aggregate level of trade.

Empirically, several studies have investigated the potential for asymmetric effects in the exchange rate-trade balance relationship since its discovery in the literature. Some studies that find evidence of asymmetry effects include: Bahmani-Oskooee et al. (2018) on China's bilateral trade with 21 trading partners; Bahmani-Oskooee and Halicioglu (2017) on bilateral trade between Turkey and its 11 trading partners; Bahmani-Oskooee and Kanitpong (2017) on 7 Asian countries; Bahmani-Oskooee et al. (2019b) on Bangladesh's bilateral trade with 11 trading partners; and Nusair (2017) on 16 European countries. Other studies include Parray et al. (2023) for the BRICS[16] countries; Shuaibu and Isah (2020) on five African countries; Nathaniel (2020) on Nigeria; Kwame Akosah and Omane-Adjepong (2017) and Iyke and Ho (2017) on Ghana. One characteristic of these studies is that they all employ the NARDL model to account for asymmetry. It appears that the choice to use the same econometric modelling approach in multiple studies is due to the distinct characteristics of the literature in each country (see Bahmani-Oskooee et al., 2019b; Bahmani-Oskooee and Gelan, 2020).

Studies using panel modelling techniques have also explored the possibility of asymmetric effects. Some of these studies include Yaya (2022) on seven countries in the WAEMU region, Khatoon et al. (2021) on bilateral trade between Bangladesh and 25 trading partners; and Mwito et al. (2021) on bilateral trade between Kenya and 30 trading partners. Relatedly, the study by Ben Doudou et al. (2020) establishes evidence of the threshold effects on bilateral trade between Tunisia and its 25 trading partners using panel estimation techniques and a time series framework.

3.2.4 J-curve effect

The J-curve effect illustrates the reaction of the trade balance to a depreciating currency. Put differently, it reflects the path of adjustments in the trade balance that takes place in response to a currency depreciation. Magee

[16]BRICS refers to the countries, Brazil, Russia, India, China and South Africa.

(1973) explains the J-curve or trade balance adjustments in three different periods, currency-contract, pass-through, and quantity-adjustment period. In the currency-contract period, which takes place in a very short time frame immediately after currency devaluation, the export and import contracts reflect the prices and quantities set prior to the devaluation of the currency. These prices and quantities remain the same. However, the trade balance deteriorates if the export contracts are in domestic currency and the import contracts are in foreign currency. In the pass-through period, import prices increase in the domestic market but fall in the export destination markets, and this is reflected in new contracts. The export and import quantities remain the same, and this is due to the fact that exporting firms may not be able to immediately adjust their production while importers need time to switch between goods and modify their order patterns. With respect to the quantity adjustment period, export and import quantities respond to the change in relative prices. Consequently, export quantities increase while import quantities fall, leading to an improvement in the trade balance.

The delayed improvement of the trade balance in response to currency devaluation is explained in terms of five adjustment lags by Junz and Rhomberg (1973). Recognition lag is the first, and it reflects the time it takes for buyers and sellers to learn about a change in relative prices. The second is the decision lag, which relates to the time it takes to initiate new orders and establish business relationships. Delivery lag, as the third, refers to the time it takes for an order to be fulfilled after a price change. Replacement lag is the fourth, and it accounts for the time it takes to replace worn-out stock or antiquated machinery. The fifth and final adjustment lag is the production lag, which reflects the time taken by producers to decide whether or not the new competitive environment warrants switching markets or expanding supply capacity.

An alternative explanation of the J-curve involves partitioning the effects of currency depreciation into two components: the price effect and the volume effect. In the context of the trade balance adjustment periods outlined by Magee (1973), the price and volume effects are equivalent to pass-through and quantity adjustment periods, respectively. In line with this, the price effect reflects shifts in the relative prices of exports and imports, while the volume effect signifies adjustments in the quantities of imports and exports.

Immediately after currency depreciation, the price effect outweighs the volume effect. This is due to the change in the relative prices of exports and imports, while the quantities of both imports and exports remain constant. Similar to the case of the pass-through period discussed above, export prices decrease while import prices increase, leading to a deterioration in the trade balance. When the export and import quantities adjust, the volume effect dominates. The degree of this adjustment in quantities, however, depends largely on the elasticities of the demand for exports and imports (Anju and Uma, 1999; Yol and Baharumshah, 2007). An improvement in the trade balance occurs when the elasticities are significant, specifically as outlined by the MLC, when the sum of the elasticities for exports and imports surpass unity.

There are multiple ways in which the J-curve is identified or defined on the basis of the estimation output of the econometric models. Bahmani-Oskooee et al. (2016) outlines the three definitions in the literature, and some or all are briefly discussed by Bahmani-Oskooee and Fariditavana (2015, 2016), Bahmani-Oskooee and Halicioglu (2017), Bahmani-Oskooee and Arize (2019) and Bahmani-Oskooee and Karamelikli (2021). The diversity in definitions arises from the evolution of econometric models, with more advanced models emerging over time. The first definition of the J-curve, the traditional definition, was introduced by Bahmani-Oskooee (1985). It is based on a model in which the variables are expressed in their first difference, reflecting a short-term relationship between the exchange rate and the trade balance. Recall that the J-curve initially depicts a deterioration and, subsequently, an improvement in the trade balance. In line with this, the exchange rate variable in the model is expected to carry a significant and negative sign in the lower or shorter lags, followed by a significant and positive sign in the higher or longer lags.

The second definition of the J-curve is based on the work of Rose and Yellen (1989) and identifies the J-curve from the short-run and long-run estimates of a model. Here, the exchange rate variable is expected to carry a significant and negative sign in the short-run part of the model and a significant and positive sign in the long-run. The short-run estimate can also be insignificant. This definition was established following the development of the cointegration and error correction model by Engle and Granger (1987) (Bahmani-Oskooee and Arize, 2019). It is noteworthy that the two definitions mentioned above do not consider asymmetry effects, as these effects were not recognised then. With the discovery of asymmetry effects, there is a third definition of the J-curve, given by Bahmani-Oskooee and Fariditavana (2015, 2016). As this definition considers asymmetry effects, the exchange rate variable is split into two variables, one representing currency depreciation and the other appreciation, which enter into the model. In the short-run, the coefficient of either currency depreciation or appreciation is expected to carry a significantly negative or insignificant sign. In the long-run, a significant and positive sign is expected from currency depreciation or appreciation (Bahmani-Oskooee and Karamelikli, 2021; Bahmani-Oskooee and Halicioglu, 2017).

The search for J-curve evidence has been one of the areas of interest in the literature. Studies prior to the 1990s showed little or no success in finding evidence for the J-curve. Furthermore, the studies at the time used aggregate trade data that reflect trade between one country and all countries (referred to as the rest of the world). By extension, the exchange rate-trade balance relationship was examined between one country and all countries. This meant that the exchange rate used in Equation 3.12 is the real effective exchange rate, reflecting the exchange rate between one country and the rest of the world. Similarly, it meant that the real foreign income used in the equation needed to be representative of the real income for the rest of the world. Therefore, the implication of using aggregate trade data was that the variables of the real effective exchange rate and the real foreign income had to be constructed. Rose and Yellen (1989) suggested the use of disaggregated data on the grounds that aggregate trade data may be subject to aggregation bias and could be the reason for the limited evidence of the J-curve. The aggregation bias arises because the real effective exchange rate, which is a weighted average, evens out fluctuations in exchange rates between one country and each of its trading partners. This implies that if a currency strengthens against the currency of one trading partner and simultaneously weakens against the currency of another trading partner, the real effective exchange rate will smooth out this divergence, causing it to have no influence on the trade balance (Rose and Yellen, 1989; Bahmani-Oskooee and Brooks, 1999). Moreover, the trade balance could show an improvement with one trading partner while simultaneously worsening with another, and this contrast may not be reflected in the overall trade balance. Furthermore, currency depreciation can lead to an improvement in trade balance with one partner and a deterioration with another, but these effects could counterbalance each other when considered in an aggregate trade level analysis (Halicioglu, 2008). With respect to the variable of real income for the rest of the world, a limitation arises due to its ad hoc construction, which can potentially lead to misleading results. These drawbacks can be mitigated by using disaggregated data (Rose and Yellen, 1989; Bahmani-Oskooee and Brooks, 1999). Following this, there has been an upsurge in research using data at the bilateral trade level and also more finely disaggregated data at the sectoral or industry trade level. This provides the basis for why this study considers bilateral trade-level data.

A review of empirical studies employing aggregate trade-level data reveals that some studies fail to establish evidence in support of the J-curve, while others do. Examples of studies that do not find evidence of the J-curve include Rose and Yellen (1989); Moffett (1989); Halicioglu (2007); Singh (2004); Bahmani-Oskooee and Gelan (2012); Kwalingana et al. (2012) and Ziramba and Chifamba (2014). The studies by Rose and Yellen (1989) and Moffett (1989) focused on the United States, while the study by Moura and Da Silva (2005) considered Brazil. Halicioglu (2007) focused on Turkey, Singh (2004) on India, and Bahmani-Oskooee and Gelan (2012) on nine African countries. The study by Kwalingana et al. (2012) covered Malawi, while that by Ziramba and Chifamba (2014) focused on South Africa. For studies that uncover evidence of the J-curve, examples include Boyd et al. (2001); Lal and Lowinger (2002); Kulkarni (1996) and Schaling and Kabundi (2014). The study by Boyd et al. (2001) involved eight OECD countries, and evidence of the J-curve is reported in six of the eight countries. Lal and Lowinger (2002) covered seven Asian countries and found evidence of the J-curve in six of the seven countries. Kulkarni (1996) focused on Ghana and Uganda, while Schaling and Kabundi (2014) on South Africa.

A review of studies that have used bilateral trade-level data reveals a mix of findings. Some studies find evidence supporting the J-curve, while others do not. Among the studies that do find evidence for the J-curve, the evidence is typically confined to a small subset of trading partners. Some studies that do not find evidence of the J-curve include Halicioglu (2007), Halicioglu (2008), Rose and Yellen (1989), and Narayan (2006). The study by Halicioglu

(2007) involved an analysis of the exchange rate - trade balance relationship of Turkey and its nine trading partners, while Halicioglu (2008) covered bilateral trades between Turkey and its 13 trading partners. The study by Rose and Yellen (1989) covered bilateral trades between the USA and its six trading partners, while the study by Narayan (2006) focused on trade between China and the USA. Unlike the above studies, other studies document evidence of the J-curve and include Bahmani-Oskooee et al. (2005, 2008, 2006) and Bahmani-Oskooee and Harvey (2009). Bahmani-Oskooee et al. (2005) examine bilateral trade between Australia and its 23 trading partners and find evidence of the J-curve in 3 partners. The study by Bahmani-Oskooee et al. (2008) covers bilateral trades between Canada and its 20 trading partners and evidence of the J-curve is established in five trading partners. Bahmani-Oskooee et al. (2006) in a study that involves bilateral trade between the UK and its 20 trading partners report evidence of the J-curve in two trading partners. Bahmani-Oskooee and Harvey (2009) find evidence of the J-curve in 5 of the 13 trading partners of Indonesia.

With the discovery of asymmetry effects in the exchange rate-trade balance relationship with the support of advances in econometric modelling techniques, there appears to have been an improvement in the finding of evidence of the J-curve. The improvement in the finding of the J-curve is reflected in existing studies that have employed both linear and non-linear econometric techniques. The asymmetry effects are accounted for using the non-linear econometric model. Some of these studies include Bahmani-Oskooee et al. (2016); Bahmani-Oskooee and Karamelikli (2021); Bahmani-Oskooee et al. (2018); Mwito et al. (2021) and Nusair (2017). The study by Bahmani-Oskooee et al. (2016) examines the exchange rate-trade balance relationship for Mexico and 13 of its trading partners. The study established evidence of the J-curve in 6 trading partners using the linear ARDL model and 10 trading partners using the NARDL model[17]. Bahmani-Oskooee and Karamelikli (2021) conducted a study that involved the United Kingdom and its 12 trading partners from the euro area. The study established evidence suggesting the presence of the J-curve in one trading partner based on the linear ARDL model and in four trading partners based on the NARDL model. Similarly, Bahmani-Oskooee et al. (2018) documents evidence of the J-curve in 5 trad-

[17] The linear ARDL model reflects symmetric effects while the NARDL model takes into consideration asymmetric effects.

ing partners with the linear ARDL model and 7 trading partners with the NARDL model in a study involving bilateral trade analysis of China with 21 of its trading partners. Mwito et al. (2021) in a study involving Kenya and its 30 trading partners reported evidence of J-curve in 7 trading partners using a linear PARDL model and in 13 trading partners using the non-linear PARDL model[18]. Furthermore, Nusair (2017), based on aggregate trade data for 16 European countries, finds no evidence of the J-curve with a linear ARDL model, but finds evidence in 12 countries with the NARDL model. As can also be observed, most studies examine evidence of the J-curve under asymmetry effects using the NARDL model.

3.2.5 Empirical studies on Zambia

For Zambia, few studies examine the relationship between the exchange rate and the trade balance. Rawlins and Praveen (1993) conducted a panel study involving 19 SSA countries, one of which included Zambia, to examine the impact of currency devaluation on trade balance. The study revealed that the devaluation positively affected the trade balance after one year. Musawa (2014), employing cointegration and vector error correction model in a study using quarterly data from 2000 to 2010, examined the exchange rate-trade balance relationship on Zambia. The findings did not indicate evidence of the J-curve, as the effect of the exchange rate on the trade balance was insignificant in the short run. However, the study established evidence of a long-term relationship with the exchange rate, which favourably affects the trade balance. Bleaney and Tian (2014) conducted a panel study involving 87 countries, one of which included Zambia, using data for the period 1994–2010. The results showed that the trade balance responded favourably to the depreciation of the currency. Alege and Osabuohien (2015) conducted a panel study involving 40 Sub-Saharan African countries, including Zambia, with data from 1980 to 2008. The results indicated that currency depreciation may not produce expected results due to the low elasticities of exports and imports. The results also suggested that imports would not be reduced with currency depreciation. One common characteristic of these studies is that

[18]The study used the pooled mean group estimator to estimate the linear and non-linear PARDL model and the reported evidence is based on the short-run cross-section estimates and the homogeneous long run estimate.

they all use aggregate data and do not account for asymmetry effects. This implies that the findings may not capture the full nature of the relationship between the exchange rate and the trade balance, as asymmetrical effects could play an important role.

However, there are two studies that include Zambia and consider the effects of asymmetry. One of them is Bahmani-Oskooee and Arize (2020), which uses the non-linear ARDL model and aggregate trade data for 13 African countries. For Zambia, the data used cover the period 1988-2015. The study finds evidence of asymmetry effects for Zambia in both the short-run and long-run. Evidence of the J-curve is found in Zambia and five other countries. The other study is Bahmani-Oskooee and Arize (2019), which involves bilateral trade data between the United States and its 20 African trading partners. In this study, Zambia is one of the 20 trading partners of the United States. The data used covered the period 1987–2015 and the results indicated evidence of significant long-term asymmetry effects. Specifically, the results showed that the appreciation of the US dollar improved the US trade balance with Zambia, while the depreciation of the US dollar had no effect. When viewed in the context of Zambia, these results indicate that the depreciation of the Zambian currency worsens the country's trade balance. One of the features of these studies is that the data period for Zambia covers multiple exchange rate regimes in that the exchange rate regime was fixed before 1992 and flexible thereafter. In this study, the data used cover the period 1999-2019 in which the exchange rate regime is flexible, and this is one of the distinguishing factors between this study and the previous ones.

The other aspect is that this study examines the exchange rate - trade balance relationship with a sample that comprises 17 trading partners of Zambia. To the knowledge of the author, such an analysis has not previously been conducted with data at the bilateral trade level. The third aspect related to the two studies above and the entire literature is that the NARDL model is widely used. This study, unlike previous studies, proposes to use the LVSTR model, which to the author's knowledge has not been previously employed. This method is used along with the non-linear PARDL model for robustness.

It should be noted that certain studies that cover Zambia focus their attention on examining the relationship between exchange rate volatility and trade, rather than the relationship between the exchange rate and the trade balance, the focal point of this study. One of these studies is by Musonda (2008), who examines the impact of exchange rate volatility on non-traditional exports during the period 1965-1999 using the error correction model. The study finds that exchange rate volatility negatively affects non-traditional exports in the short and long-run. The other study is by Chipili (2013), and examines the effect of exchange rate volatility on trade flows during the period 1980–2004 using aggregate and sectoral data and the Johansen cointegration model. Based on aggregate data, the findings show that the volatility of the exchange rate negatively affects exports and imports in the long-run. With sectoral data, the results show that the exchange rate volatility has no adverse effects on exports.

3.3 Methodology

In examining the asymmetric relationship between the exchange rate and the trade balance, the study employs two methodologies: a time series modelling technique and a panel data model. This combination of methodologies enriches the analysis. The time series model allows for analysis of the exchange rate-trade balance relationship with each of the trading partners. On the other hand, the panel modelling approach enables the analysis on all trading partners collectively. The time series model implemented is the Logistic Vector Smooth Transition Regression (LVSTR) model, while the panel data model employed is the non-linear Panel Autoregressive Distributed Lag (PARDL) model.

The estimation of the LVSTR and non-linear PARDL models is performed based on Equation 3.12 that along with its derivation is presented in subsection 3.2.2. This equation is used in most studies, such as Bahmani-Oskooee and Fariditavana (2015, 2016); Bahmani-Oskooee and Arize (2020); Bahmani-Oskooee and Karamelikli (2021); Nusair (2017); Mwito et al. (2021) and Arize et al. (2017).

3.3.1 Logistic Vector Smooth Transition Regression (LVSTR) model

The study employs the LVSTR model to investigate the presence of nonlinearity in the relationship between the trade balance and its determinants based on a regime-switching environment induced by exchange rate changes. One of the advantages of the model is that it is multivariate and, as such, allows for interrelationship between the variables. Secondly, the model allows for smooth switch between regimes, and the thresholds are determined by the model.

The LVSTR model is recent and its modelling strategy was developed by Teräsvirta and Yang (2014), as also observed by Bucci et al. (2022). The LVSTR model, a vector model, is generally an extension of the univariate smooth transition regression. The initial application of the vector model that included the smooth transition was by Rothman et al. (2001) in the smooth transition vector error correction model, followed by Camacho (2004) in a bivariate vector smooth transition regression model that included exogenous variables (Teräsvirta and Yang, 2014).

The LVSTR model has been used in various fields of literature, although its use is not extensive. For example, Gefang and Strachan (2009) uses it in a bayesian approach to examine how international business cycles affect the United Kingdom economy. Caggiano et al. (2020) uses the model to examine how unexpected increases in uncertainty of economic policy affect US unemployment during both economic downturns and upswings. Neves and Semmler (2022) employs the model to examine how the relationship between credit and economic output is impacted by low and high levels of financial stress in Brazil. Bucci et al. (2019) uses it to investigate whether macroeconomics plays a role in forecasting correlated movements in stock market volatility. The model is also used by Balcilar et al. (2021) to examine the effects of asymmetry in ERPT for the BRICS countries. The LVSTR model has also been used by Schleer and Semmler (2015), Bolboaca and Fischer (2019), Cheikh et al. (2018), among others. In the case of the literature on the relationship between the exchange rate and the trade balance, the LVSTR model has not been previously used. The closest model is the univariate smooth transition regression employed in the study by Arize et al.

(2017), albeit solely for the purpose of testing non-linear dynamics in the relationship between the exchange rate and trade balance. Therefore, the use of the LVSTR model constitutes a novel contribution.

The LVSTR model of order k with two extreme regimes can be specified in a reduced form, following Hubrich and Teräsvirta (2013) and Bucci et al. (2019), as follows:

$$y_t = \alpha_1 + \sum_{j=1}^{k} \varphi_{1j} y_{t-j} + \psi_1 x_t + G_t(\gamma, c : s_t)[\alpha_2 + \sum_{j=1}^{k} \varphi_{2j} y_{t-j} + \psi_2 x_t] + \epsilon_t \quad (3.13)$$

Where y_t represents an $n \times 1$ vector of endogenous variables, trade balance ($ln(X_t/M_t)$), real exchange rate ($lnRER_t$) and real domestic income (lnY_t^d). α_1 and α_2 are $n \times 1$ intercept vectors, φ_{1j} and φ_{2j}, for $j = 1, .., k$, is a $n \times n$ parameter matrices, and y_{t-j} reflects a matrices of lagged endogenous variables. ψ_1 and ψ_2 are $n \times m$ parameter matrices and x_t is an $m \times 1$ vector of exogenous variables, real foreign income (lnY_t^f). $G(\gamma, c : s)$ represents the transition function, which makes the model non-linear. ϵ_t represents an $n \times 1$ error vector, defined as $\epsilon_t \sim N(0, \Omega_t)$, where Ω_t is a positive definite variance-covariance matrix.

Equation 3.13 can be reparameterised as follows:

$$\begin{aligned} y_t = \alpha_1 + \alpha_2 G_t(\gamma, c : s_t) + \sum_{j=1}^{k} \varphi_{1j} y_{t-j} + \sum_{j=1}^{k} \varphi_{2j} y_{t-j} G_t(\gamma, c : s_t) \\ + \psi_1 x_t + \psi_2 x_t G_t(\gamma, c : s_t) + \epsilon_t \quad (3.14) \end{aligned}$$

The above equation can be restated in reduced form in the following manner:

$$y_t = G_t \beta' z_t + \epsilon_t \quad (3.15)$$

where $G_t = G_t(\gamma, c : s_t)$, $\beta' = [G_t^{-1}\alpha_1 + \alpha_2 \quad G_t^{-1}\varphi_{1j} + \varphi_{2j} \quad G_t^{-1}\psi_1 + \psi_2]$, and $z_t = (1, y'_{t-j}, x'_t)'$. Based on the model specification, the coefficients associated with G_t are non-linear. The LVSTR model is therefore comprised of linear and non-linear coefficients. G_t, which account for non-linear dynamic effects between variables in the model, is a $n \times n$ diagonal matrix defined as follows:

$$G_t = G_t(\gamma, c : s) = diag[G_1(y_1, c_1, s_{1t}), \ldots, G_n(y_n, c_n, s_{nt})] \quad (3.16)$$

Every element on the diagonal is defined as follows:

$$G^r_{i,t}(s^r_{i,t};\gamma^r_i,c^r_i) = [1 + exp[-\gamma^r_i(s^r_{i,t} - c^r_i)]]^{-1}, \gamma^r_i > 0 \tag{3.17}$$

Based on the transition function, γ represents the gamma or speed of transition from one regime to the other. A high number suggests rapid switches between regimes, whereas a lower value indicates gradual changes between regimes. c reflect the transition threshold or rather the value of the transition variables based on which switches between regimes take place. s represents the transition variable. $G(\gamma, c : s)$ is bounded between zero and one. If $G(\gamma, c : s) = 0$, the LVSTR model reduces to a linear VAR model and, if $G(\gamma, c : s) = 1$, the LVSTR model becomes a Threshold Vector Autoregressive model, in which transitions between regimes are abrupt. An indication of the value of $G(\gamma, c : s)$ can be obtained from the interaction between the transition variable and the threshold parameter. $G(\gamma, c : s)$ tends to zero when the transition variable is very low and much below the threshold parameter and to one when the transition variable is extremely high and far beyond the threshold parameter. The extreme regimes are determined in the model based on the threshold parameter and its interaction with the transition variable. Extremely low values of the transition variable relative to the threshold parameter identify the lower regime, while extremely high levels of the transition variable above the threshold parameter define the upper regime. Additionally, the transition parameter, γ, provides some insight into the value of $G(\gamma, c : s)$. When γ approaches infinity, $G(\gamma, c : s)$ tends to one, and when γ is zero, $G(\gamma, c : s)$ becomes a constant.

Before its estimation, the LVSTR model should be empirically tested to establish whether it fits the data adequately. Therefore, the model is only applied on the basis of empirical support in favour of its use. Accordingly, a linearity test is performed based on the Langrage multiplier with an asymptotic chi-square distribution. This test considers the null hypothesis of a linear model, defined as $H_0 : \gamma = 0$, against the alternative hypothesis of the LVSTR model, stated as $H_1 : \gamma > 0$. As highlighted above, when $\gamma = 0$, it follows that $G(\gamma, c : s)$ becomes a constant, thus resulting in the LVSTR model described in Equation 3.13 becoming a linear VAR model. With the linearity test, an identification problem arises, since the parameter γ is not part of the linear VAR model supported by the null hypothesis. The parameter γ is an element of the LVSTR model that is identified by the alternative hypothesis and not the null hypothesis. This makes the parameter γ a nuisance. This problem is solved by replacing $G(\gamma, c : s)$ with the third-order Taylor expansion around $\gamma = 0$, as suggested by Luukkonen et al. (1988). An auxiliary regression is obtained, on which the linearity test is conducted. Based on Equation 3.15, the auxiliary regression is given as follows:

$$y_t = z_t\beta_0 + z_t s_t\beta_1 + z_t s_t^2\beta_2 + z_t s_t^3\beta_3 + \epsilon_t \tag{3.18}$$

Where β_i, $i = 0, ..., 3$, represents the coefficients, and s_t reflects the transition variable. If the test result supports the rejection of the null hypothesis, the LVSTR model is estimated. As the transition variable is the same for all equations in the model, the use of a joint linearity test is appropriate.

The estimation of the LVSTR model can be carried out using two different optimisation methodologies. The first is non-linear least-squares estimation presented in Equation 3.19 and the second is the maximum log-likelihood estimation depicted in Equation 3.20.

$$\hat{\theta} = \arg\min_{\theta} \sum_{t=1}^{T} (y_t - G_t\beta' z_t)'(y_t - G_t\beta' z_t) \tag{3.19}$$

$$ll(y_t|I_t;\theta) = -\frac{Tn}{2}ln(2\pi) - \frac{T}{2}ln|\Omega| - \frac{1}{2}\sum_{t=1}^{T}(y_t - G_t\beta' z_t)'\Omega^{-1}(y_t - G_t\beta' z_t) \tag{3.20}$$

where $\hat{\theta}$ represent the parameters to be estimated, $[\alpha_i, \varphi_{ij}, \psi_i, \gamma, c]$ where $i = [1, 2]$ and reflects the linear and non-linear parameters in the model. T represents the number of time periods. Both methodologies produce similar results. However, it is important to ensure that the initial values of the parameters γ and c are well selected to avoid the model converging on a local minimum. Therefore, a grid search is used to determine the initial values of these parameters. The selected initial values correspond to the sum of squared residuals that is the smallest (Hubrich and Teräsvirta, 2013).

3.3.2 Non-linear Panel Auto-distributed lag model

As indicated already, the study also employs the non-linear Panel Autoregressive Distributed Lag (PARDL) model to analyse the exchange rate-trade balance relationship for Zambia and its trading partners. This model provides numerous advantages. First, and probably most important, the model facilitates the examination of asymmetry effects in the relationship between the exchange rate and the trade balance. Based on this model, the exchange rate variable can be split into two distinct variables: one reflecting currency depreciation and the other indicating currency appreciation. This, in turn, helps determine whether currency depreciation and appreciation have equal effects on the trade balance. Second, the model generates estimates for both the short-run and the long-run, enabling the analysis of the impact of currency depreciation and appreciation in both time frames. Specifically, this framework allows for examining asymmetry effects and the J-curve hypothesis in both the short-run and long-run. In connection with this, the model also produces results of cointegration, reflected by the error correction term, which aids in determining whether a long-term relationship between the variables exists or not. The statistical significance of the error correction term confirms the validity of the long-run estimates. Third, the model accommodates regressors with the same or different orders of integration (Pesaran et al., 1999, 2001). This is in contrast to conventional panel models, where the cointegration feature of this model does not require the regressors to have the same orders of integration. Last but not the least, the non-linear PARDL model is tailored to address the problem of endogeneity, and as such, the regressors are not strictly required to be purely exogenous (Jarrett et al., 2019; Koengkan et al., 2020). This also means that some regressors can indeed be endogenous. The non-linear PARDL model addresses this endogeneity by including lagged values of the regressors (Riti et al., 2021; Asteriou et al., 2021). As a result, the estimates derived from the model are consistent, efficient, and unbiased (Riti et al., 2021).

As indicated earlier, the model estimations in this study are based on Equation 3.12. However, this equation is reparametrized and specified as follows:

$$ln(X_t/M_{it}) = \kappa lnRER_{it} + \psi Y_{it} \tag{3.21}$$

where $Y_{it} = ln(Y_{it}^f/Y_t^d)$. This adjustment, also employed by Mwito et al. (2021), follows Khan and Hossain (2010). The adjustment indicates that relative real income is important in the analysis rather than absolute real income. The interpretation of the relative real income variable, though argued to be ambiguous by Khan and Hossain (2010), is indicated by Khatoon et al. (2021) to be consistent with the literature. Variations in this variable reflect the relative changes in real foreign income and real domestic income[19]. In terms of the expected effect on the trade balance, it is expected that a rise in real income (Y_{it}) positively affects the trade balance, while a decrease is likely to have a negative effect.

The non-linear PARDL model is, by construction, an extension of the linear PARDL model. Following Pesaran et al. (1999), the linear PARDL model is specified as follows:

$$y_{it} = \sum_{j=1}^{p} \Phi_{ij} y_{it-j} + \sum_{j=0}^{q} \phi_{ij} X_{it-j} + u_i + \epsilon_{it} \tag{3.22}$$

Where y_{it} represents the dependent variable, $ln(X_{it}/M_{it})$. y_{it-j} reflects the lag of the dependent variable. X_{it} is a k-dimension of the vector of independent variables $[ln(RER_{it}), Y_{it}]$. u_i is the observed fixed effects and ϵ_{it} is the error term. Φ_i represents the coefficients of the lags of the dependent variable and ϕ_i reflects the coefficients of the independent variables. p and q represent the lag lengths.

Reparameterisation of Equation 3.22 leads to the following:

$$\Delta y_{it} = \omega_i y_{it-1} + \eta_i X_{it} + \sum_{j=1}^{p-1} \Phi^*_{ij} \Delta y_{it-j} + \sum_{j=0}^{q-1} \phi^*_{ij} \Delta X_{it-j} + u_i + \epsilon_{it} \tag{3.23}$$

Where $\omega_i = -(1 - \sum_{j=1}^{p} \Phi_{ij})$, $\eta_i = \sum_{j=0}^{q} \phi_{ij}$, $\Phi^*_{ij} = -\sum_{m=j+1}^{p} \Phi_{im}$ where $j = 1, 2, ..., p-1$, $\phi^*_{ij} = -\sum_{m=j+1}^{q} \phi_{im}$ where $j = 1, 2, ..., q-1$.

Following Blackburne III and Frank (2007), further reparameterisation can lead to the error correction representation of Equation 3.23, specified as follows:

$$\Delta y_{it} = \omega_i (y_{it-1} - \eta_i X_{it}) + \sum_{j=1}^{p-1} \Phi^*_{ij} \Delta y_{it-j} + \sum_{j=0}^{q-1} \phi^*_{ij} \Delta X_{it-j} + u_i + \epsilon_{it} \tag{3.24}$$

where the part, $\omega_i(y_{it-1} - \eta_i X_{it})$, reflects the error correction term. ω_i is speed of adjustment in long-term equilibrium and serves as an indicator of

[19] Khatoon et al. (2021) indicates that an increase in the variable of real income implies a greater increase in real foreign income compared to real domestic income. It could also mean that real foreign income is rising while real domestic income is declining or that both variables are declining, but with real domestic income declining faster than real foreign income. The converse applies.

cointegration when it carries a significant and negative sign. The coefficient η_i is defined as $\sum_{j=0}^{q} \phi_{ij}/(1 - \sum_{k}^{q} \Phi_{ik})$.

It is noteworthy that Goswami and Junayed (2006) uses a model specification similar to Equation 3.23 and Equation 3.24 in a study that examines the exchange rate-trade balance relationship between the United States and its 19 trading partners from the Organisation for Economic Cooperation and Development. This is also the case with Mwito et al. (2021) in a study that involves a bilateral trade analysis of Kenya and its 30 trading partners.

To account for asymmetry, the exchange rate variable, $ln(RER_{it})$, is split into two variables, one variable representing exchange rate depreciation (RER_{it}^{+}) and the other variable capturing exchange rate appreciation (RER_{it}^{-}). This procedure is guided by the work of Shin et al. (2014). The variables RER_{it}^{+} and RER_{it}^{-} as partial sums of the exchange rate are constructed as follows:

$$RER_{it}^{+} = \sum_{k=1}^{t} \Delta ln(RER_{ik}^{+}) = \sum_{k=1}^{t} max(\Delta ln(RER_{ik}^{+}, 0) \tag{3.25}$$

$$RER_{it}^{-} = \sum_{k=1}^{t} \Delta ln(RER_{ik}^{-}) = \sum_{k=1}^{t} min(\Delta ln(RER_{ik}^{-}, 0) \tag{3.26}$$

The exchange rate variable in Equation 3.23 and Equation 3.24 is then replaced with the two newly constructed variables, RER_{it}^{+} and RER_{it}^{-} . The presence of asymmetry effects in the relationship between the exchange rate and the trade balance is determined using a Wald test. The null hypothesis suggests symmetric effects, while the alternative hypothesis indicates asymmetric effect. In simple terms, the test assesses whether the impact of positive and negative exchange rate shocks on the trade balance is equal or not. The rejection of the null hypothesis suggests that there is evidence of asymmetry, implying that the trade balance reacts unevenly to positive and negative exchange rate shocks.

The study considers two estimators to estimate the non-linear PARDL model. These are the Mean Group (MG) estimator, introduced by Pesaran and Smith (1995), and the Pooled Mean Group (PMG) estimator, developed by Pesaran et al. (1999). The MG estimator allows for variations of the estimates in the short-run and long-run between cross-section units. On the other hand, the PMG estimator provides for short-run coefficients to vary between cross-section units, while the long-run coefficients are restricted to be the same for all cross-section units. The choice of a more efficient model among these two estimators is determined by the Hausman test. The null hypothesis of the test suggests that the PMG estimator is efficient, while the alternative hypothesis favours the MG estimator as being efficient. The non-linear PARDL methodology has been considered recently in studies that address the exchange rate-trade balance relationship. For example, the studies by Barkat et al. (2022) and Mwito et al. (2021).

3.4 Data

The study analyses the asymmetric relationship between the exchange rate and trade balance using bilateral trade data between Zambia and its 17 trading partners. The list of trading partners, including information on their trade share, is presented in Table 3.1. Two data sets are used: monthly data for the period 1999:M1–2019:M12 for time series analysis and annual data over the same period for panel data analysis. The variables used in the study include trade balance, real exchange rate, real domestic income, and real foreign income. It is worth noting that the start date of the data coincides with the introduction of the euro, which partly explains the selection of the sample period. The euro is the domestic currency of some of the trading partners of Zambia. Each of the variables used in the study is described briefly, along with their data source, below.

Trade balance is defined as the ratio of exports to imports, expressed in natural logarithms. A positive value represents a trade balance surplus, while a negative value implies a deficit in the trade balance. The data is taken from the Zambia Statistics Agency.

Exchange rate is the real exchange rate and reflects the value of the Zambian currency per unit of the currency of the trading partner. The study uses the real exchange rate (RER) based on multiple sources of support. First, the theoretical derivation of the relationship between the exchange rate and the trade balance, represented by Equation 3.12, highlights the significance of the real exchange rate. Second, most studies employ RER to investigate both the asymmetry effects and the J-curve hypothesis, as this study.

The real exchange rate is calculated as a product of the bilateral nominal exchange rate and the price ratios. The IMF International Financial Statistics database provides data on the US dollar-Kwacha exchange rate and the Euro-Kwacha exchange rate[20]. This data effectively covers the bilateral exchange rates for Zambia and its trading partners, the United States, Belgium, Germany, and the Netherlands.

The bilateral real exchange rate of Zambia versus each of the above trading partners is calculated as shown below[21].

$$RER_i = \frac{EXR_i^d \times CPI_i^f}{CPI^d} \tag{3.27}$$

where RER_i is the real exchange rate between the Zambian currency and the currency of the i-th trading partner. EXR_i^d represents the nominal exchange rate between the Zambian Kwacha and the US dollar in the case of the United States as the trading partner, and also represents the nominal exchange rate between the Zambian Kwacha and the Euro in the case of the trading partners, Belgium, Germany, and the Netherlands. The nominal exchange is measured in domestic currency value per unit of the foreign currency, the US dollar or the euro. CPI_i^f is the consumer price index of the i-th trading partner and CPI^d represents the consumer price index for Zambia. Data on the consumer price index is also obtained from the IMF International Financial Statistics database. The bilateral exchange rates between Zambia and other trading partners are computed using cross-rates through the US dollar using data from the IMF International Financial Statistics database. The formula used is shown below.

$$RER_i = \frac{EXR^d \times CPI_i^f}{EXR_i^f \times CPI^d} \tag{3.28}$$

where EXR^d is the nominal exchange rate between the Zambian Kwacha and the US dollar, while EXR_i^f is the nominal exchange rate between the currency of the i-th trading partner and the US dollar. Both exchange rates are expressed as the value of the national currency per unit of a US dollar. By extension, an increase in the level of the real exchange rate reflects a real depreciation of the Zambian currency against the i-th trading partner's currency.

[20]The Kwacha is the currency for Zambia.

[21]A similar formula is used by Bahmani-Oskooee and Karamelikli (2021); Bahmani-Oskooee et al. (2019b); Goswami and Junayed (2006) and others.

Real domestic income is represented by real Gross Domestic Product (GDP). For time-series analysis, constant price GDP measured in local currency is used, whereas for panel data, constant price GDP measured in US dollars at 2015 prices is used. Both datasets are available only in annual frequency. For time-series analysis, GDP data is converted into monthly data using the quadratic-match sum technique. GDP data is taken from the World Bank Group Databank for World Development Indicators.

Real foreign income is, as with real domestic income, represented by the real Gross Domestic Product (GDP). The constant price GDP measured in local currencies of the trading partners of Zambia is used for time series analysis while the 2015 constant price GDP in US dollars is used for panel data analysis. Both datasets are available only in annual frequency. The GDP data used for time series are converted into monthly data using the quadratic-match sum technique. The data is taken from the World Bank Group Databank for World Development Indicators.

3.4.1 Overview on Zambia on exchange rate and trade balance dynamics

Zambia's exchange rate management system has undergone several changes since independence in 1964, ranging from fixed to flexible exchange rate regimes[22]. However, Zambia has maintained a flexible exchange rate regime since 1992, supported by the abolition of exchange rate controls in 1994. Before 1992, the exchange rate management system at play included an exchange rate fixed with the British pound (1967-1971), fixed with the US dollar (1972-1976 and 1988-1989), pegged to the Special Drawing Rights (1977-1982), and pegged to a basket of currencies of five major trading partners (1983-1984). Furthermore, it included a Dutch auction system (1985-1987) and a dual exchange rate system (1989-1992) (Musonda, 2008).

Zambia participated in IMF structural reform programmes in which currency devaluation was one of the reforms and this was in the period 1983/4 - 1987 (Sano, 1988). Before this, specifically in the 1960s and early 1970s, Zambia's economic performance was strong, supported by rising and elevated copper

[22] A detailed review of the exchange rate policy in Zambia is provided by Mungule (2004) and Chipili (2010).

prices in the international copper markets. Copper earnings constituted about 93% of exports and 40% of GDP. The collapse of copper prices in 1975 due to increased excessive supplies in the international copper markets marked the beginning of the problem of balance of payments deficits and economic misfortunes for Zambia. In 1975, the current account recorded a deficit, representing 30% of GDP, after being approximately in balance in 1974, and the deficits after that continued (Colclough, 1988). These deficits, which in the 1980-1982 period were estimated at 20% of GDP, were financed through external borrowing, leading to a tripling of the external debt to US$3.6 billion, representing 100% of GDP during the period 1974 – 1982. IMF credit constituted part of the external debt and was not attached to economic reforms. It was approximately US$635.0 million, representing 17.4% of the total external debt (Wulf, 1988). The troubling economic situation with persistent current account deficits prompted Zambia to negotiate with the IMF and adopt the structural adjustment programme with its economic reforms, which led to a currency devaluation of 60% (Colclough, 1988). However, the structural programme, including economic reforms, was cancelled in 1987, not due to currency devaluation, but due to disagreement by the Zambian government over the reduction of maize subsidies amid the growing budget deficit (Sano, 1988).

The adoption of the flexible exchange rate regime, which has been in place since 1992, was a crucial element of reforms aimed at expanding trade. In line with this, Zambia in the 1990s and early 2000s became a signatory to various trade agreements. Some of the trade agreements include the African Growth and Opportunity Act (AGOA), the Cotonou Agreement with the European Union, the Southern African Development Community (SADC), the Common Market for Eastern and Southern Africa (COMESA) (see Chipili, 2013; Mudenda, 2005, for details). In 2021, Zambia completed the ratification process for the African Continental Free Trade Area (AfCFTA) agreement[23].

Despite the above initiatives, Zambia's trade is not very diversified in terms of its trading partners, as a small number of trading partners represent more than 50% of the total exports and imports. In 2019, according to the 2019 Bank of Zambia Annual Report[24], exports to the five main trading partners,

[23] Further details are available at, https://www.uneca.org/stories/zambia-latest-country-ratify-african-continental-free-trade-area-afcfta-agreement

[24] The 2019 Bank of Zambia Annual Report, as well as other Annual Reports, can be

Switzerland, China, the Democratic Republic of the Congo, Singapore and South Africa, jointly represented 88% of total exports. On the import side, the five main trading partners, South Africa, China, the United Arab Emirates, India, and the Democratic Republic of the Congo, collectively represented 63% of all imports. Switzerland, which is the largest export market, accounted for 41% of all exports, while South Africa, the main import source country, accounted for 31% of total imports.

A review of the trading activities between Zambia and its 17 trading partners, which were selected based on data availability, confirms limited diversification of trade. With trade measured as the sum of exports and imports, it is observed that the 17 trading partners jointly constitute a trade share of 74%, while the top five trading partners have a trade share of 60%. Table 3.1 lists the trading partners and provides information on their individual trade shares, while Figure 3.3 provides information on export and import shares. Information on the annual trade share of the 17 countries during the period 1999-2019 is presented in Figure 3.1, while that of the top five trading partners is shown in Figure 3.2. The relationship between the exchange rate and the trade balance for each of the trading partners is depicted in the appendix in Figure B.1.

accessed at https://www.boz.zm/annual-reports.htm

Table 3.1: Trading Partners and their trade share (%)

Countries	**1999**	**2019**	**Average**	**Period**
Switzerland	8.21	20.54	17.16	20.90
South Africa	25.96	17.74	26.36	20.71
China	0.36	17.75	8.66	13.10
United Kingdom	29.12	1.14	8.38	3.07
India	1.70	2.84	2.37	2.58
Singapore	0.36	4.54	1.28	2.52
Kenya	0.35	0.74	1.34	1.57
Tanzania	2.54	1.88	1.58	1.30
Mauritius	0.23	1.49	0.76	1.27
Japan	3.49	1.33	1.37	1.25
USA	1.49	1.34	1.15	1.03
Malawi	0.93	0.88	1.00	0.91
Hong Kong	0.23	0.93	0.58	0.78
Germany	2.12	0.87	0.94	0.77
Belgium	3.57	0.33	1.07	0.73
Netherlands	1.21	0.45	0.94	0.58
Sweden	0.38	0.47	0.52	0.49
Total	82.24	75.28	75.46	73.55

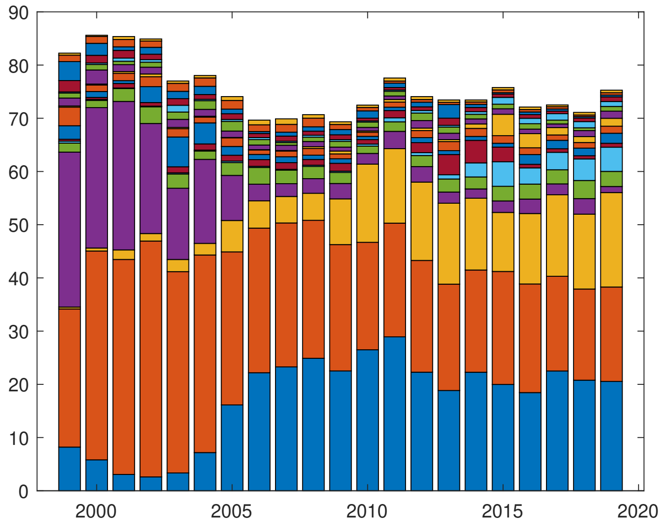
Source: Author compilation based on data from the Zambia Statistics Agency

Table 3.2: Distribution of Exports, Imports, and Trade among Trading Partners over the period 1999-2019

Country	**Export (%)**	**Import (%)**	**Total (%)**
Switzerland	41.60	0.61	20.90
South Africa	7.57	33.59	20.71
China	16.41	9.85	13.10
United Kingdom	3.34	2.81	3.07
India	1.17	3.96	2.58
Singapore	4.29	0.78	2.52
Kenya	0.72	2.40	1.57
Tanzania	1.06	1.53	1.30
Mauritius	0.24	2.29	1.27
Japan	0.48	2.00	1.25
USA	0.14	1.90	1.03
Malawi	1.55	0.28	0.91
Hong Kong	0.90	0.66	0.78
Germany	0.27	1.26	0.77
Belgium	0.50	0.95	0.73
Netherlands	0.41	0.74	0.58
Sweden	0.03	0.93	0.49
Total	80.70	66.54	73.55

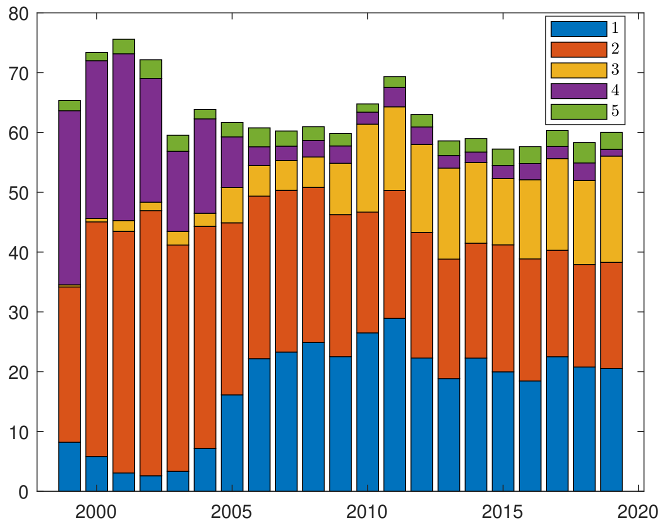
Source: Author compilation based on data from the Zambia Statistics Agency

Figure 3.1: Trade share of the 17 trading partners of Zambia



Source: Author, Zambia Statistics Agency data.

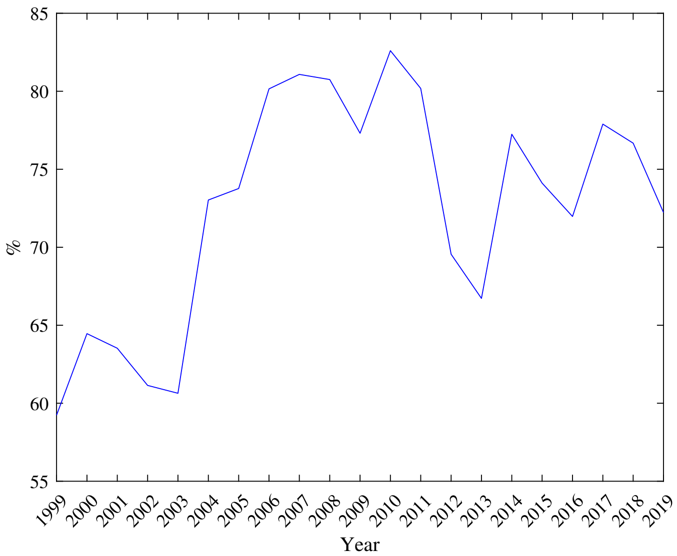
Figure 3.2: Trade share of the top 5 trading partners of Zambia



Notes: "1" = Switzerland, "2" = South Africa, "3" = China, "4" = the United Kingdom and "5" = India. Source: Author, Zambia Statistics Agency data.

Figure 3.3 plots mineral exports as a percentage of total exports. Mineral exports are shown to have represented more than 60% of total exports during the sample period. This reflects that minerals dominate exports, which is consistent with the indication given by Chipili (2016). The larger share of mineral exports, along with a small number of trading partners accounting for a larger share of trade, makes the case of Zambia unique. The indication in the literature that commodities are associated with low elasticities (e.g., Ndlela and Ndlela, 2002; Oladipupo, 2011), make the analysis of the effect of the exchange rate on Zambia's bilateral trade balance with the 17 trading partners more appealing. This is particularly the case in the context of whether currency depreciation leads to an improvement in the trade balance. Detailed information on the products traded by Zambia with each of the trading partners is shown in Appendix B in Table B.1 and Table B.2.

Figure 3.3: Share of minerals in exports (%)



Notes: The minerals include copper, cobalt and gold. Source: Author, Bank of Zambia.

3.4.2 Unit Root Testing

Unit root tests are performed on all variables prior to model estimation, as it is an important step to avoid generating spurious results. Two sets of unit root tests are conducted, one for time series data and the other for panel data[25]. With respect to time series data, the Augmented Dickey-Fuller Test (ADF) and the Phillips-Perron Test (PP) unit root tests are used to conduct the unit root tests. The null hypothesis of unit root tests suggests the presence of unit roots, whereas the alternative hypothesis suggests that there is no unit root in the variables. MacKinnon critical values, presented in Table 3.3,

[25]The time series data is used in estimation of the LVSTR model, while panel data is used in estimating the non-linear PARDL model.

are used to determine whether to reject the null hypothesis or not. The null hypothesis is rejected if, at the significance level of 10%, 5%, or 1%, the test statistic is greater than the critical value in absolute terms. This means that the null hypothesis cannot be rejected if the test statistic is less than the critical value in absolute terms at the given significance levels.

Table 3.3: MacKinnon Critical Values

1% Significance level	5% Significance level	10% Significance level
-3.4768	-2.8818	-2.572

The results of the unit root tests are shown in Table 3.4[26]. With respect to the results at the level of the variables, it is shown that the trade balance variable, TB, is associated with test statistics greater than the critical values in absolute terms for both types of tests for all trading partners. This implies that TB is stationary in all models of trading partners. Along the same lines, the results indicate that the real exchange rate variable (RER) is stationary for the models of Belgium and Germany, while the real foreign income variable, GDP_f, is stationary in the cases of China, Hong Kong, Mauritius, and South Africa. The variable of real domestic income (GDP_d) is a common variable in all models and, as such, the results of the unit root tests are reported only in the model involving Belgium to avoid repetition. The results indicate that GDP_d is stationary based on all types of tests. A review of the results of the unit root tests for the variables in their first difference establishes that all variables for all models or trading partners are associated with test statistics greater than the critical values in absolute terms at the level of significance of 1%. Therefore, the null hypothesis on all variables in all models is rejected. The LVSTR model is estimated with variables in their first difference.

Table 3.4: Unit Root Test Results

Variable	**Level**		**Difference**	
	ADF t-statistic	PP t-statistic	ADF t-statistic	PP t-statistic
Belgium				
TB	-7.750***	-7.643***	-24.466***	-32.142***

[26]The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. "UK" = United Kingdom and "USA" = United States of America.

Table 3.4 continued from previous page

Variable	Level		Difference	
RER	-2.669**	-2.752*	-13.936***	-13.863***
GDP_d	-4.963***	-2.683*	-6.266***	-5.849***
GDP_f	-2.918***	-1.939	-9.605***	-9.869***
China				
TB	-7.673***	-7.528***	-27.116***	-38.239***
RER	-1.806	-1.918	-13.730***	-13.665***
GDP_f	-9.073***	-4.645***	-5.053***	-4.288***
Germany				
TB	-7.415***	-7.328***	-25.153***	-29.729***
RER	-2.583*	-2.639*	-13.883***	-13.803***
GDP_f	-0.143	-0.379	-10.274***	-10.683***
Hong Kong				
TB	-12.465***	-12.639***	-28.882***	-36.637***
RER	-1.942	-1.977	-13.3***	-13.231***
GDP_f	-5.684***	-3.391***	-7.831***	-7.772***
India				
TB	-8.182***	-8.242***	-23.028***	-27.677***
RER	-1.877	-2.032	-13.575***	-13.49***
GDP_f	0.917	0.479	-8.499***	-8.667***
Japan				
TB	-8.565***	-8.691***	-24.855***	-30.757***
RER	-2.043	-2.111	-13.583**	-13.567***
GDP_f	-2.231	-1.886	-10.664***	-11.063***
Kenya				
TB	-6.185***	-5.789***	-26.808***	-31.103***
RER	-0.703	-0.69	-13.974***	-13.872***
GDP_f	4.078***	2.363	-9.047***	-9.218***
Malawi				
TB	-11.935***	-12.246***	-25.627***	-30.379***
RER	-1.862	-1.986	-12.508***	-12.461***
GDP_f	2.393	1.191	-7.550***	-7.498***
Mauritius				
TB	-7.286***	-7.200***	-20.909***	-23.108***
RER	-2.060	-2.084	-14.245***	-14.178***
GDP_f	-5.056***	-2.954**	-8.217***	-8.071***
Netherlands				

Table 3.4 continued from previous page

Variable	**Level**		**Difference**	
TB	-4.979***	-4.35***	-24.643***	-28.927***
RER	-2.500	-2.587*	-13.863***	-13.790***
GDP_f	-1.950	-1.380	-8.866***	-9.054***
Singapore				
TB	-9.699***	-10.079***	-26.547***	-33.834***
RER	-2.015	-2.085	-14.043***	-13.982***
GDP_f	-3.516***	-2.27	-9.445***	-9.680***
South Africa				
TB	-8.592***	-8.848***	-26.997***	-32.850***
RER	-2.349	-2.372	-13.903***	-13.806***
GDP_f	-8.495***	-5.070***	-7.664***	-7.627***
Sweden				
TB	-16.237***	-16.240***	-29.587***	-45.420***
RER	-2.355	-2.389	-13.853***	-13.764***
GDP_f	-2.182	-1.542	-9.892***	-10.233***
Switzerland				
TB	-7.484***	-7.289***	-23.246***	-30.002***
RER	-2.507	-2.592	-14.183***	-14.126***
GDP_f	-1.994	-1.376	-9.771***	-10.088***
Tanzania				
TB	-10.559***	-10.848***	-25.092***	-31.720***
RER	-2.257	-2.276	-13.175***	-13.097***
GDP_f	0.458	0.252	-9.616***	-9.858***
UK				
TB	-5.115***	-4.599***	-21.132***	-23.611***
RER	-1.995	-2.042	-14.251***	-14.230***
GDP_f	-2.437	-1.669	-9.494***	-9.790***
USA				
TB	-6.953***	-6.752***	-24.273***	-29.053***
RER	-1.704	-1.779	-13.576***	-13.510***
GDP_f	-2.175	-1.409	-8.897***	-9.039***

In addition to the unit root tests conducted by the ADF and PP methods, a further examination is performed using the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) unit root test. The null hypothesis of the test differs from that of the unit root tests used earlier in that it posits the series is stationary. The alternative hypothesis suggests that the series is not stationary. In view of this, if the test results suggest that the null hypothesis cannot be rejected, the implication is that there is no unit root in the series. Unit test results are presented in the table below. The results indicate that when variables are expressed in their first differences, the test statistics for all variables are lower than the critical value of 0.739 at the 1% significance level for all countries, except for China and South Africa in relation to the variable GDP_f. This implies that all countries have stationary variables, except China and South Africa, where the variable GDP_f is not stationary. In view of the finding of no stationarity in the variable GDP_f for China and South Africa, less emphasis is placed on the results of the time series modelling for these countries.

Next, the unit root test is performed for panel series. The non-linear PARDL model, which is nested by the ARDL model, allows for the inclusion of variables integrated of either order zero or one. This means that the model accommodates variables that are stationary at levels, in their first difference, or a combination of both. Consequently, the literature suggests that unit root testing may not be necessary when using this estimation methodology. However, unit root testing is performed here to ensure that none of the variables has an order of integration greater than one. This is because if a series has an integration order of 2 or more, the estimates may be misleading (Riti et al., 2021; Nkoro and Uko, 2016). The unit root tests employed on panel data include the Levin-Lin-Chu (LLC), Im, Pesaran, and Shin (IPS) and Cross-sectionally augmented Im, Pesaran and Shin (CIPS) unit root tests. LLC and ADF tests assume cross-sectional independence in the variables, while the CIPS test assumes that the variables are cross-sectionally dependent (Baltagi, 2013). As with the unit root tests conducted earlier on time-series data, the null hypothesis suggesting the existence of unit roots in series is tested against the alternative hypothesis indicating the absence of unit roots. For the LLC and IPS unit root tests, the p-values are used to determine whether the null hypothesis should be rejected or not. If p-values are less than 0.01, 0.05, or 0.1, the null hypothesis is rejected. With respect to the CIPS unit root test, the critical values are used to guide the decision on whether to reject the null hypothesis or not. If the CIPS statistic is greater than the critical value[27] in absolute terms, then the null hypothesis is rejected.

[27]CIPS critical values are presented in notes under Table 3.6

Table 3.5: KPSS Unit Root Test

Countries	**Levels**				**First Difference**				**CV 1%**
	TB	RER	GDP_d	GDP_f	ΔTB	ΔRER	ΔGDP_d	ΔGDP_f	
Belgium	1.454	1.165	2.033	1.991	0.048	0.196	0.733	0.215	0.739
China	1.071	0.494		2.037	0.063	0.311		1.001	0.739
Germany	1.261	12.329		1.952	0.044	0.201		0.040	0.739
Hong	0.285	0.878		1.991	0.281	0.505		0.507	0.739
India	0.953	0.485		2.035	0.085	0.285		0.162	0.739
Japan	0.136	1.338		1.711	0.052	0.220		0.111	0.739
Kenya	0.278	1.303		2.037	0.058	0.300		0.401	0.739
Malawi	0.309	1.525		2.029	0.109	0.246		0.257	0.739
Mauritius	0.210	0.707		2.048	0.071	0.263		0.340	0.739
Netherlands	1.716	1.223		1.883	0.138	0.182		0.160	0.739
Singapore	1.495	0.589		2.032	0.039	0.331		0.289	0.739
South Africa	1.025	1.373		1.962	0.038	0.183		0.988	0.739
Sweden	1.191	1.504		1.973	0.051	0.155		0.126	0.739
Switzerland	1.130	0.724		2.025	0.037	0.211		0.102	0.739
Tanzania	0.492	0.942		2.038	0.052	0.441		0.099	0.739
United Kingdom	0.816	1.439		1.889	0.061	0.202		0.207	0.739
United States	1.496	1.010		1.970	0.034	0.311		0.181	0.739

The variable GDP_d is common to all models; consequently, the results are only reported under the model for Belgium to avoid repetition. "CV 1%" refers to the critical value at the significance level of 1%.

The results of the unit root test are shown in Table 3.6. The results at the levels of the variables show that TB_{it} does not have a unit root in the three unit root tests. This is reflected in p-values less than 0.01 for the LLC and IPS unit root tests and a CIPS test statistic of -2.488, which is greater than -2.40 in absolute terms. This implies that TB_{it} is stationary at the level of significance of 1% for all types of tests. The results also show that RER_{it}^{-}[28] is stationary based on the LLC and IPS unit root tests, but not the CIPS unit root test. In the first difference of the variables, the results suggest rejection of the null hypothesis of unit root for all variables and for all types of tests. All variables have p-values less than 0.01 under the LLC and IPS unit root tests and test statistics greater than -2.40 in absolute terms under the CIPS unit root test. Therefore, all variables are stationary at the 1% significance level.

Table 3.6: Panel Unit Root Test Results for the Sample

Variables	Level			First difference		
	LLC	IPS	CIPS	LLC	IPS	CIPS
TB_{it}	0.000***	0.001***	-2.488***	0.000***	0.000***	–4.470***
RER_{it}^{+}	1.000	0.982	-1.954	0.000***	0.000***	-3.877***
RER_{it}^{-}	0.000***	0.090*	-1.790	0.000***	0.000***	-3.464***
GDP_{it}	0.000***	1.000	-1.235	0.000***	0.000***	-3.295***

The figures under LLC and IPS are p-values while those under CIPS are test statistics. The critical values of CIPS are -2.10, -2.21, and -2.40 at the 10%, 5%, and 1% levels of significance, respectively. The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

The results of the unit root tests confirm that the non-linear PARDL model is appropriate for estimating the relationship between the exchange rate and the trade balance. This is because the variables have different orders of integration. TB_{it} is integrated on order zero, while the rest of the variables are integrated on order 1[29].

[28] The exchange rate variable is split into two separate variables, one reflecting currency depreciation (RER_{it}^{+}) and the other appreciation (RER_{it}^{-}) based on Equation 3.25 and Equation 3.26 presented in subsection 3.3.2.

[29] Pesaran et al. (2001) showed that the Autoregressive Distributed Lag (ARDL) model does not require that all variables be integrated of the same order for the estimation of the cointegration relationship between the variables; some variables can be integrated of order zero, while others of order 1.

3.5 Empirical Estimation and Analysis

Empirical estimations involve the LVSTR model and the non-linear PARDL model. Estimations are first conducted with the LVSTR model and then the non-linear PARDL model. As indicated earlier, the estimation of the LVSTR model is carried out on each of the 17 trading partners of Zambia, while the non-linear PARDL model is estimated on the sample of 17 trading partners. The published R code by Bucci et al. (2022) is used to estimate the LVSTR model.

3.5.1 LVSTR Model Estimation

3.5.1.1 Optimal Lag Length

Before estimating the LVSTR model, the optimal lag length is determined for each of the models. There are seventeen models altogether, each representing a trading partner. Following Caggiano et al. (2020), the optimal lag length is determined from the linear Vector Autoregressive (VAR) model using the Akaike Information Criterion (AIC). The optimal number of lags for each of the models is presented in Table 3.7. As observed, the recommended number of lags is three for 5 models and four for the rest of the models.

Table 3.7: Lag selection

No.	Model	AIC
1	Belgium	4
2	China	4
3	Germany	3
4	Hong Kong	3
5	India	4
6	Japan	3
7	Kenya	4
8	Malawi	4
9	Mauritius	3
10	Netherlands	4
11	Singapore	4
12	South Africa	3
13	Sweden	4
14	Switzerland	4
15	Tanzania	4
16	UK	4
17	USA	4

3.5.1.2 Linearity Tests

Linearity tests are conducted, and these tests are critical. First, these tests facilitate the determination of whether the estimation of the LVSTR model has empirical support. Secondly and importantly, these tests indicate the possible non-linearity between the trade balance and its determinants induced by the exchange rate. Therefore, the outcome of these linearity tests provides some preliminary responses to the first research question regarding whether evidence of non-linearity exists.

The exchange rate with a one-period lag (i.e. ΔRER_{t-1}) is the threshold variable in all three equations of the system[30]. A joint linearity test is conducted since the exchange rate variable is the threshold variable in all equations. The linearity tests establish whether increases (i.e., real currency depreciation) and decreases (i.e., currency appreciations) induce a different behavioural relationship of the endogenous variables with their lags and exogenous variables.

[30]The model has three endogenous variables, trade balance, real exchange rate and real domestic income, hence three equations. Real foreign income is an exogenous variable in the model.

The linearity test involves the null hypothesis favouring the linear model (i.e., the VAR model) and the alternative hypothesis that indicates that the LVSTR model best fits the data. The null hypothesis is rejected if the test statistic is greater than the critical value; otherwise, it cannot be rejected. The results of the linearity tests on all models are presented in Table 3.8. The results show that the test statistics are greater than the critical value in all models and suggest that the null hypothesis should be rejected. In line with this and based on the p-values, the null hypothesis supporting the linear model is rejected at the significance level of 1%. These results potentially suggest the presence of exchange rate-induced non-linearity between the trade balance and its determinants.

Table 3.8: Joint Linearity Test Results

Model	LM Statistic	Critical value	P value
Belgium	285	26.1	0.0000
China	297	26.1	0.0000
Germany	51.4	26.1	0.0000
Hong Kong	282	26.1	0.0000
India	296	26.1	0.0000
Japan	279	26.1	0.0000
Kenya	59.8	26.1	0.0000
Malawi	32.9	26.1	0.0030
Mauritius	277	26.1	0.0000
Netherlands	60	26.1	0.0000
Singapore	292	26.1	0.0000
South Africa	56.2	26.1	0.0000
Sweden	292	26.1	0.0000
Switzerland	49.5	26.1	0.0000
Tanzania	288	26.1	0.0000
UK	57.7	26.1	0.0000
USA	271	26.1	0.0000

3.5.1.3 LVSTR estimation output

Following the favourable results of the linearity test above, the LVSTR model with two regimes based on Equation 3.13 is estimated for the 17 models. While ΔRER_{t-1} is the threshold variable in all equations, the LVSTR model provides that each equation has its transition function and, therefore, its own threshold and slope parameters. The estimation results of the model are presented in Table 3.9, Table 3.10, Table 3.11, Table 3.12, Table 3.13, and

Table 3.14. It should be noted that only the results for the trade balance equation are reported, given their relevance to the research objectives.

The estimation results for all models are reviewed first based on the estimates of the threshold and slope parameters. The results show that the threshold parameter, a point that distinguishes the regimes, differs between models. Ideally, this point should be close to zero as a divide of depreciation and appreciation of the currency. This is because values below the threshold reflect currency appreciation, while values above the threshold represent currency depreciation. Generally, the results show that the threshold parameter is close to zero for all models except Malawi and Singapore with thresholds of -0.854 and -0.918, respectively. With respect to the slope parameter, γ, which represents the speed of transitions between regimes, the results show that its estimates in all models are greater than zero. The results further indicate that the USA model has the highest slope parameter at 914.9, suggesting that the changes between regimes are abrupt. However, it is shown that the South African model has the lowest slope parameter at 5.1, implying gradual and smooth transitions between regimes. These results suggest that changes in the Zambian trade balance with the United States are more sensitive to exchange rate changes than that with South Africa.

The estimation results of the LVSTR model are reviewed for each of the 17 models with respect to the regression coefficients. The review aims to uncover the responses of the trade balance to the exchange rate in a regime-switching environment influenced by the exchange rate. This is important for generating responses to the research question of whether there is evidence of the J-curve. As highlighted earlier, the J-curve depicts the response of the trade balance to currency depreciation, in which it initially worsens before starting to improve. According to Bahmani-Oskooee (1985), evidence of the J-curve is captured from the estimation output of a model based on the effect of the exchange rate at lower and higher lags. The effect is expected to be significant and negative at lower lags, while at higher lags it is expected to be significant and positive. In the context of the estimation output of the LVSTR model, there are two regimes: the lower regime reflecting currency appreciation and the higher regime representing depreciation. The regression coefficients on each model are presented in two columns, the first column labelled 'Linear' capturing the linear coefficients and the second column 'Non-linear' representing the non-linear coefficients. It should be noted that linear coefficients represent the lower regime, while the combination of linear and non-linear ones represent the higher regime. The impact of currency depreciation on the trade balance is captured from the perspective of the higher regime of the LVSTR model.

Table 3.9: LVSTR Model estimation output - Belgium, China and Germany

$$y_t = \alpha_1 + \sum_{j=1}^{k} \varphi_{1j} y_{t-j} + \psi_1 x_t + G_t(\gamma, c : s_t)[\alpha_2 + \sum_{j=1}^{k} \varphi_{2j} y_{t-j} + \psi_2 x_t] + \epsilon_t$$

Parameters	**Belgium**		**China**		**Germany**	
	Linear	Non-linear	Linear	Non-linear	Linear	Non-linear
$Constant$	1.666***	-0.247	37.985***	-42.071***	0.293**	-0.038
	(0.264)	(0.264)	(0.127)	(0.127)	(0.139)	(0.139)
ΔTB_{t-1}	-0.872***	-0.542***	0.560***	-2.433***	-1.142***	-0.502***
	(0.060)	(0.060)	(0.058)	(0.058)	(0.061)	(0.061)
ΔRER_{t-1}	14.113***	2.306	135.643***	122.319***	-0.058	2.473**
	(2.166)	(2.166)	(2.953)	(2.953)	(1.164)	(1.164)
ΔGDP^d_{t-1}	21.029	39.788	-0.513***	-0.999***	-35.819	-69.152
	(159.493)	(159.493)	(0.001)	(0.001)	(109.046)	(109.046)
ΔTB_{t-2}	-0.482***	-0.465***	0.352***	-1.971***	-0.521***	-0.241***
	(0.069)	(0.069)	(0.072)	(0.072)	(0.068)	(0.068)
ΔRER_{t-2}	8.800***	4.368**	-39.880***	34.420***	-1.526	-0.527
	(2.175)	(2.175)	(2.985)	(2.985)	(1.144)	(1.144)
ΔGDP^d_{t-2}	22.285	42.865	-0.930***	-1.699***	-35.888	-69.398
	(160.365)	(160.365)	(0.001)	(0.001)	(108.685)	(108.685)
ΔTB_{t-3}	-0.659***	-0.267***	0.829***	-1.869***	0.071	-0.200***
	(0.068)	(0.068)	(0.073)	(0.073)	(0.061)	(0.061)
ΔRER_{t-3}	2.312	3.192	20.362***	-13.468***	-4.562***	2.529**
	(2.186)	(2.186)	(2.811)	(2.811)	(1.130)	(1.130)
ΔGDP^d_{t-3}	22.176	42.645	-0.475***	-0.982***	-35.308	-68.71
	(158.156)	(158.156)	(0.001)	(0.001)	(106.447)	(106.447)
ΔTB_{t-4}	-0.187***	-0.278***	-0.471***	-0.068		
	(0.059)	(0.059)	(0.058)	(0.058)		
ΔRER_{t-4}	2.516	1.134	-23.178***	24.279***		
	(2.165)	(2.165)	(2.786)	(2.786)		
ΔGDP^d_{t-4}	21.455	41.357	-1.110***	-1.822***		
	(153.168)	(153.168)	(0.001)	(0.001)		
ΔGDP^f_t	-2.092	-4.083	0.147***	0.143***	139.412	273.322
	(16.136)	(16.136)	(0.001)	(0.001)	(216.790)	(216.790)
γ	100.000		7.030		100.000	
c	-0.044		0.014		-0.047	
AIC	535.040		634.090		208.500	
BIC	633.070		732.120		285.610	
LL	-239.520		-289.040		-82.250	

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

The regression coefficients are now reviewed, starting with Table 3.9. The effect of the regressors is explained in terms of the signs that the coefficients carry, and not in the context of elasticity. The results for Belgium show that the linear coefficient of the exchange rate at the first lag is significant and positive. This implies that the exchange rate in the lower regime, which reflects currency appreciation, significantly and favourably affects the trade balance. On the other hand, the exchange rate's non-linear coefficient is insignificant. This implies that the effect of the exchange rate in the higher regime is insignificant. This further implies that currency depreciation does not affect the Zambian trade balance with Belgium. At the second lag, the exchange rate's linear and non-linear coefficients carry significant and positive signs. This implies that the exchange rate favourably influences the trade balance in the lower and higher regimes. At the remaining lags, three and four, the exchange rate's linear and non-linear coefficients are insignificant. This implies that the exchange rate does not affect the trade balance when it is appreciating and depreciating with these lags. Therefore, the effect of the exchange rate is insignificant in the lower and higher regimes. Based on the second lag of the exchange rate, which is significant in both regimes, the results suggest that currency depreciation improves trade balance. However, this influence of the exchange rate does not reflect the pattern of the J-curve in which the lower lags reflect a worsening of the trade balance, and the higher lags an improvement in the trade balance.

Moving to China, the results show that the linear and non-linear coefficients of the exchange rate at the first lag are both positive and significant in the lower and higher regimes. At the second lag, the linear exchange rate coefficient is significantly negative, while the non-linear coefficient is significantly positive. This result implies that the exchange rate negatively affects the trade balance in the lower regime, the period of currency appreciation. Considering both the linear and non-linear coefficients in the higher regime, the results show that the exchange rate effect on the trade balance moves towards a positive sign. At the third lag, the exchange rate effect is significantly positive in the lower regime but moves towards a negative effect in the higher regime. In its fourth lag, the exchange rate significantly affects the trade balance in both regimes. It negatively affects the trade balance in the lower regime, and the effects turn positive in the higher regime. The results for the higher regime, representing currency depreciation, show a pattern in which the trade balance initially improves, then appears to worsen, and then improves. This pattern is not consistent with the J-curve.

In the case of Germany, the exchange rate, in its first lag, exhibits an insignificant effect in both the lower and higher regimes. The non-linear exchange rate coefficient is positive and significant, suggesting that currency depreciation improves the trade balance. However, the influence of the exchange rate in the higher regime is considered insignificant because of the insignificant linear coefficient. At the second lag, the effect of the exchange rate on the trade balance is insignificant for both regimes. The effect of the exchange rate on the third lag is significant in both regimes. In the lower regime, the exchange rate affects the trade balance negatively, while in the higher regime, its effect moves towards a positive sign. The influence of the exchange rate on the trade balance in the higher regime depicted by these results with currency depreciation exhibiting an influence on the trade balance that is insignificant in the first two lags and then a significant favourable influence in the third lag does not fully support the presence of the J-curve.

With respect to the estimation results in Table 3.10, the results in the case of Hong Kong show that the impact of the exchange rate in its first lag is insignificant in both the lower and the higher regimes. At its second lag, the impact of the exchange rate on the trade balance is significant in both regimes, but different. It affects the trade balance positively in the lower regime and negatively in the higher regime. The effect of the exchange rate on the third lag is insignificant in both regimes. Based on these estimation results, in which the currency depreciation effect is only significant in the second lag and affects the trade balance in a negative way, there is no sufficient support for the J-curve.

The estimation results for India show that the exchange rate in its first lag impacts the trade balance significantly and negatively in both regimes. At the second lag, the effect of the exchange rate is significant and affects the trade balance negatively in the lower regime but positively in the higher regime. At the third and fourth lag, the exchange rate effect is insignificant in both regimes. The non-linear coefficient, however, is significant and exhibits a positive influence at the third lag and a negative influence at the fourth lag. Based on lags one and two that are significant in both regimes, these results show that the trade balance in the high regime initially deteriorates and later improves, consistent with the J-curve pattern. For Japan, the results show that the effect of the exchange rate on its first lag is negative and insignificant in both the lower and higher regimes. In subsequent lags, the exchange rate is only significant in the lower regime and negatively affects the trade balance. These results do not provide evidence in favour of the J-curve.

Table 3.10: LVSTR Model estimation output - Hong Kong, India and Japan

$$y_t = \alpha_1 + \sum_{j=1}^{k} \varphi_{1j} y_{t-j} + \psi_1 x_t + G_t(\gamma, c : s_t)[\alpha_2 + \sum_{j=1}^{k} \varphi_{2j} y_{t-j} + \psi_2 x_t] + \epsilon_t$$

Parameters	**Hong Kong**		**India**		**Japan**	
	Linear	Non-linear	Linear	Non-linear	Linear	Non-linear
Constant	-0.038	0.23	-0.567***	0.986***	-2.998***	0.305*
	(0.178)	(0.178)	(0.181)	(0.181)	(0.153)	(0.153)
ΔTB_{t-1}	-0.865***	-0.256***	-0.249***	-1.219***	0.514***	-0.700***
	(0.060)	(0.060)	(0.059)	(0.059)	(0.058)	(0.058)
ΔRER_{t-1}	0.104	-1.491	-7.708***	-3.832***	-4.538	-6.275*
	(1.782)	(1.782)	(1.444)	(1.444)	(2.900)	(2.900)
ΔGDP^d_{t-1}	-26.229	-36.171	-16.927	-22.936	0.031***	0.052***
	(100.957)	(100.957)	(98.091)	(98.091)	(0.001)	(0.001)
ΔTB_{t-2}	-0.460***	-0.182***	-0.137**	-1.013***	1.229***	-0.537***
	(0.070)	(0.070)	(0.065)	(0.065)	(0.064)	(0.064)
ΔRER_{t-2}	4.711***	-3.601**	-6.511***	11.668***	-6.355*	-3.586
	(1.786)	(1.786)	(1.455)	(1.455)	(2.924)	(2.924)
ΔGDP^d_{t-2}	-27.077	-39.726	-16.642	-22.712	0.030***	0.050***
	(100.253)	(100.253)	(98.038)	(98.038)	(0.001)	(0.001)
ΔTB_{t-3}	-0.291***	-0.082	0.268***	-1.326***	1.114***	-0.420***
	(0.061)	(0.061)	(0.065)	(0.065)	(0.058)	(0.058)
ΔRER_{t-3}	0.33	-1.585	1.785	5.243***	-12.764***	2.851
	(1.765)	(1.765)	(1.449)	(1.449)	(2.883)	(2.883)
ΔGDP^d_{t-3}	-25.67	-35.848	-16.821	-22.907	0.050***	0.068***
	(98.248)	(98.248)	(96.610)	(96.610)	(0.001)	(0.001)
ΔTB_{t-4}			0.260***	-0.914***		
			(0.059)	(0.059)		
ΔRER_{t-4}			2.143	-19.445***		
			(1.435)	(1.435)		
ΔGDP^d_{t-4}			-16.261	-22.1		
			(94.395)	(94.395)		
ΔGDP^f_t	-47.088	-69.444	-6.807	-9.186	-0.043***	-0.091***
	(188.116)	(188.116)	(43.077)	(43.077)	(0.003)	(0.003)
γ	159.497		21.165		45.083	
c	0.006		0.036		-0.070	
AIC	410.070		314.970		718.510	
BIC	487.180		413.000		795.630	
LL	-183.030		-129.480		-337.260	

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

Table 3.11: LVSTR Model estimation output - Kenya, Malawi, and Mauritius

$$y_t = \alpha_1 + \sum_{j=1}^{k} \varphi_{1j} y_{t-j} + \psi_1 x_t + G_t(\gamma, c : s_t)[\alpha_2 + \sum_{j=1}^{k} \varphi_{2j} y_{t-j} + \psi_2 x_t] + \epsilon_t$$

Parameters	**Kenya**		**Malawi**		**Mauritius**	
	Linear	Non-linear	Linear	Non-linear	Linear	Non-linear
Constant	-0.178	0.04	-0.058	-0.116	-0.277	0.439
	(0.116)	(0.116)	(0.153)	(0.153)	(0.300)	(0.300)
ΔTB_{t-1}	-0.670***	-0.594***	-0.297***	-0.594***	-0.450***	0.098
	(0.059)	(0.059)	(0.063)	(0.063)	(0.062)	(0.062)
ΔRER_{t-1}	-1.883**	-0.700	-0.822	-1.644*	-17.119***	-7.575
	(0.911)	(0.911)	(0.914)	(0.914)	(6.595)	(6.595)
ΔGDP^d_{t-1}	-47.596	-93.388	11.014	22.027	-0.015***	-0.039***
	(66.900)	(66.900)	(95.258)	(95.258)	(0.002)	(0.002)
ΔTB_{t-2}	-1.094***	-0.135*	-0.181**	-0.362***	-0.309***	0.158**
	(0.070)	(0.070)	(0.072)	(0.072)	(0.064)	(0.064)
ΔRER_{t-2}	2.999***	0.013	0.587	1.174	-15.732**	2.54
	(0.916)	(0.916)	(0.930)	(0.930)	(6.619)	(6.619)
ΔGDP^d_{t-2}	-47.27	-93.507	11.566	23.132	-0.016***	-0.041***
	(66.465)	(66.465)	(95.216)	(95.216)	(0.003)	(0.003)
ΔTB_{t-3}	-0.906***	0.012	-0.123*	-0.246***	-0.167***	0.195***
	(0.070)	(0.070)	(0.071)	(0.071)	(0.061)	(0.061)
ΔRER_{t-3}	-2.170**	0.868	-0.697	-1.394	11.172*	5.893
	(0.918)	(0.918)	(0.931)	(0.931)	(6.624)	(6.624)
ΔGDP^d_{t-3}	-44.832	-88.569	12.85	25.699	-0.008**	-0.023***
	(65.526)	(65.526)	(92.317)	(92.317)	(0.003)	(0.003)
ΔTB_{t-4}	-0.379***	-0.095	-0.054	-0.109*		
	(0.060)	(0.060)	(0.061)	(0.061)		
ΔRER_{t-4}	-1.31	-1.055	1.143	2.286**		
	(0.899)	(0.899)	(0.919)	(0.919)		
ΔGDP^d_{t-4}	-41.899	-83.068	13.354	26.708		
	(63.433)	(63.433)	(88.840)	(88.840)		
ΔGDP^f_t	226.533	441.996**	101.797	203.595	-0.015***	-0.017***
	(205.354)	(205.354)	(220.512)	(220.512)	(0.003)	(0.003)
γ	100.000		60.013		206.334	
c	-0.043		-0.854		0.034	
AIC	95.450		254.040		1,051.260	
BIC	193.480		352.080		1,128.370	
LL	-19.720		-99.020		-503.630	

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

The estimation results in Table 3.11 for Kenya, Malawi and Mauritius are reviewed. For Kenya, the results show that the effect of the exchange rate is only significant in lags 1 to 3 in the lower regime and affects the trade balance negatively at lag 1, positively at lag 2, and negatively at lag 3. At lag 4, the effect of the exchange rate is insignificant in both regimes. These results do not present any lag in which the effect of the exchange rate is significant in both the lower and higher regimes. In view of this, the impact of currency depreciation on the trade balance is insignificant, and as such, there is no support for the J-curve. In the case of Malawi, the effect of the exchange rate in all lags is insignificant in all regimes. However, it should be noted that the non-linear coefficients at the first and fourth lags are significant. In the first lag, the sign is negative, suggesting deterioration in the trade balance, and in the fourth lag, it is positive, indicating improvement in the trade balance. These results do not suggest the presence of the J-curve, as the associated linear coefficients are insignificant. For Mauritius, the exchange rate is significant only in the lower regimes and affects the trade balance negatively in the first and second lags and positively in the third lag. These results do not align with the evidence of the J-curve.

The results of the Netherlands, Singapore, and South Africa in Table 3.12 are reviewed. For the Netherlands, the exchange rate at its first and second lag has an insignificant effect on the trade balance in the lower and higher regimes. However, at its third and fourth lags, the exchange rate is significant in both regimes. At the third lag, the exchange rate negatively affects the trade balance in the lower regime, but positively impacts it in the higher regime. The effect of the exchange rate reverses at the fourth lag, with the trade balance positively impacted in the lower regime and negatively in the higher regime. Based on the lags 3 and 4 that are significant in both regimes, these results show a pattern in the higher regime in which the trade balance in response to currency depreciation improves and then deteriorates. This pattern is inconsistent with the J-curve. For Singapore, the effect of the exchange rate on all lags is insignificant in both regimes, although the non-linear coefficients are significant at lags 3 and 4. Given that the impact of the exchange is insignificant, there is no support for the J-curve. With respect to South Africa, the exchange rate in its first lag is significant and negative in both regimes. At the second and third lag, the exchange rate effect in the lower regimes is negative, whereas in the higher regimes, it is positive. These results, depicting an initial negative influence on the trade balance of the exchange rate in the higher regime and a subsequent positive influence, suggest the presence of the J-curve. However, this evidence is given less emphasis due to the unfavourable KPSS unit root test results.

Table 3.12: LVSTR Model estimation output - Netherlands, Singapore and South Africa

$$y_t = \alpha_1 + \sum_{j=1}^{k} \varphi_{1j} y_{t-j} + \psi_1 x_t + G_t(\gamma, c : s_t)[\alpha_2 + \sum_{j=1}^{k} \varphi_{2j} y_{t-j} + \psi_2 x_t] + \epsilon_t$$

Parameters	**Netherlands**		**Singapore**		**South Africa**	
	Linear	Non-linear	Linear	Non-linear	Linear	Non-linear
Constant	0.202	-0.306**	0.058	0.116	-3.725***	9.351***
	(0.132)	(0.132)	(0.313)	(0.313)	(0.061)	(0.061)
ΔTB_{t-1}	-0.496***	-0.550***	-0.348***	-0.697***	-1.015***	0.353***
	(0.061)	(0.061)	(0.063)	(0.063)	(0.062)	(0.062)
ΔRER_{t-1}	1.334	0.153	-2.467	-4.933	-8.624***	-22.095***
	(1.005)	(1.005)	(7.003)	(7.003)	(0.464)	(0.464)
ΔGDP^d_{t-1}	9.874	6.232	0.002	0.004*	-5.530	-7.117
	(73.404)	(73.404)	(0.003)	(0.003)	(49.384)	(49.384)
ΔTB_{t-2}	0.024	-0.526***	-0.235***	-0.470***	-0.338***	-0.313***
	(0.068)	(0.068)	(0.076)	(0.076)	(0.070)	(0.070)
ΔRER_{t-2}	1.245	-2.418**	0.182	0.364	-3.800***	8.712***
	(0.997)	(0.997)	(7.053)	(7.053)	(0.459)	(0.459)
ΔGDP^d_{t-2}	14.412	15.132	0.000	0.000	-5.266	-6.815
	(75.611)	(75.611)	(0.002)	(0.002)	(49.020)	(49.020)
ΔTB_{t-3}	0.134**	-0.451***	-0.116	-0.232***	-0.560***	0.852***
	(0.068)	(0.068)	(0.075)	(0.075)	(0.061)	(0.061)
ΔRER_{t-3}	-2.434**	2.749***	7.624	15.249**	-2.161***	6.555***
	(0.993)	(0.993)	(7.013)	(7.013)	(0.455)	(0.455)
ΔGDP^d_{t-3}	10.514	7.824	-0.001	-0.002	-5.390	-6.981
	(73.773)	(73.773)	(0.002)	(0.002)	(48.154)	(48.154)
ΔTB_{t-4}	-0.177***	-0.214***	0.002	0.004		
	(0.060)	(0.060)	(0.062)	(0.062)		
ΔRER_{t-4}	7.957***	-6.145***	-8.299	-16.597**		
	(0.985)	(0.985)	(6.976)	(6.976)		
ΔGDP^d_{t-4}	13.398	12.759	0.002	0.004		
	(71.527)	(71.527)	(0.003)	(0.003)		
ΔGDP^f_t	373.106	649.022**	0.006	0.012	2.256	3.124
	(267.884)	(267.884)	(0.012)	(0.012)	(149.970)	(149.970)
γ	16.603		52.918		5.147	
c	-0.023		-0.918		0.179	
AIC	148.650		1,078.690		-196.350	
BIC	246.680		1,176.730		-119.240	
LL	-46.320		-511.350		120.180	

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

The results in Table 3.13 for Sweden, Switzerland, and Tanzania are next in line for review. For Sweden, the effect of the exchange rate on its first lag is positive in both the lower and higher regimes. In the second lag, the impact of the exchange rate is only significant in the lower regime in which it exhibits a negative influence on the trade balance. At the third lag, the impact of the exchange rate is insignificant in both regimes. However, the effect of the exchange rate is significant in the fourth lag. It affects the trade balance positively in the lower regime and negatively in the regime. Based on the significant lags in both regimes (i.e., lags 1 and 4), the results in the higher regime, in which the trade balance is affected positively in the initial lag and negatively in the fourth lag, suggest no support of the J-curve. In Switzerland's case, the impact of the exchange rate in its first lag is significant and positive in both the lower and higher regimes. In the second lag, the impact of the exchange rate is insignificant in both regimes. However, the effect of the exchange rate at the third lag is significant, with the exchange rate exhibiting a negative effect in the lower regime and a positive effect in the higher regime. At the fourth lag, the impact of the exchange rate is insignificant. Based on the significant lags in both regimes (i.e., lags 1 and 3), the trade balance in the higher regime is positively affected in all lags, reflecting a pattern inconsistent with the J-curve. For Tanzania, the effect of the exchange rate is significant in both regimes only for the first lag. In the higher regime, the results suggest that currency depreciation improves trade balance. This does not align with the short-run J-curve pattern.

The UK and USA estimation results in Table 3.14 are reviewed. For the UK, the effect of the exchange rate is insignificant in all lags in all regimes, except for the third lag, in which the trade balance is affected positively in the lower regime and negatively in the higher regime. Based on the third lag that is significant in both regimes, the higher regime depicts a deterioration of the trade balance. However, this does not constitute sufficient support for the J-curve. The estimation results for the USA show a significant effect of the exchange rate at its first lag in both regimes. In subsequent lags, the effect of the exchange rate is significant only in lower regimes in which the trade balance is positively affected. Based on the first lag that is significant in both regimes, these results show that the trade balance initially deteriorates in response to currency depreciation. This outcome is consistent with the short-run J-curve, but long-run support for the J-curve is not available.

Table 3.13: LVSTR Model estimation output - Sweden, Switzerland and Tanzania

$$y_t = \alpha_1 + \sum_{j=1}^{k} \varphi_{1j} y_{t-j} + \psi_1 x_t + G_t(\gamma, c : s_t)[\alpha_2 + \sum_{j=1}^{k} \varphi_{2j} y_{t-j} + \psi_2 x_t] + \epsilon_t$$

Parameters	**Sweden**		**Switzerland**		**Tanzania**	
	Linear	Non-linear	Linear	Non-linear	Linear	Non-linear
Constant	5.331***	-0.389	5.281***	-4.600***	0.526**	-0.304
	(0.321)	(0.321)	(0.129)	(0.129)	(0.238)	(0.238)
ΔTB_{t-1}	-0.598***	-0.919***	0.451***	-1.384***	-0.332***	-0.922***
	(0.059)	(0.059)	(0.060)	(0.060)	(0.059)	(0.059)
ΔRER_{t-1}	61.630***	11.765*	16.254***	17.275***	5.134**	4.015**
	(6.760)	(6.760)	(1.016)	(1.016)	(1.986)	(1.986)
ΔGDP^d_{t-1}	0.057***	0.101***	11.591	14.21	-104.629	-156.236
	(0.002)	(0.002)	(75.719)	(75.719)	(143.077)	(143.077)
ΔTB_{t-2}	-0.386***	-0.692***	0.178**	-0.915***	-0.447***	-0.337***
	(0.073)	(0.073)	(0.067)	(0.067)	(0.066)	(0.066)
ΔRER_{t-2}	-24.709***	-8.661	-1.645	4.039***	-0.014	3.971**
	(6.831)	(6.831)	(1.000)	(1.000)	(2.007)	(2.007)
ΔGDP^d_{t-2}	-0.029***	-0.007***	23.383	33.047	-107.789	-166.872
	(0.002)	(0.002)	(75.226)	(75.226)	(143.194)	(143.194)
ΔTB_{t-3}	-0.718***	-0.531***	0.355***	-0.881***	-0.624***	-0.005
	(0.073)	(0.073)	(0.067)	(0.067)	(0.066)	(0.066)
ΔRER_{t-3}	0.643	-2.455	-3.904***	4.694***	2.277	-12.304***
	(6.873)	(6.873)	(1.000)	(1.000)	(2.004)	(2.004)
ΔGDP^d_{t-3}	0.113***	0.158***	11.100	13.548	-103.876	-156.861
	(0.003)	(0.003)	(74.454)	(74.454)	(140.551)	(140.551)
ΔTB_{t-4}	-0.375***	-0.288***	0.734***	-1.033***	-0.080	-0.309***
	(0.059)	(0.059)	(0.060)	(0.060)	(0.059)	(0.059)
ΔRER_{t-4}	17.540**	-14.464*	0.518	-5.569***	-1.180	10.810***
	(6.754)	(6.754)	(0.994)	(0.994)	(1.975)	(1.975)
ΔGDP^d_{t-4}	0.038***	0.075***	25.159	35.713	-98.482	-144.995
	(0.003)	(0.003)	(72.381)	(72.381)	(137.271)	(137.271)
ΔGDP^f_t	-0.085***	-0.044***	282.777	448.876	-2.880	-2.230
	(0.006)	(0.006)	(285.422)	(285.422)	(2.212)	(2.212)
γ	150.874		7.356		100.000	
c	-0.049		-0.023		0.003	
AIC	1,087.670		163.700		479.400	
BIC	1,185.700		261.740		577.440	
LL	-515.830		-53.850		-211.700	

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

Table 3.14: LVSTR Model estimation output - UK and USA

$$y_t = \alpha_1 + \sum_{j=1}^{k} \varphi_{1j} y_{t-j} + \psi_1 x_t + G_t(\gamma, c : s_t)[\alpha_2 + \sum_{j=1}^{k} \varphi_{2j} y_{t-j} + \psi_2 x_t] + \epsilon_t$$

Parameters	**UK**		**USA**	
	Linear	Non-linear	Linear	Non-linear
Constant	-0.152	-0.254*	1.136***	0.077
	(0.140)	(0.140)	(0.166)	(0.166)
ΔTB_{t-1}	-0.418***	-0.322***	-1.091***	-0.529***
	(0.063)	(0.063)	(0.062)	(0.062)
ΔRER_{t-1}	-1.215	4.900***	11.329***	-2.755*
	(1.056)	(1.056)	(1.451)	(1.451)
ΔGDP^d_{t-1}	87.384	100.254	-27.191	-53.244
	(79.137)	(79.137)	(102.151)	(102.151)
ΔTB_{t-2}	-0.299***	-0.821***	-1.680***	-0.320***
	(0.068)	(0.068)	(0.068)	(0.068)
ΔRER_{t-2}	0.961	7.497***	14.468***	-0.829
	(1.058)	(1.058)	(1.467)	(1.467)
ΔGDP^d_{t-2}	76.053	86.852	-28.748	-56.770
	(79.411)	(79.411)	(102.282)	(102.282)
ΔTB_{t-3}	-0.071	-0.757***	-1.072***	-0.285***
	(0.068)	(0.068)	(0.068)	(0.068)
ΔRER_{t-3}	1.940*	-16.745***	4.057***	0.333
	(1.055)	(1.055)	(1.462)	(1.462)
ΔGDP^d_{t-3}	89.360	101.782	-28.335	-55.994
	(77.514)	(77.514)	(100.718)	(100.718)
ΔTB_{t-4}	-0.073	-0.377***	-0.348***	-0.118*
	(0.064)	(0.064)	(0.062)	(0.062)
ΔRER_{t-4}	-1.563	16.071***	2.832*	1.610
	(1.047)	(1.047)	(1.448)	(1.448)
ΔGDP^d_{t-4}	89.166	101.413	-27.867	-55.153
	(75.203)	(75.203)	(97.820)	(97.820)
ΔGDP^f_t	-348.865	-426.779	5.789	11.490
	(273.529)	(273.529)	(20.946)	(20.946)
γ	39.999		914.918	
c	0.069		-0.039	
AIC	176.240		313.210	
BIC	274.280		411.240	
LL	-60.120		-128.600	

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively.

Based on the estimation outputs of the LVSTR model reviewed above, the plots of the logistic function of the trade balance equation for each of the 17 models are presented in Figure 3.4, together with diagnostic information. For each of the models, there are four panels. According to Bucci et al. (2022), the first one presents the observed and fitted time series of the trade balance[31]

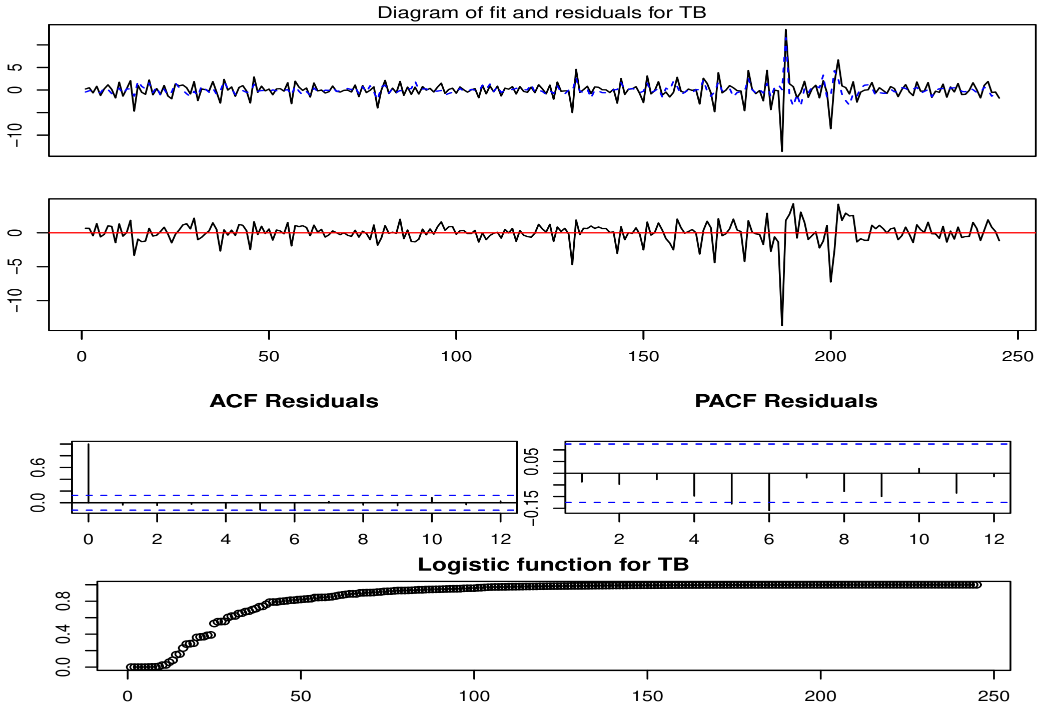
[31] The trade balance is defined as $ln(X_t/M_t)$.

with the observed series in black and the fitted in blue. The second panel captures the movements of the residuals around zero, as reflected by the red line. The third panel presents the autocorrelation function and the partial autocorrelation of residuals. The final and fourth panel, which is of interest in this chapter, shows the logistic function of the trade balance equation. The logistic function reflects the shifts between the lower and higher regimes. This enables the determination of further support relating to the presence of non-linearity between the trade balance and its determinants.

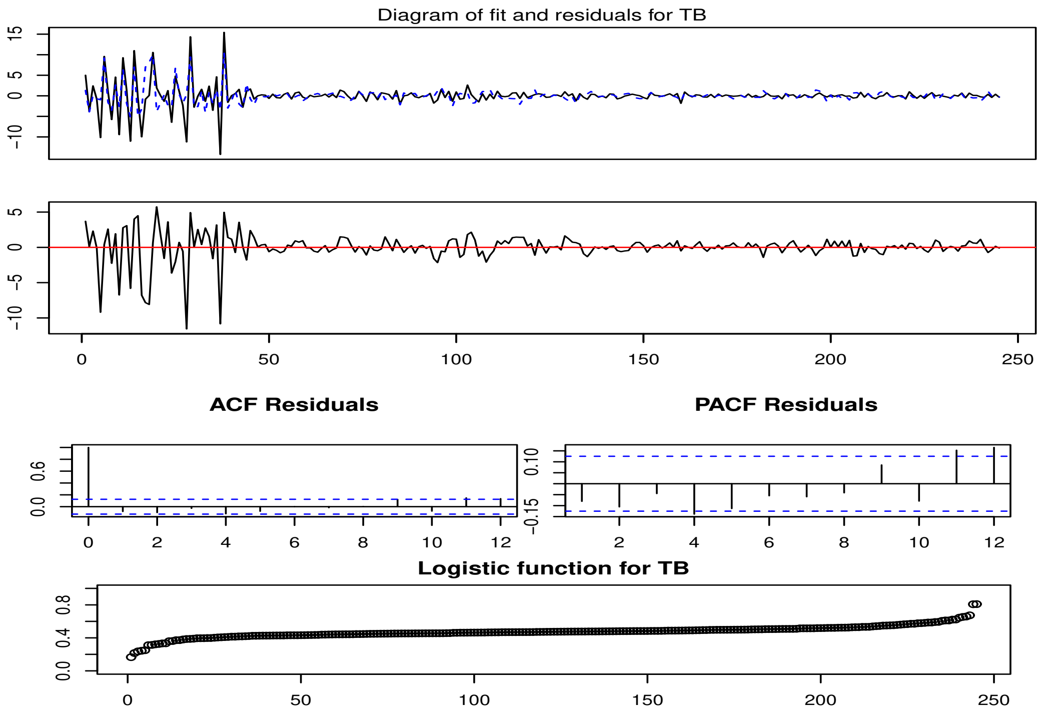
A review of the logistic function of the trade balance equation shows switches between regimes in all models except for two, Malawi and Singapore. The situation for the Malawi and Singapore models appears to be in line with the results of the LVSTR model, in which the threshold parameters of these two models were found to be further away from zero. Furthermore, the effect of the exchange rate on the trade balance in the lower and higher regimes was found to be insignificant. The review of the plots further shows that the plot for the USA model shows sharp switches, which is also consistent with the earlier finding of a larger slope parameter. The plot for South Africa is smooth, reflecting gradual switches between regimes and a low slope parameter reported in the LVSTR estimation output. The transition between regimes reflected in the 15 models provides further evidence of the non-linearity relationship between the trade balance and its determinants. It confirms non-linear trade balance response to the exchange rate and real incomes when the exchange rate change is below and above a certain threshold.

Figure 3.4: Plots based on LVSTR model estimation

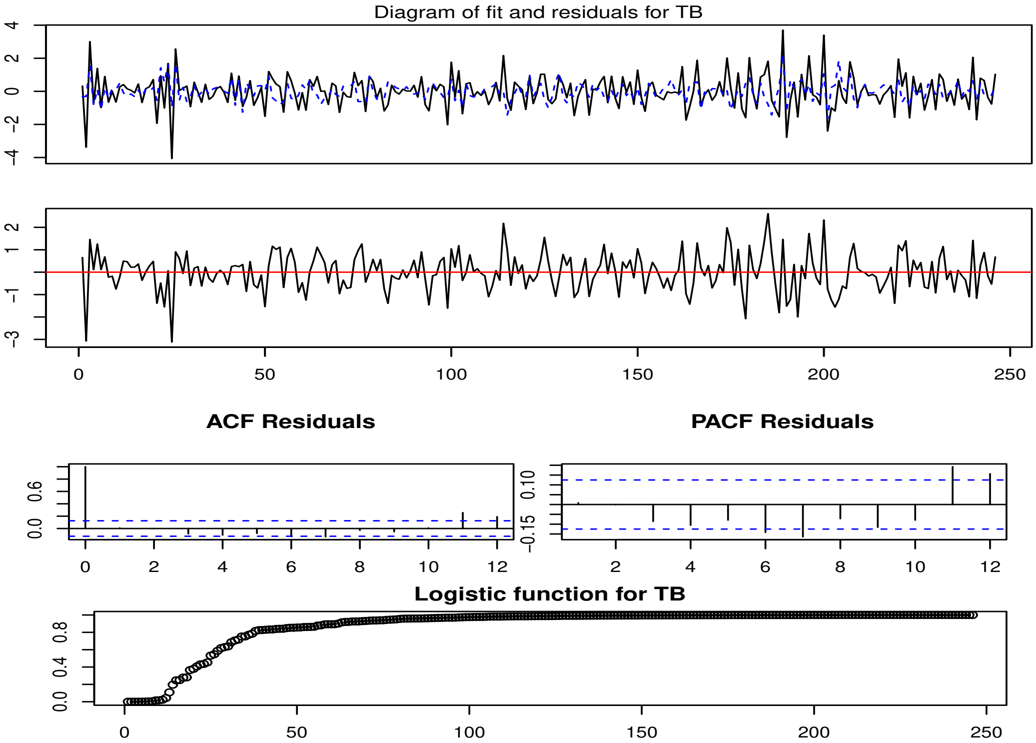
(a) Belgium



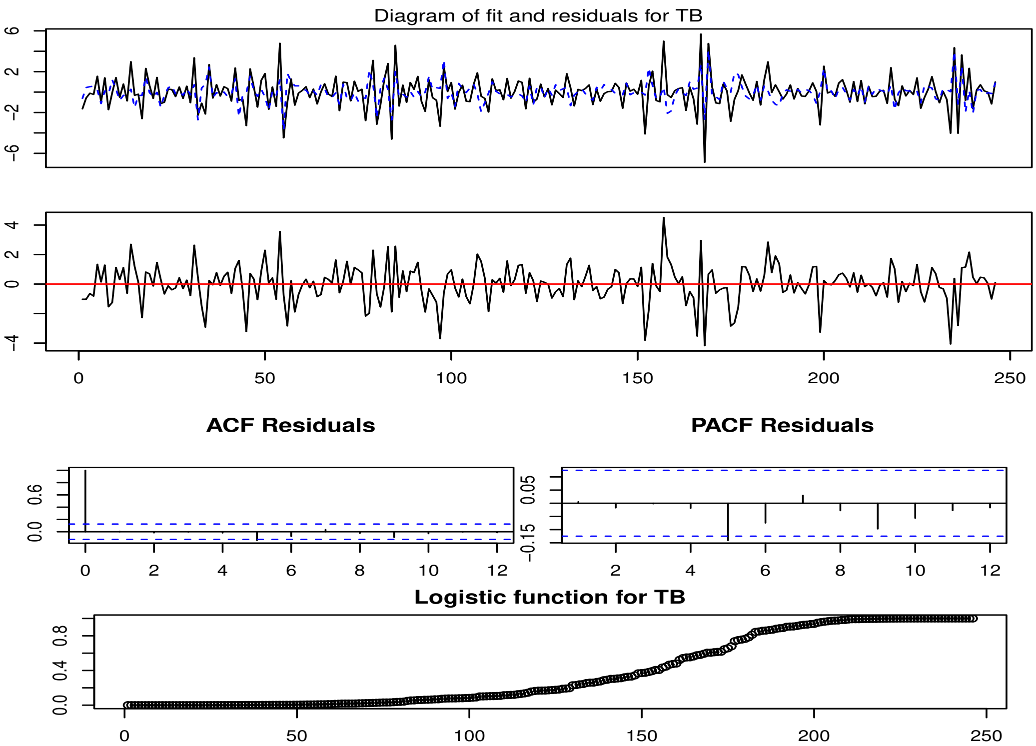
(b) China



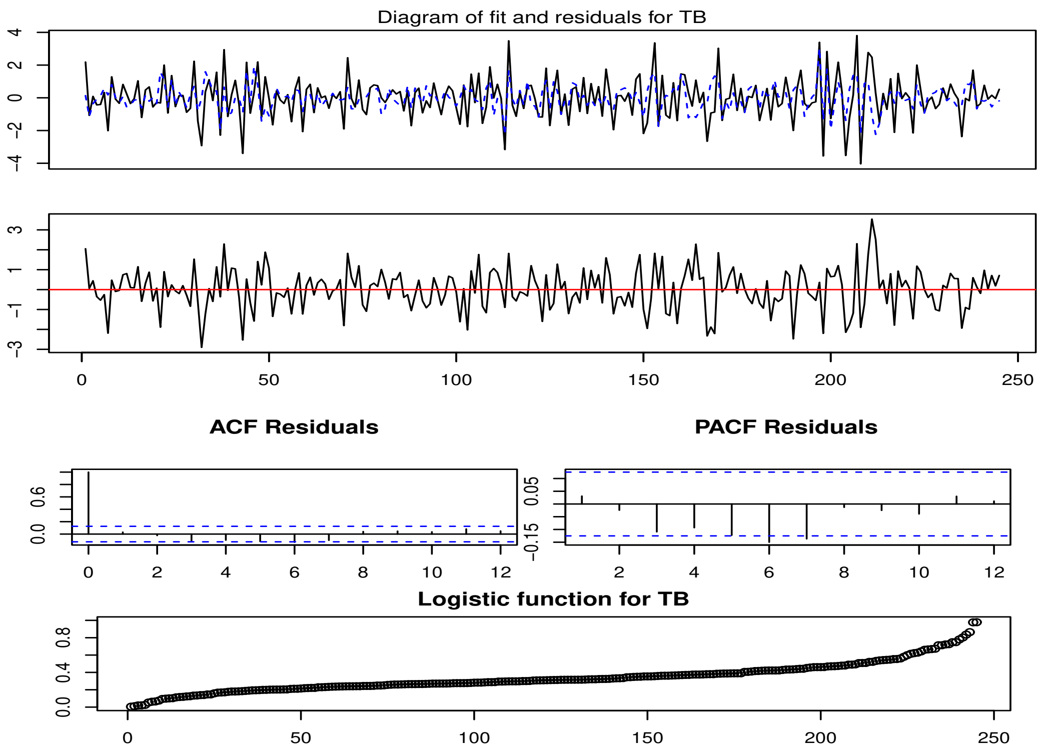
(c) Germany



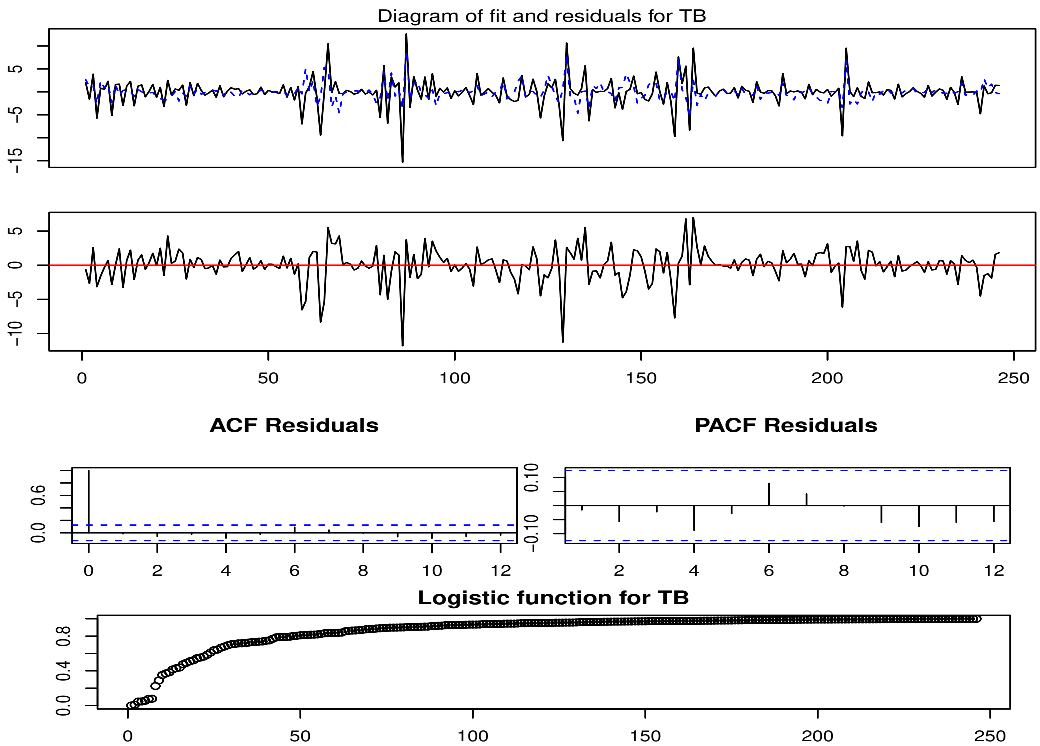
(d) Hong Kong



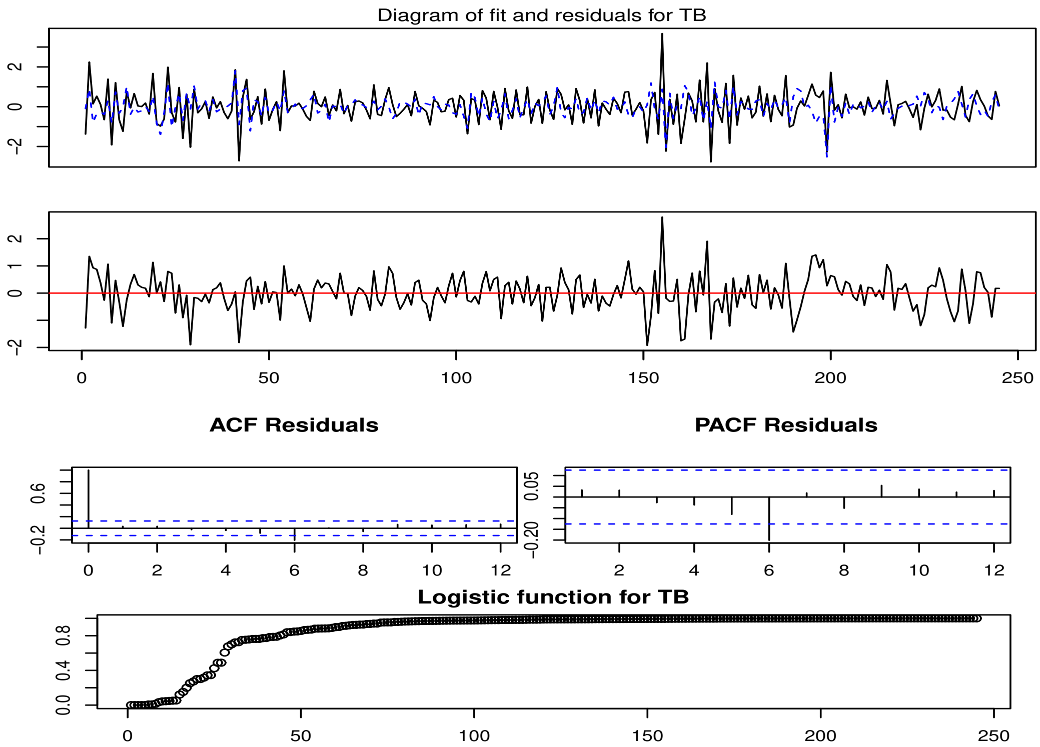
(e) India



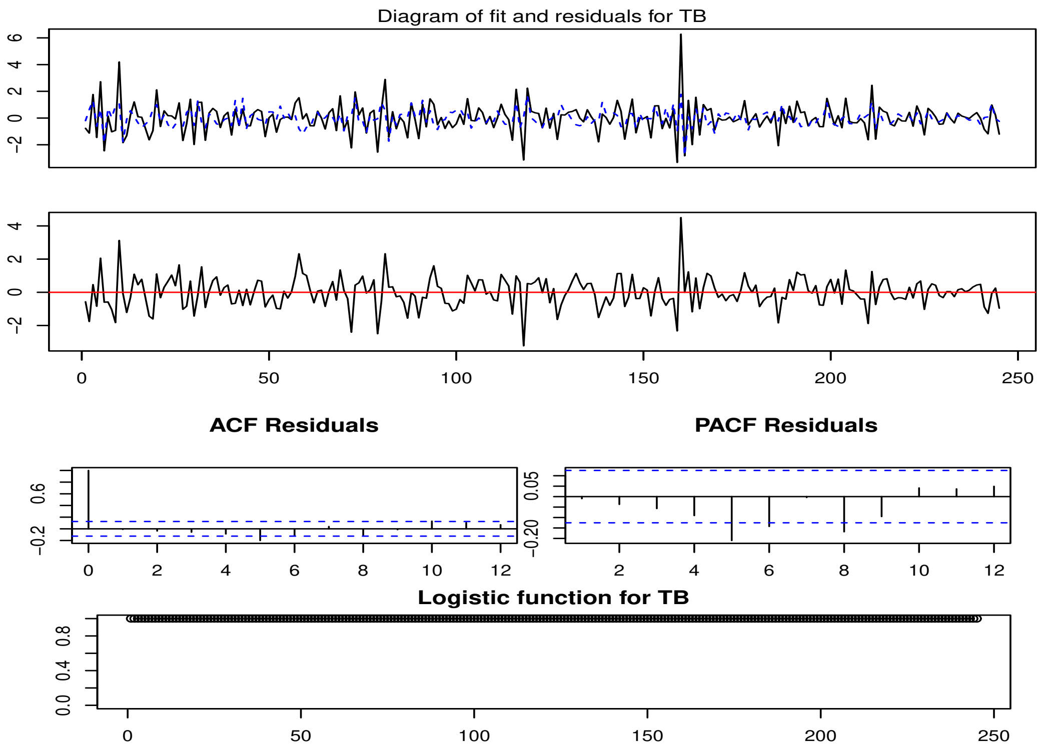
(f) Japan



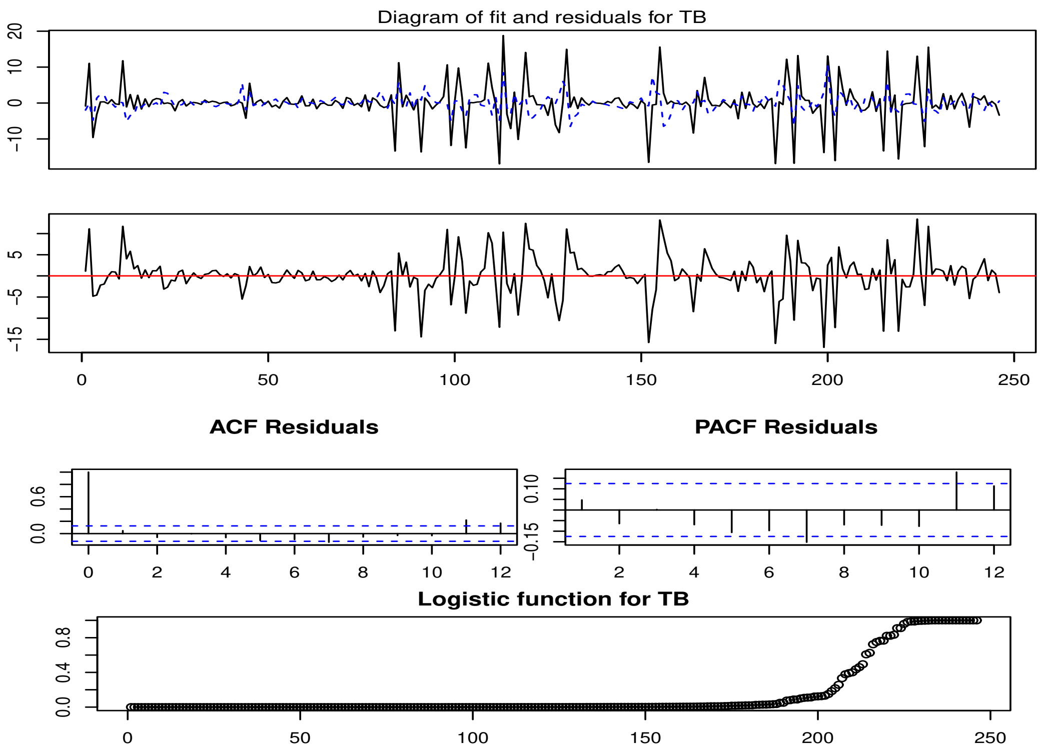
(g) Kenya



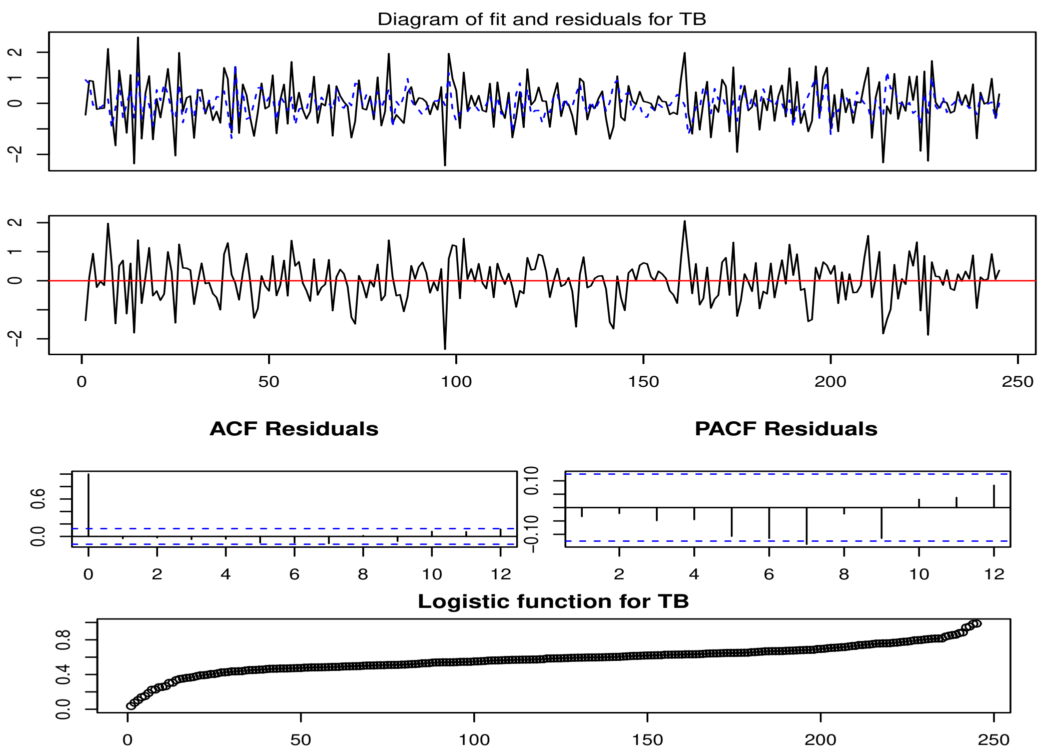
(h) Malawi



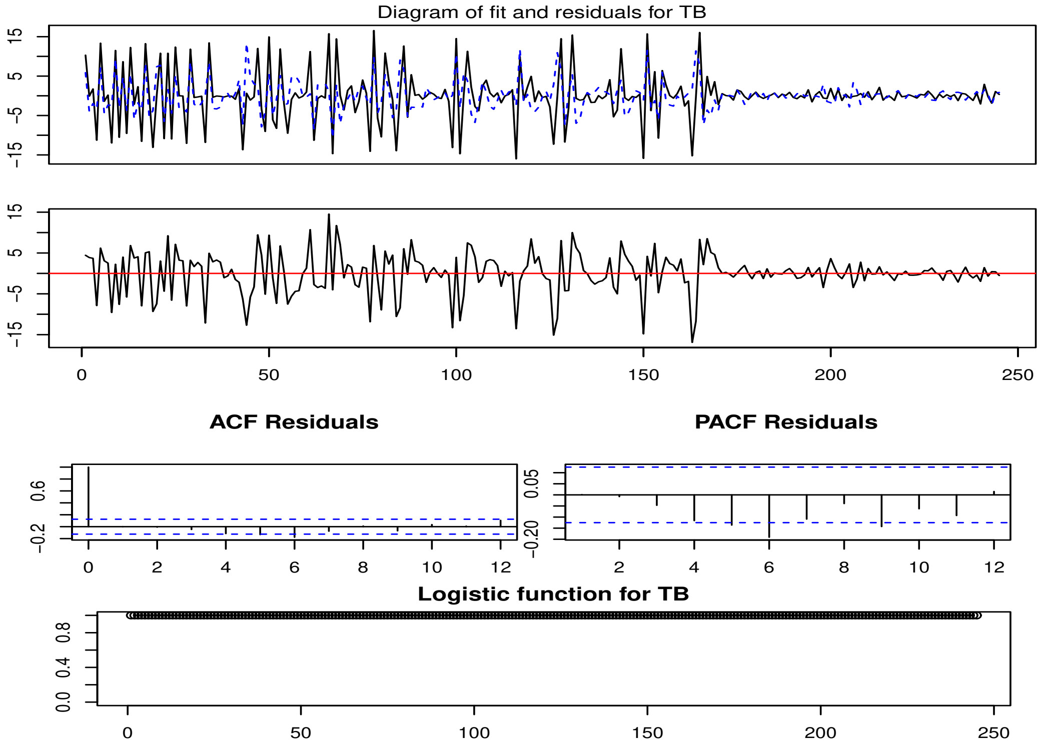
(i) Mauritius



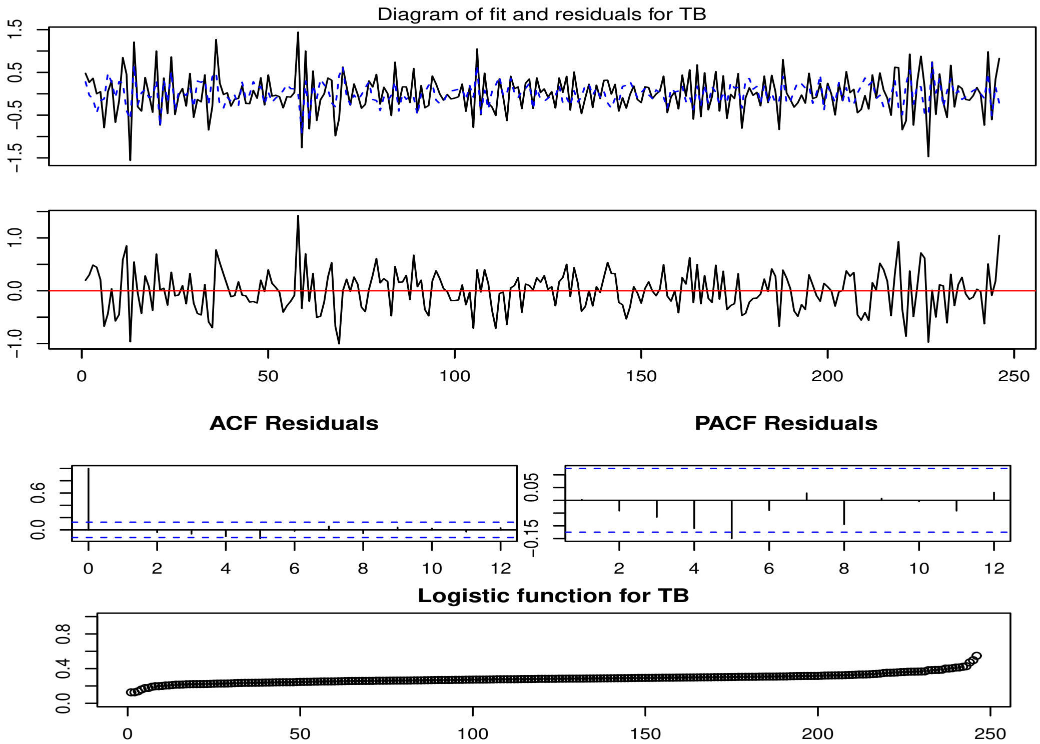
(j) The Netherlands



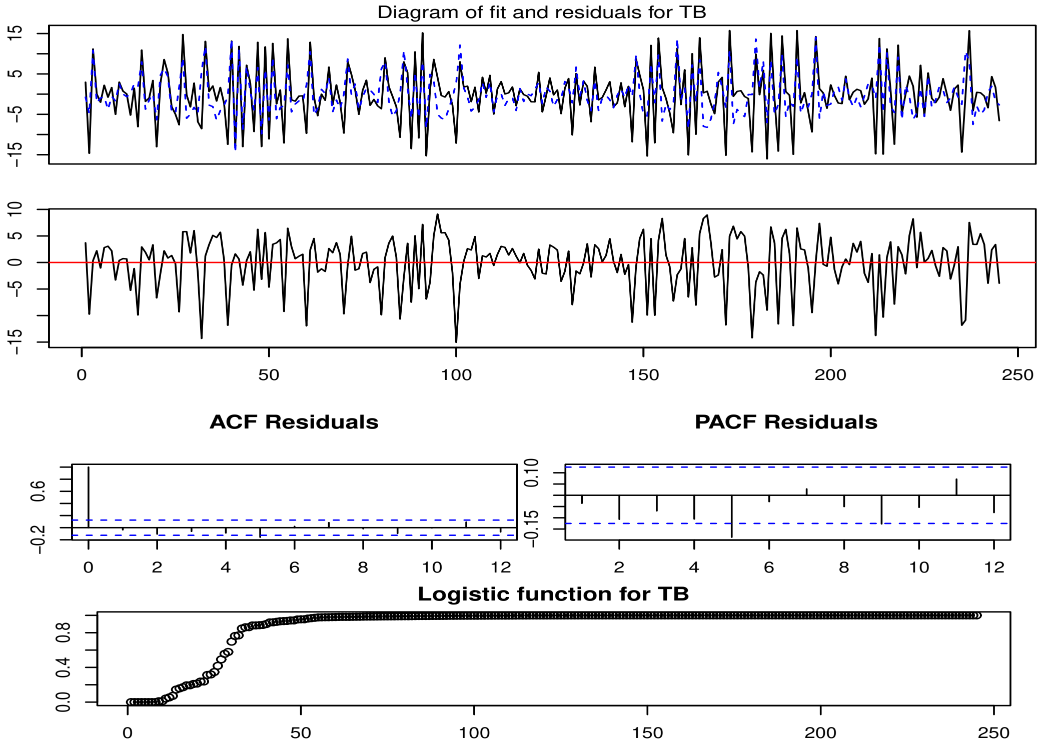
(k) Singapore



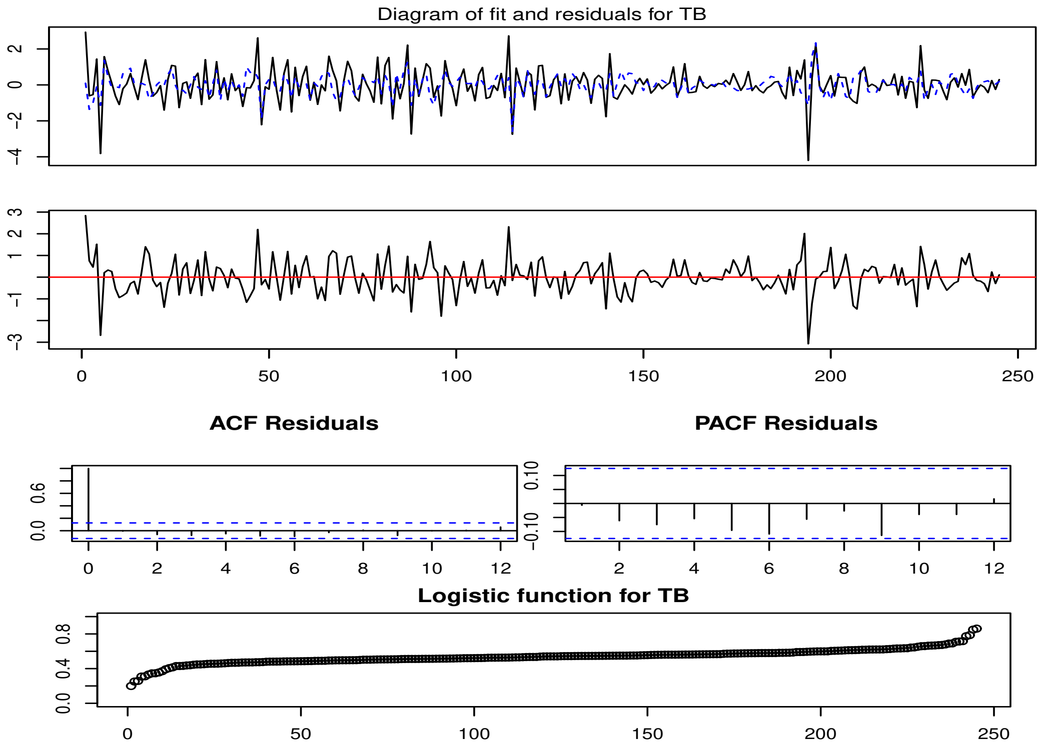
(l) South Africa



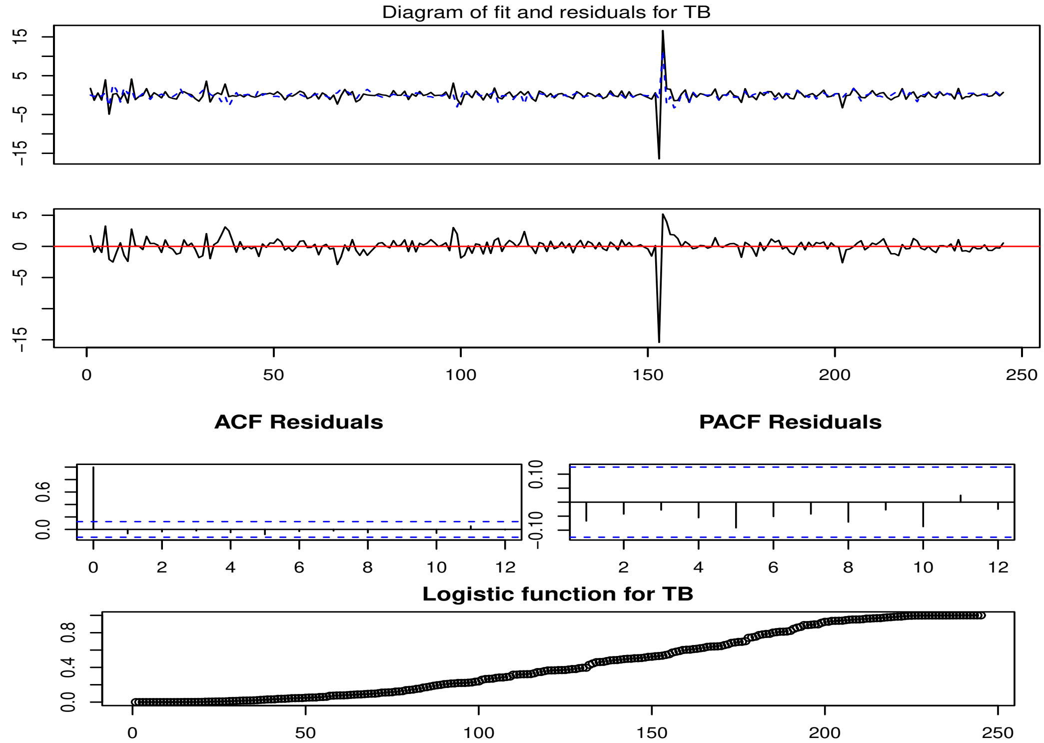
(m) Sweden



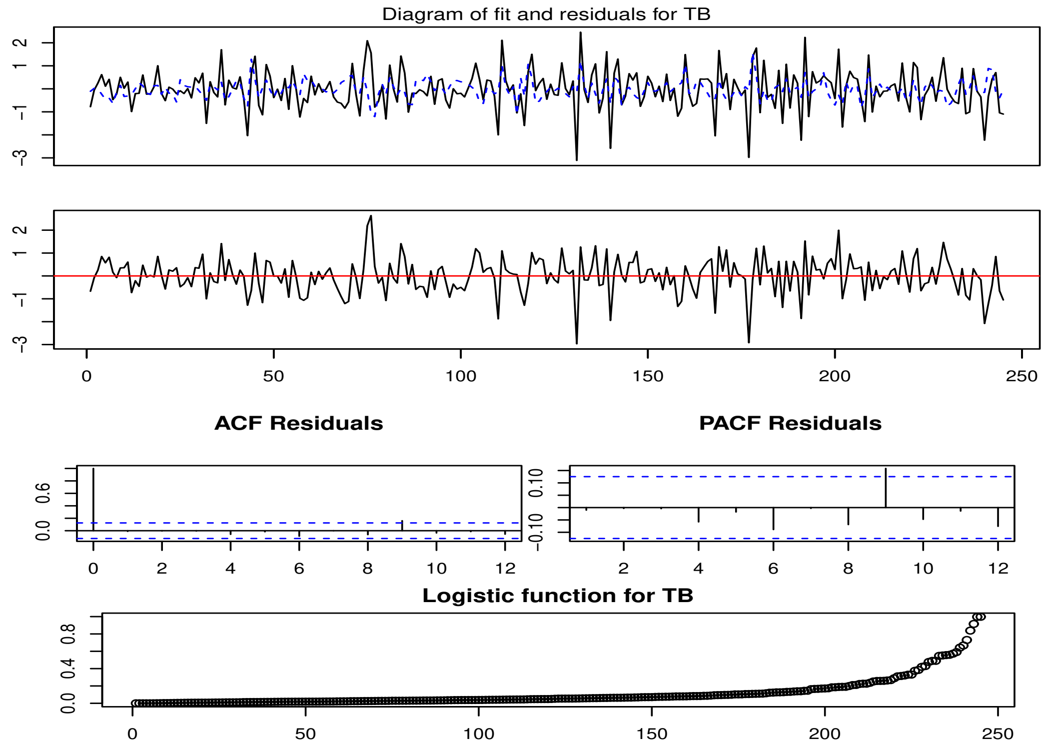
(n) Switzerland



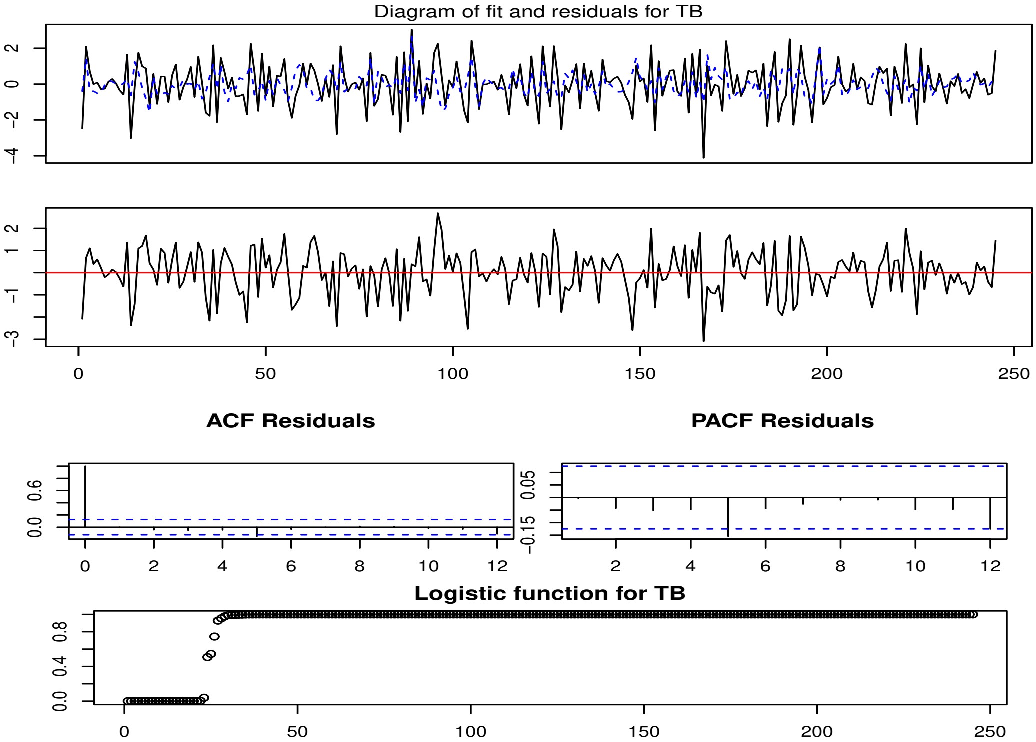
(o) Tanzania



(p) United Kingdom



(q) USA



The analysis carried out based on the estimation results of the LVSTR model shows that the effect of the exchange rate on the trade balance in regime-switching environments governed by the exchange rate is non-linear. The non-linearity was supported by the linearity tests and the plots of the logistic function of the trade balance. The estimation output of the LVSTR model provided means to assess the presence of the J-curve in each of the 17 models. Based on the results of the higher regime of the model, which represented the effect of currency depreciation on the trade balance, limited evidence in support of the J-curve was found. Evidence of the J-curve was found only in the case of India and South Africa. However, the result for South Africa is given less emphasis due to the unfavourable results of the KPSS unit root test. The limited evidence aligns with the remarks of Bahmani-Oskooee et al. (2018) regarding the mixed evidence of the J-curve in the literature.

Several factors could explain why there is limited evidence of the J-curve for Zambia. Drawing from Ndlela and Ndlela (2002), one reason is that Zambia, like many countries in the southern part of Africa, exports mainly primary commodities associated with low elasticities. Mineral exports from Zambia, for example, account for more than 70% of the country's total exports. The second possible reason is that most exported products, including minerals, are priced in foreign currency and the price is predetermined on international markets. According to Oladipupo (2011), this can result in exports that have low elasticities. Another possible reason is that imports are associated with low elasticities. As indicated by Ndlela and Ndlela (2002), imports by countries in Southern Africa have few substitutes. This implies that currency depreciation may not significantly influence expenditure switching to products produced locally.

Following the time series analysis of the exchange rate and trade balance of Zambia with each trading partner, the study is extended to a panel examination for further insight. In the panel study, the dynamics between the exchange rate and trade balance is explored using a single sample comprising all of Zambia's trading partners. This analysis is conducted in the section below.

3.5.2 Non-linear Panel Auto Distributed Lag Model

The non-linear PARDL model is estimated to explore asymmetry and J-curve effects in the relationship between the exchange rate and the trade balance. As already highlighted, one of the advantages of this model is that it generates short-run and long-run estimates, making it possible to assess the effect of the exchange rate in both the short-run and the long-run. In addition, it allows for the splitting of the exchange rate into depreciation and appreciation to enable the determination of asymmetry effects. Furthermore, the model enables the determination of whether cointegration exists between the variables based on the estimates of the error-correction term it produces.

However, non-linear PARDL model has a limitation in that it does not account for cross-sectional dependence. Chudik et al. (2016) suggests the use of the cross-sectionally augmented distributed lag (CS-DL) model in the presence of cross-sectional dependence. It is indicated that the CS-DL model outperforms the panel ARDL model when T (time period) is relatively moderate and falls within the range of 30–50. However, the CS-DL model lacks the capability of incorporating feedback effects that run from the dependent variable to the regressors, and this makes it weaker compared to the CS

ARDL model. The CS ARDL model could not be implemented because of the limited number of observations in the panel.

The non-linear PARDL model is estimated. As indicated in subsection 3.3.2, two estimators, PMG (Pooled Mean Group) or MG (Mean Group), are considered in estimating the non-linear PARDL model. The choice of the estimator is determined using the Hausman test. It is noteworthy that these estimators have different underlying assumptions and, as such, produce different results. The PMG estimator assumes the homogeneity of the long-run estimates and the heterogeneity of the short-run estimates. In this regard, long-term estimates are pooled, while short-term estimates are averaged. On the other hand, the MG estimator assumes heterogeneity for both long-run and short-run estimates, and, as such, the estimates are averaged. However, both estimators assume the heterogeneity of the error variances (Pesaran et al., 1999; Blackburne III and Frank, 2007). Given these different estimator assumptions, it is imperative to perform the Hausman test to ensure that the correct estimator is selected for the estimation of the model.

The non-linear PARDL model is estimated on a sample comprising 17 trading partners of Zambia. The estimation output of the non-linear PARDL model is presented in Table 3.15. The PMG estimator is used, and this is supported by the Hausman test result, which suggests that the null hypothesis favouring the PMG estimator over the MG estimator cannot be rejected. As can be observed in the estimation output, the Hausman test result shows that the test has a p-value of 0.465, which is greater than 0.05. This implies that the null hypothesis cannot be rejected at the significance level of 5%. The lag lengths of the variables in the model are determined using the Schwarz-Bayesian Information Criteria (SBIC) following Mwito et al. (2021). The optimal lag length determined for the model is PARDL-SBIC(1,1,1,1)[32], shown in Appendix B in Figure B.2.

The estimation results of the model in Table 3.15 are now reviewed, starting with the long-term estimates. As shown, currency depreciation, RER^{+}_{it}, has a positive but insignificant effect on the trade balance. This implies that currency depreciation does not lead to an improvement in the trade balance, contrary to what the elasticity approach to the balance of payments postulates. On the other hand, the effect of currency appreciation, RER^{-}_{it},

[32]This lag length is stated as presented in EViews, through which it is determined.

on the trade balance is positive and significant. This result means that currency appreciation causes a deterioration in the trade balance in the long-run. Specifically, an appreciation of 1% leads to a deterioration of 0.79% in the trade balance.

In the short-run section of the results, the coefficient of the error correction term (ECT_{it-1}) is shown to be negative and significant. This implies that there is a long-term relationship between the variables, which validates the long-term results. The coefficient of ECT_{it-1} indicates that the deviations from equilibrium in the previous period are corrected at a speed of 0.49. The effect of currency depreciation (ΔRER_{it}^{+}) on the trade balance is negative, which implies that currency depreciation worsens the trade balance in the short-run. This finding is consistent with the literature. It is as a result of the price effect outweighing the volume effect in the immediate period after a currency depreciation, as highlighted by Anju and Uma (1999) and others. The impact of the appreciation of the currency (ΔRER_{it}^{-}) is positive, but statistically insignificant.

In line with the objective of the study, the short-run and long-run estimates of currency depreciation and appreciation are subjected to the Wald test to establish whether there is evidence of asymmetry effects. The null hypothesis of the Wald test indicates that there is no asymmetry effect, while the alternative hypothesis suggests the presence of an asymmetry effect. The long-run asymmetry test result (that is, LR Wald test) is associated with a p-value of 0.151, and, as such, the null hypothesis cannot be rejected at the significance level of 5%. This suggests that the trade balance does not respond asymmetrically to currency depreciation and appreciation in the long-run. For short-run asymmetry (that is, SR Wald test), the results show a p-value of 0.054, suggesting the rejection of the null hypothesis at the 10% significance level. The implication is that there is evidence of short-term asymmetry effects, with currency depreciation exerting a stronger influence on trade balance compared to currency appreciation.

Table 3.15: Non-linear PARDL Estimation output

$\Delta y_{it} = \omega_i(y_{it-1} - \eta_i X_{it}) + \sum_{j=1}^{p-1} \Phi_{ij}^* \Delta y_{it-j} + \sum_{j=0}^{q-1} \phi_{ij}^* \Delta X_{it-j} + u_i + \epsilon_{it}$

Variables	**Coefficients**
Long-run	
RER_{it}^{+}	0.142
	(0.562)
RER_{it}^{-}	0.794**
	(0.379)
GDP_{it}	2.446***
	(0.454)
Short-run	
ECT_{it-1}	-0.488***
	(0.085)
ΔRER_{it}^{+}	-2.612**
	(1.058)
ΔRER_{it}^{-}	0.579
	(0.798)
ΔGDP_{it}	-4.455
	(3.384)
$CONST.$	-4.310***
	(1.196)
Diagnostics Tests	
LR Wald test	2.060
	[0.151]
SR Wald test	3.720*
	[0.054]
Hausman test	2.560
	[0.465]

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. Figures in round brackets are standard errors, while those in square brackets are p-values.

The evidence of the J-curve is checked from the estimated results. The definition of the J-curve[33], based on asymmetry effects, given by Bahmani-Oskooee and Fariditavana (2015, 2016) and explained by Bahmani-Oskooee and Karamelikli (2021) and Bahmani-Oskooee and Halicioglu (2017) is used to establish whether there is evidence of the J-curve. According to the definition, currency depreciation or appreciation is expected to have a significant

[33]The J-curve definition is discussed in subsection 3.2.4.

positive long-run coefficient. In contrast, in the short-run, the currency depreciation or appreciation coefficient is expected to be negative and significant. In line with the definition, an insignificant short-run estimate also represents a short-run J-curve pattern. The results of the estimation show that the short-run estimate of currency depreciation is negatively statistically significant, indicating that depreciation worsens the trade balance. This confirms the short-run J-curve pattern. In the long-run, the coefficient of currency depreciation is positive but statistically insignificant and, as such, does not indicate the long-run J-curve pattern. However, the currency's appreciation coefficient is positive and statistically significant, confirming the long-term pattern of the J-curve. Therefore, it is established that there is evidence of the J-curve. It is noteworthy that Bahmani-Oskooee and Arize (2020), employing aggregate trade-level data for Zambia and accounting for asymmetry effects, established evidence of the J-curve. However, their study found that the J-curve pattern in the long run was supported by currency depreciation, unlike this study where it is associated with currency appreciation. The disparity in results could be attributed to the use of different datasets, as this study uses bilateral data rather than aggregate data, and its sample does not include all trading partners of Zambia.

To gain further insights, the cross-section results of the non-linear PARDL model are examined, considering that the model allows for variation in short-run estimates across countries. These results enable an analysis of the connection between the exchange rate and the trade balance regarding both the asymmetry effects and the J-curve phenomenon with each trading partner in the short-run. The short-run cross-section results of the model are depicted Table 3.16.

The results show that the error correction term is negative and statistically significant for 12 of the 17 trading partners. This suggests the existence of a long-term equilibrium between the trade balance, exchange rate, and real incomes. In terms of the effect of the exchange rate on the trade balance, the model results show that currency depreciation causes a significant deterioration in Zambia's trade balances with four trading partners: India, Mauritius, the Netherlands, and Sweden. This reflects evidence of the short-run J-curve pattern. However, as highlighted earlier, the short-run definition also includes insignificant estimates. When this is taken into account, all countries exhibit the J-curve.

Table 3.16: PMG Cross-section Estimation results

Country	ECT_{it-1}	ΔRER^{+}_{it}	ΔRER^{-}_{it}	ΔGDP_{it}	$CONST.$	Wald Test
Belgium	-0.922***	-0.360	1.772	-23.418***	-8.237***	0.090
	(0.259)	(5.540)	(2.743)	(8.855)	(2.729)	[0.770]
China	-0.347***	0.476	-3.702**	-18.414**	-4.513**	1.710
	(0.073)	(1.949)	(1.696)	(7.758)	(1.744)	[0.191]
Germany	-0.476**	-0.497	2.051	5.500	-6.342**	0.220
	(0.214)	(3.941)	(1.950)	(4.832)	(3.058)	[0.638]
Hong Kong	-0.193	2.997	0.535	-1.456	-1.424	0.270
	(0.190)	(3.013)	(2.678)	(8.953)	(1.203)	[0.605]
India	-0.733***	-4.276**	-3.474*	3.541	-8.760***	0.060
	(0.187)	(1.945)	(1.941)	(6.616)	(2.518)	[0.803]
Japan	-0.528***	-1.027	1.329	21.751**	-6.602**	0.140
	(0.172)	(4.925)	(2.749)	(9.716)	(2.984)	[0.712]
Kenya	-0.329**	-1.785	-4.412	13.779**	-1.095	0.200
	(0.161)	(2.613)	(3.985)	(6.064)	(0.690)	[0.658]
Malawi	-0.262*	-0.346	0.067	7.922*	1.504*	0.030
	(0.141)	(1.489)	(1.233)	(4.118)	(0.783)	[0.863]
Mauritius	-0.532***	-14.946*	8.227**	-34.108*	0.383	5.270**
	(0.180)	(7.851)	(4.011)	(19.690)	(0.614)	[0.022]
Netherlands	-1.280***	-6.446***	0.154	-17.798***	-12.416***	3.620*
	(0.180)	(2.472)	(1.392)	(3.882)	(3.031)	[0.057]
Singapore	-0.100	3.129	-0.999	-1.097	-0.614	0.350
	(0.121)	(4.908)	(3.320)	(7.582)	(0.904)	[0.555]
South Africa	-0.209	-0.927	0.648	-3.194	-1.717	0.690
	(0.131)	(1.261)	(0.916)	(3.763)	(1.091)	[0.407]
Sweden	-0.301*	-8.521**	2.683	-7.736**	-3.279*	4.140**
	(0.167)	(4.120)	(1.946)	(3.837)	(1.759)	[0.042]
Switzerland	-0.039	-1.707	-2.015	1.010	-0.087	0.010
	(0.092)	(2.616)	(1.777)	(5.420)	(0.503)	[0.935]
Tanzania	-0.942***	-3.972	5.709**	-13.670	-0.673	2.920*
	(0.195)	(3.844)	(2.467)	(8.605)	(0.706)	[0.088]
UK	-0.219	-2.012	-1.669	-1.036	-2.865	0.000
	(0.269)	(4.879)	(3.205)	(7.537)	(2.961)	[0.962]
USA	-0.880***	-4.191	2.941	-7.311	-16.539*	3.030*
	(0.242)	(2.575)	(2.043)	(5.576)	(5.535)	[0.082]

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. Figures in round brackets are standard errors, while those in square brackets are p-values.

The effects of asymmetry are examined using the Wald test. It is observed that the p-values associated with the test are below 0.1 in five trading partners: Mauritius, The Netherlands, Sweden, Tanzania and the USA. These p-values suggest the rejection of the null hypothesis of no asymmetry effects. Therefore, there is evidence of asymmetry effects on the impact of the exchange rate on the trade balance with these individual trading partners. The trade balance with these trading partners reacts more strongly to currency depreciation than to currency appreciation.

As part of the check of the robustness of the results, the estimations of the model are carried out on the sample as previously, but with the lag lengths determined by the Akaike Information Criteria (AIC). The optimal lag is PARDL-AIC (2,2,2,2) and is presented in Appendix B in Figure B.3. The model is estimated using the PMG estimator based on the favourable results of the Hausman test. The model estimation results are presented in Table 3.17, and the short-run cross-section estimation results are shown in Table 3.18.

The estimation results for the model in the long-run section show that the effect of currency depreciation on the trade balance is insignificant, but that of currency appreciation is significant and affects the trade balance positively. In the short-run, the results show evidence of cointegration and that currency depreciation negatively affects the trade balance significantly. The results also suggest evidence of asymmetric effects, but in the long-run rather than in the short-run, as observed in the earlier model. Evidence of the J-curve is also found. These results are broadly consistent with those established based on the model using lags determined by the SBIC, reported in Table 3.15. It is noteworthy, however, that the short-run cross-section estimation results in Table 3.18 exhibit variations, especially for the effects of asymmetry, which lack evidence in all trading partners. The effect of currency depreciation is negative and significant in four trading partners: India, The Netherlands, Sweden, and the United Kingdom. This reflects short-run deterioration in the trade balance, consistent with the short-run J-curve pattern. Taking into account the insignificant estimates of currency depreciation reflects more evidence of the J-curve in the short-run.

As a further check of the robustness of the results, the long-run variables in the model are lagged by one period. The results are reported in Appendix B in Table B.4 and in Table B.6, and are generally found to remain consistent. The effect of the exchange rate on the trade balance is similar both in the short term and in the long term and aligns with the estimation results reported in Table 3.15 and Table 3.17. The short-run cross-section estimation results of these models are presented in Table B.5 and Table B.7. These results when compared to those reported in Table 3.16 and Table 3.18 present greater variation. In view of this, less emphasis is given to short-run cross-section estimation results.

Table 3.17: Non-linear PARDL Estimation output - AIC

$$\Delta y_{it} = \omega_i(y_{it-1} - \eta_i X_{it}) + \sum_{j=1}^{p-1} \Phi_{ij}^* \Delta y_{it-j} + \sum_{j=0}^{q-1} \phi_{ij}^* \Delta X_{it-j} + u_i + \epsilon_{it}$$

Variables	**Coefficients**
Long-run	
RER_{it}^{+}	-0.134
	(0.339)
RER_{it}^{-}	0.855***
	(0.276)
GDP_{it}	2.197***
	(0.328)
Short-run	
ECT_{it-1}	-0.644***
	(0.139)
ΔTB_{it-1}	0.011
	(0.102)
ΔRER_{it}^{+}	-2.182**
	(1.012)
ΔRER_{it-1}^{+}	0.475
	(1.353)
ΔRER_{it}^{-}	0.472
	(0.804)
ΔRER_{it-1}^{-}	-0.345
	(1.043)
ΔGDP_{it}	-3.465
	(3.551)
ΔGDP_{it-1}	-5.770
	(4.359)
$CONST.$	-5.668***
	(2.104)
Diagnostics Tests	
LR wald	15.710***
	[0.000]
SR Wald	0.410
	[0.521]
Hausman	1.810
	[0.612]

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. Figures in round brackets are standard errors, while those in square brackets are p-values.

Table 3.18: PMG short-run Cross-section estimation results - AIC

	ECT_{it-1}	ΔTB_{it}	ΔRER^{+}_{it}	ΔRER^{+}_{it-1}	ΔRER^{-}_{it}	ΔRER^{-}_{it-1}	ΔGDP_{it}	ΔGDP_{it-1}	$CONST$.s	Wald Test
Belgium	-0.964**	0.016	-4.673	1.194	3.511	-2.663	-22.396**	-3.425	-7.602**	0.160
	(0.407)	(0.270)	(6.411)	(5.820)	(3.074)	(3.027)	(8.880)	(12.136)	(3.389)	[0.691]
China	-0.609***	-0.182	1.770*	2.349**	-5.199***	-0.575	-16.540***	-16.688***	-7.039***	1.940
	(0.066)	(0.111)	(1.067)	(1.047)	(1.065)	(1.153)	(4.982)	(5.148)	(1.809)	[0.164]
Germany	-0.592**	0.143	0.944	-1.820	1.857	2.007	7.934	-1.948	-6.894*	0.090
	(0.295)	(0.259)	(4.702)	(4.291)	(2.323)	(2.294)	(5.283)	(5.608)	(3.511)	[0.768]
Hong Kong	-0.455***	0.462*	3.899	2.391	-1.165	3.105	-6.713	22.166***	-2.455**	1.090
	(0.165)	(0.244)	(2.491)	(2.492)	(2.244)	(2.114)	(7.770)	(7.219)	(0.998)	[0.297]
India	-1.173***	0.237	-4.509**	-1.515	-2.920	-2.847	5.382	-3.052	-12.562***	0.070
	(0.232)	(0.194)	(2.137)	(2.038)	(2.314)	(2.191)	(9.017)	(9.384)	(2.671)	[0.791]
Japan	-0.516*	-0.096	0.201	-2.236	1.263	-1.880	28.359*	-7.796	-5.774	0.070
	(0.282)	(0.225)	(5.986)	(6.858)	(2.839)	(2.938)	(14.165)	(18.164)	(3.921)	[0.795]
Kenya	-0.364***	0.406**	0.085	6.956***	-4.675	-0.843	11.506**	-2.720	-1.665***	0.930
	(0.135)	(0.176)	(1.880)	(1.832)	(3.376)	(2.744)	(5.439)	(6.538)	(0.496)	[0.336]
Malawi	-0.178	-0.418**	0.188	2.147*	1.529	-2.217**	-3.520	2.144	0.768	0.100
	(0.122)	(0.182)	(1.346)	(1.280)	(1.283)	(1.109)	(5.892)	(4.226)	(0.745)	[0.750]
Mauritius	-0.926***	-0.009	-4.558	-6.168	4.374	12.458***	-32.340*	-63.521***	-0.515	0.180
	(0.162)	(0.186)	(6.788)	(6.727)	(3.451)	(3.911)	(17.061)	(16.740)	(0.581)	[0.667]
Netherlands	-1.375***	0.335**	-6.165**	7.148***	-0.381	-1.384	-17.483***	0.820	-12.033***	0.050
	(0.316)	(0.154)	(2.404)	(2.488)	(1.305)	(1.233)	(3.555)	(4.980)	(3.239)	[0.816]
Singapore	-0.118	-0.047	1.262	-2.904	0.543	3.091	0.472	17.100**	-0.022	0.200
	(0.131)	(0.266)	(4.624)	(4.692)	(3.595)	(2.969)	(7.680)	(6.627)	(0.882)	[0.655]
South Africa	-0.045	-0.706***	-1.063	1.188	0.808	-1.453*	3.445	-7.473***	-0.596	0.060

Table 3.18 continued from previous page

	ECT_{it-1}	ΔTB_{it}	ΔRER^{+}_{it}	ΔRER^{+}_{it-1}	ΔRER^{-}_{it}	ΔRER^{-}_{it-1}	ΔGDP_{it}	ΔGDP_{it-1}	$CONST.$s	Wald Test
	(0.152)	(0.197)	(1.480)	(1.295)	(1.071)	(0.750)	(3.286)	(2.841)	(0.939)	[0.803]
Sweden	-0.543***	0.318*	-12.451***	-10.112***	5.183***	0.433	-10.768***	3.112	-4.839***	2.440
	(0.149)	(0.166)	(3.384)	(3.326)	(1.485)	(1.654)	(3.279)	(3.378)	(1.493)	[0.118]
Switzerland	0.015	-0.680**	-0.403	-2.885	-4.612**	-1.068	3.759	-3.264	0.057	0.850
	(0.093)	(0.283)	(2.754)	(2.524)	(2.159)	(1.603)	(5.702)	(5.954)	(0.466)	[0.356]
Tanzania	-1.225***	0.195	-3.595	-2.944	5.369	0.045	-10.903	-4.165	-0.478	0.220
	(0.274)	(0.241)	(4.887)	(4.041)	(3.332)	(2.786)	(8.922)	(9.251)	(0.874)	[0.637]
UK	0.128	-0.578	-8.280*	14.377*	0.655***	-8.927	9.397***	-11.963	0.303	0.260
	(0.272)	(0.305)	(4.485)	(4.235)	(2.631)	(3.106)	(9.320)	(8.075)	(2.571)	[0.610]
USA	-2.007***	0.785***	0.245	0.916	1.887	-3.146*	-8.499	-17.416***	-35.004***	0.070
	(0.322)	(0.192)	(2.166)	(1.992)	(1.636)	(1.739)	(6.064)	(5.857)	(7.302)	[0.790]

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. Figures in round brackets are standard errors, while those in square brackets are p-values.

The estimation results of the non-PARDL model reveal evidence of asymmetry effects, although the nature of this evidence varies. Specifically, the model estimated with the order of lags determined by SBIC shows short-run asymmetry, while the one with lag order determined by AIC indicates long-run asymmetry. However, this variation in evidence is consistent with previous findings by Bahmani-Oskooee and Fariditavana (2015) and Bahmani-Oskooee and Fariditavana (2016). This further supports the notion of potential pricing-to-market and price rigidity based on which exporters react differently to currency depreciation and appreciation.

Empirical results also uncover evidence of the J-curve phenomenon. However, the long-run endorsement of the J-curve arises from currency appreciation rather than depreciation. This finding implies that currency depreciation alone may not enhance the trade balance, even if the relationship between the exchange rate and the trade balance is thought to have improved due to the identification of asymmetry effects. The insignificant effect of currency depreciation on trade balance in the long-run suggests the presence of low elasticities associated with exports.

3.6 Conclusion

The relationship between the exchange rate and the trade balance has received a lot of attention and has been extensively tested empirically, yet there is still controversy. The context in which the relationship is empirically examined relates to whether currency depreciation improves trade balance. This relationship was previously examined based on the symmetric assumption, in which it was viewed that currency depreciation and appreciation affected the trade balance in the same magnitude. However, evidence of asymmetry effects has recently been found. This evidence suggests that the trade balance reacts unevenly to currency depreciation and appreciation in that it reacts more to one and less to the other. The discovery of asymmetry effects is of interest, as it implies that not accounting for asymmetry effects could lead to misleading empirical results and incorrect policy decisions.

A review of the literature on studies investigating asymmetry effects reveals that most studies employ single-equation models. Specifically, the NARDL model is used in various country studies. The application of the same methodology seems to be justified by the notion that the literature for each country is distinct. In line with this perspective in the literature, the chapter uses bilateral trade data that involve Zambia and its 17 trading partners to examine the non-linear, asymmetric and J-curve effects in the exchange rate-trade balance relationship. Zambia's trade pattern is unique, with a significant portion of trade concentrated with only a few trading partners, and minerals dominating exports. This uniqueness makes conducting research on Zambia particularly appealing.

Unlike previous studies, this chapter employs the LVSTR model, which constitutes one of the novel contributions to the literature. The LVSTR model is a non-linear model involving multiple equations and accounts for interrelationships between variables. The LVSTR model allows observations to switch between the lower and higher regimes, and the shift between these regimes is smooth. The model determines the threshold level within the model, which is one of its advantages relative to other models. The exchange rate change with a one-period lag is used as the threshold variable, and based on this, the regimes change in the system. The possibility of non-linearity in the exchange rate-trade balance relationship is first detected by whether the data provide empirical support for carrying out estimations with the LVSTR model and, secondly, the plots of the logistic function of the trade balance. To complement the findings of the estimations of the LVSTR model and provide further insight, a non-linear PARDL model is also employed to determine whether asymmetry effects exist.

The findings of the study, drawn from the estimation results of the LVSTR model, indicate a more pronounced presence of non-linearity in the relationship among the variables within the model. This non-linearity is strongly supported by linearity tests in all the trading partners of Zambia. This finding implies that trade balance adjustments in response to the exchange rate, real domestic income, and real foreign income vary depending on changes in the exchange rate. This finding is supported by plots of the logistic function of the trade balance in all trading partners, except Malawi and Singapore. With respect to the J-curve, its presence is limited, as evidence is only found in one trading partner, India.

The study's findings, drawn from the estimation outcomes of the non-linear

PARDL model, reveal that when all trading partners are collectively analysed as a sample, currency depreciation does not appear to impact the trade balance in the long term. On the contrary, currency appreciation positively influences the trade balance, suggesting that it leads to a deterioration of the trade balance. These long-term results are supported by cointegration. In the short-run, currency depreciation is found to negatively affect the trade balance, whereas currency appreciation has no effect. The study also finds evidence of asymmetry effects. Evidence of the J-curve is also found, supported by a negative effect of currency depreciation on the trade balance in the short term and a positive effect of currency appreciation in the long term, using the definition of the J-curve given by Bahmani-Oskooee and Fariditavana (2015, 2016). It is noteworthy that the analysis conducted for robustness check in which more lags are incorporated into the model generally yields similar results.

The finding of non-linearity and asymmetry effects in this chapter corroborates similar findings reported in existing research. This implies that asymmetry effects should be considered when analysing the exchange rate-trade balance relationship. This further implies that the policy design should account for asymmetry effects. The limited evidence of the J-curve and the finding of an insignificant long-term effect of currency depreciation in the panel study implies that currency depreciation alone cannot improve the trade balance, although asymmetry effects are believed to have enhanced the relationship between the exchange rate and the trade balance. To address this situation, there is a need to reduce dependence on exports of primary commodities. This could involve developing structural reforms that support economic diversification. Furthermore, it is necessary to reduce import dependence. This can be achieved by promoting domestic production and making investments in research and development to create substitutes for some imported goods. However, it is important to note that implementing the suggested structural changes takes time and, consequently, addressing the excessive trade deficit in the short run would imply tightening monetary and fiscal policies to constrain import demand.

Chapter **4**

Exchange Rate Effect on Foreign Direct Investment: Does Trade openness, Natural resources and Institutions induce non-linearity?

4.1 Introduction

Foreign Direct Investment (FDI), as defined by OECD (2008) and UNCTAD (2014), is an investment made in a country (i.e., the host or recipient country) by an investor from a different country (i.e., the investor's home country also referred to as the source or investing country), in which the investor has a long-term relationship, lasting interest, and control. FDI is closely related to Foreign Portfolio Investment (FPI) in that they are both international capital flows. However, the two are different.

FDI and FPI vary in several aspects. With FDI, investors actively participate in investment management, whereas for FPI, they do not, as the investment is passively managed (Ball et al., 2004). FPI is typically in bonds or stocks. However, FDI can take the form of brownfield investments (that is, the purchase of existing production plants), greenfield investments (that is, the establishment of new production plants), or mergers (Alfaro and Chauvin, 2020; Hill, 2008). In addition, FDI is different from FPI in that FDI is more information demanding about prospective investments relative to FPI and, as a result, is more responsive to changes in the exchange rate (Froot and Stein, 1991; Jehan and Hamid, 2017). Furthermore, FDI is associated with less volatility compared to FPI because FDI is less reversible relative to FPI (UNCTAD, 2019). These differences imply that FDI and FPI may have different determinants.

As documented in the literature, FDI is associated with a number of benefits, especially for developing countries. Most of these countries have lower incomes and savings levels, resulting in insufficient resources to fund investment. FDI provides a source of financing for investments that is cheaper compared to financing obtained from international capital markets. For most developing countries, access to these markets may not even be available. In addition to providing cheaper financing, FDI leads to job creation, poverty reduction, transfer of technology and managerial skills, increases in government tax revenues, and accelerated economic growth (see Asiedu, 2002; Kiyota and Urata, 2004; Cambazoglu and Gunes, 2016). The substantial decline in the receipts of official development assistance and foreign aid in developing countries amid increasing financing needs indicates the importance of FDI (Asiedu and Lien, 2011).

Given the importance of FDI highlighted above, the relationship between the exchange rate and FDI is considered in the context of whether the exchange rate can encourage FDI inflows to the host country. The literature presents mixed views on the effect of the exchange rate on FDI inflows. One side of the literature supports the view that currency depreciation of the host country encourages FDI inflows, and another considers currency appreciation as a driver of FDI inflows. There is also a side of the literature that disputes the possible influence of the exchange rate on FDI (see Blonigen, 1997; Chakrabarti and Scholnick, 2002). The absence of consensus creates uncertainty among policy makers about the significance of the exchange rate in influencing FDI.

The study is motivated by the lack of consensus highlighted above. Relatedly, a review of the existing literature reveals that the connection between the exchange rate and the FDI inflows has been investigated in the context of a direct relationship. In view of this, the study considers the indirect relationship using a non-linear econometric model. This approach can uncover the circumstances or conditions under which the relationship between the exchange rate and FDI inflows holds. Implementing this approach may also provide insight into the nature of the relationship between the exchange rate and FDI, thereby contributing to resolving the conflicting perspectives.

Generally, the literature exploring the indirect relationship between FDI and its determinants is limited, as also confirmed by a review of previous research by Dimitrova et al. (2020). The role of moderating or mediating effects is largely not taken into account in the analysis. Taking into account the mediating effects is crucial to understanding how another variable alters the impact of one variable on FDI inflows. This approach can offer insight into whether a mediator variable amplifies or decreases the influence of a particular FDI determinant. As a result, such an analysis can be of great significance in guiding the formulation of appropriate and impactful policies.

Previous research on FDI inflows analysis that accounts for the mediating effects uses mainly linear models. These models incorporate the interaction term to capture the mediating effects. Additionally, a squared variable of interest may be added as a regressor when the analysis intends to capture non-linear effects (e.g., Furceri and Borelli, 2008; Havi, 2021; Jehan and Hamid, 2017; Asamoah et al., 2022; Asiedu, 2013; Ogbonna et al., 2022; Cleeve et al., 2015; Asiedu and Lien, 2011). The limitation of using linear models is that thresholds are determined outside the model. In addition, it is difficult to extract evidence of non-linearity. These limitations can be addressed with the use of a non-linear model, and this partly motivates the study.

For previous research employing non-linear models, the focus is mostly on other determinants of the FDI and not on the exchange rate (e.g., Taşdemir, 2022; Aluko, 2020; Kurul, 2017). Studies that consider the exchange rate tend to explore the asymmetric effects, specifically investigating whether FDI responds evenly to currency depreciation and appreciation (e.g., Qamruzzaman et al., 2019). Therefore, there is no study that investigates whether a third variable non-linearly influences the relationship between the exchange rate and FDI. The existence of this gap in the literature motivates the study.

In line with the above, the objective of the study is to examine the relationship between the exchange rate and FDI inflows, considering the roles of trade openness, natural resources, and institutions. The study, therefore, investigates whether the relationship between the exchange rate and FDI is non-linearly influenced by threshold variables - trade openness, natural resources, and institutions. Furthermore, it explores whether currency depreciation encourages FDI at lower or higher levels of the threshold variables. It should be noted that existing research uses these threshold variables to account for the mediating effects in the analysis of FDI and other determinants (e.g., Furceri and Borelli, 2008; Arratibel et al., 2011; Asiedu and Lien, 2011; Taşdemir, 2022; Asamoah et al., 2016; Asiedu, 2002). To address the research question, the Dynamic Panel Threshold (DPT) model, developed by Seo and Shin (2016) and Seo et al. (2019), is used. The study seeks to establish the following:

1. To determine whether non-linearity exists between the exchange rate and FDI under each of the threshold variables;

2. To determine the thresholds at which the variables—trade openness, natural resources, and institutional quality—induce non-linearity between the exchange rate and FDI;

3. To determine the impact of the exchange rate on FDI at the lower and higher levels of each of the threshold variables; and

4. To determine how FDI is affected by its other determinants in the lower and higher regimes induced by the threshold variables.

This study makes a novel contribution by examining the non-linear influence of trade openness, natural resources, and institutional quality on the relationship between the exchange rate and foreign direct investment (FDI). Such an analysis has not been conducted before, as previous studies have tended to examine the exchange rate-FDI nexus based on the direct relationship. This analysis seeks to provide insight on whether the exchange rate encourages FDI inflows when the host country is characterised by greater openness, abundant natural resources, and stronger institutions. In addition, the study contributes to the literature by extending this analysis to examine the non-linear relationship between FDI and its other determinants within the model.

The study conducts its analysis using a sample consisting of 44 African countries. The decision to only consider African countries stems in part from limited research on this continent that addresses the relationship between the exchange rate and the FDI. The other consideration is that Africa has unique characteristics, including a lower share of FDI receipts than other continents[34]. Given these distinctive characteristics, it is conjectured that policies employed by other continents to attract FDI may not work in Africa (Asiedu, 2002). Instead, African governments can gain valuable insight by learning from the experiences of their fellow African countries rather than relying on the experiences of other continents (Asiedu, 2006). This implies that having a sample that includes countries from different continents may not be inappropriate, especially with respect to drawing policy recommendations to increase FDI inflows. Therefore, the study limits its sample to African countries to address these considerations effectively.

To provide a glimpse of the findings, the study reveals compelling evidence indicating that the relationship between the exchange rate and FDI is influenced non-linearly by trade openness, natural resources, and institutional quality. The threshold levels of trade openness, natural resources, and institutions are established, and it is found that the exchange rate affects FDI differently at varying levels of trade openness, natural resources, and institutions. Generally, the impact of the exchange rate is found to be positive, implying that currency depreciation encourages FDI inflows. This evidence provides support in favour of the side of literature that indicates that currency depreciation encourages FDI inflows. Along similar lines, the study provides new evidence suggesting that currency depreciation encourages FDI inflows when the host country is more open, has abundant natural resources, and has weaker institutions.

The remainder of the chapter is structured as follows: Section 4.2 reviews the patterns and trends of FDI inflows, while Section 4.3 provides theoretical and empirical literature. Specifically, the section initially reviews the general theory and empirical literature on FDI. Subsequently, it narrows its focus to examine theory and empirical literature concerning the relationship between the exchange rate and FDI. Finally, it concludes by providing an overview of the analysis of mediating effects used in the existing literature. Section 4.4 describes the methodology and Section 4.5 presents the data used for analysis. Section 4.6 focuses on model estimations and empirical results, while Section 4.7 draws the conclusion of the chapter.

[34]See Section 4.2 for a detailed review

4.2 Patterns and Trends in FDI inflows

Over the years, there has been a notable increase in FDI inflows worldwide. As shown in Table 4.1, global FDI inflows from 1970 to 2019 totalled US$32,115.74 billion[35]. Between 2010 and 2019, global FDI inflows amounted to US$16,002.26 billion, a substantial increase compared to the US$237.99 billion recorded in the 1970s. A comparison of FDI receipts in the 1970-1979 period by continent shows that Europe was the top recipient with US$102.59 billion, followed by America with US$ 90.08 billion, Asia with US%20.94 billion and Africa, the smallest recipient, with US$11.24 billion. Extending the comparison to the 2010-2019 period, Europe continued to be the top recipient with US$5,213.11 billion, but Asia took the second place with US$ 4,987.98 billion, surpassing America, which received US$4,791.17 billion in FDI. Africa maintained its position as the least FDI recipient continent with receipts of US$491.32 billion, which is less than what all other continents received in the 1990s. It is evident from this that Africa is the least recipient of FDI flows. It is noticeable that Asia is associated with a steady and solid increase in the level of FDI inflows during the 1970-2019 period. Table 4.2 presents the annual averages of FDI inflows, and the trends are consistent with those observed in Table 4.1 and discussed.

Table 4.1: Global FDI Inflows (US$ billion)

	1970 - 79	1980 - 89	1990 - 99	2000 - 09	2010 - 19	Total
World	237.99	929.23	3,980.01	10,966.25	16,002.26	32,115.74
Africa	11.24	22.02	66.36	310.89	491.32	901.83
America	90.08	438.26	1,373.00	2,973.38	4,791.17	9,665.89
Asia	20.94	120.77	755.29	2,477.19	4,987.98	8,362.16
Europe	102.59	305.07	1,703.30	4,989.60	5,213.11	12,313.66

Source: Author's computations based on UNCTAD data.

[35] All data used in Section 4.2 is obtained from the UNCTAD website and is available at https://unctadstat.unctad.org/datacentre/dataviewer/US.FdiFlowsStock

Table 4.2: Global FDI Inflows - Annual Averages (US$ billion)

	1970 - 79	1980 - 89	1990 - 99	2000 - 09	2010 - 19
World	23.80	92.92	398.00	1,096.62	1,600.23
Africa	1.12	2.20	6.64	31.09	49.13
America	9.01	43.83	137.30	297.34	479.12
Asia	2.09	12.08	75.53	247.72	498.80
Europe	10.26	30.51	170.33	498.96	521.31

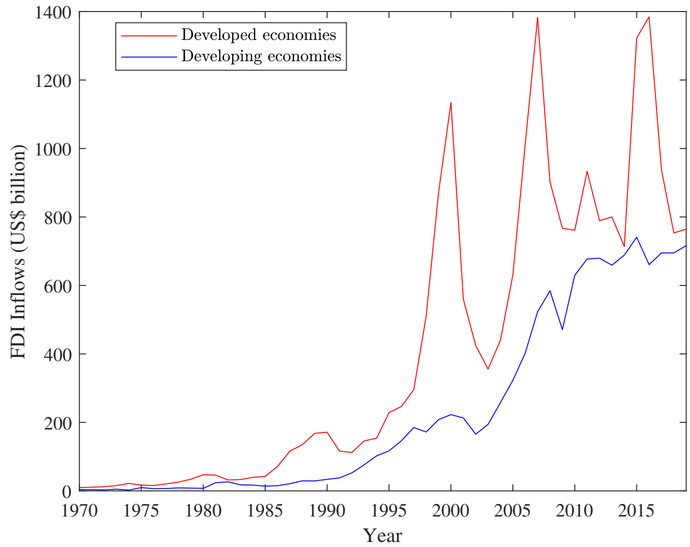
Source: Author's computations based on UNCTAD data.

Figure 4.1 displays the distribution and trend of FDI receipts between developed and developing countries from 1970 to 2019. In particular, a significant surge in the volume of FDI inflows is evident for both developed and developing countries, particularly in the late 1980s and early 1990s. This rise in FDI inflows can be attributed to an increase in the number of source countries[36], better economic conditions in many developing nations, and eased restrictions on profit repatriation (UNCTAD, 1991). However, the amount of FDI into developed countries consistently outpaced that flowing into developing countries during the period 1970-2019.

The plots of FDI inflows scaled by GDP are presented in Figure 4.2 to provide further insight. Similarly to the trend observed in Figure 4.1, there is a distinct increase in FDI receipts for developed and developing countries from the 1980s. However, the plots demonstrate that developing countries have consistently outperformed developed countries in terms of FDI receipts for much of the period, taking into account the size of the countries. This appears to suggest that although the absolute amount of FDI inflows to developing countries is smaller compared to developing countries, it is comparatively larger for developing countries when scaled to their respective economic sizes. However, Figure 4.2 shows that FDI inflows remain relatively low for both developed and developing countries, accounting for less than 4.5% of GDP during the 1970-2019 period.

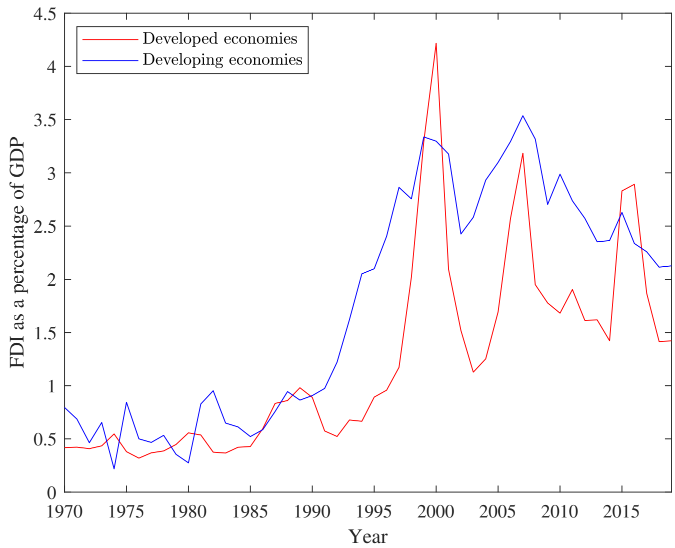
[36]Largely, the coming onto board by Japan as a source country of FDI, reducing the established positions of the United States and the United Kingdom. Other emerging sources included Singapore, Hong Kong, and Taiwan (China province)

Figure 4.1: Patterns of inflows of FDI in Developed and Developing countries



Source: Author, UNCTAD data.

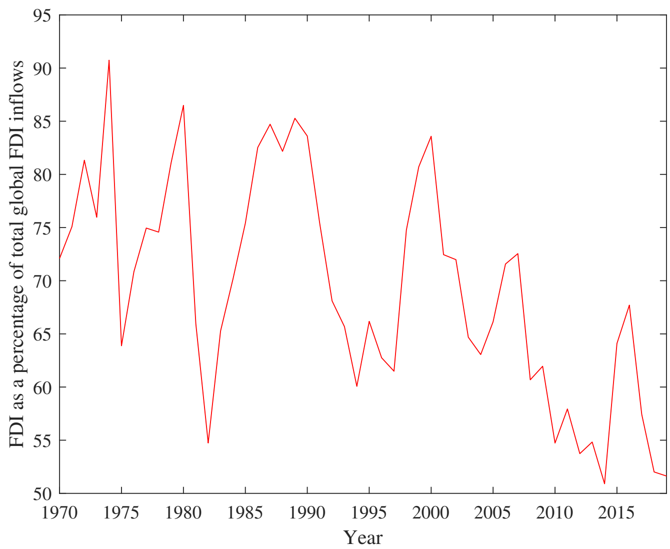
Figure 4.2: Patterns of inflows of FDI in Developed and Developing countries - GDP



Source: Author, UNCTAD data.

Figure 4.3 depicts the proportion of FDI inflows into developed countries as a percentage of total global FDI inflows. For the period 1970-2019, there is a noticeable downward trajectory in the share of FDI inflows. In 1970, developed countries received 72% of global FDI, but this proportion had sunk to 52% by 2019. This development signifies a corresponding increase in the share of FDI receipts in developing countries, rising from 18% in 1970 to 48% in 2019. This suggests that developing countries are increasingly receiving more FDI than developed countries over time.

Figure 4.3: Trend of share of FDI inflows to Developed countries (%)



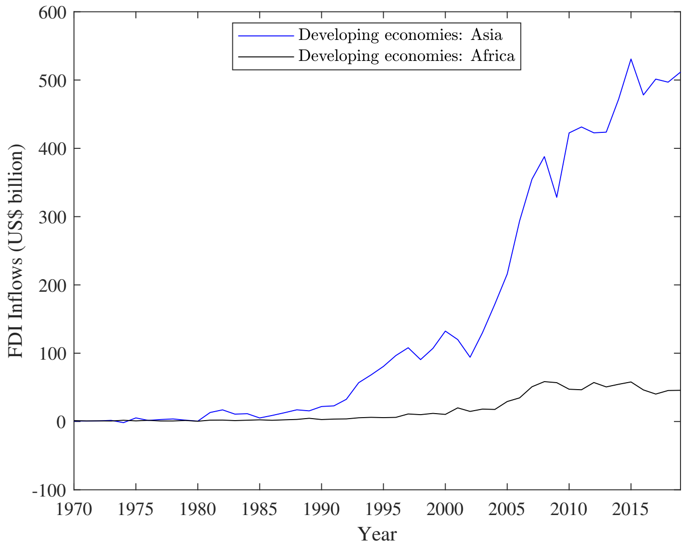
Source: Author, UNCTAD data.

The distribution of FDI inflows to developing countries by regions during the 1970-2019 period, as reflected in Figure 4.4, shows that Asia received the most FDI, while Africa received the least amount. Beginning in the 1980s, many developing countries, initially with IMF support, implemented several structural reforms, including economic liberalisation, to create investor-friendly environments and to support FDI inflows (Kodongo and Ojah, 2013). The surge in the level of FDI, especially since the 1990s, may be attributed to these reforms. However, the response of FDI inflows to these reforms was negligible in the case of Africa. One of the reasons for this is that the reforms implemented in Africa were not extensive (Asiedu, 2004; UNCTAD, 1991). Figure 4.5 shows the plots of FDI inflows into Asia and Africa as a percentage of FDI inflows into developing countries. Notably, Asia[37] accounts for a greater share of FDI, which has increased and represents more than 60% of FDI to developing countries since 2003. The share of FDI to Africa does not reflect an increase, but a decrease to 6.4% in 2019 from approximately

[37]The sharp decline in proportion of FDI to Asia in 1974 is associated with Oil price shock

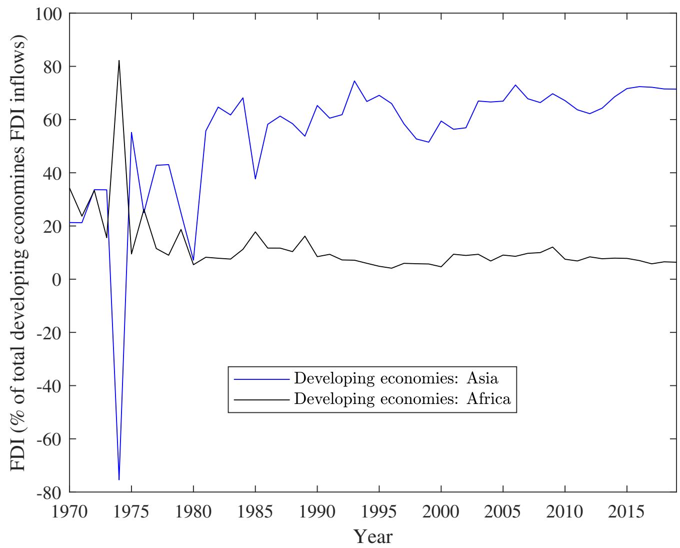
20% in 1976. Concerns about higher corruption levels, poor infrastructure, and weak governance may explain the lower level of FDI receipts (Kandiero and Chitiga, 2006). Another challenge related to Africa is the problem of its undifferentiated image in the eyes of foreign investors (UNCTAD, 1999). This implies that unfavourable conditions for foreign investors in one country could be taken to apply to all African countries.

Figure 4.4: Trends in FDI inflows in Developing countries



Source: Author, UNCTAD data.

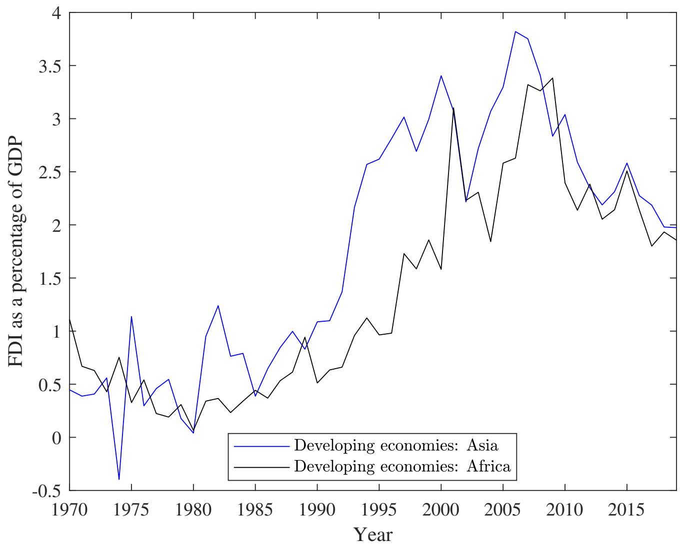
Figure 4.5: Trends in FDI inflows in Developing countries (%)



Source: Author, UNCTAD data.

Figure 4.6 depicts the trend of FDI inflows expressed as a share of GDP. It reveals that the level of FDI inflows to Africa remains generally lower compared to Asia when the size of the countries is taken into account. However, the gap between the two regions has been narrowing since around 2010. It is important to note that the FDI measured against GDP remains low, consistently below 4% between 1970 and 2019.

Figure 4.6: Trends in FDI inflows in Developing countries - GDP



Source: Author, UNCTAD data.

The distribution of FDI inflows among African regions is depicted in Table 4.3 and Table 4.5 lists the countries that belong to each of the regions.

Table 4.3: Total FDI inflows (US$ billion)

	1970-79	1980-89	1990-99	2000-09	2010-19	Total
Northern Africa	1.84	8.95	20.14	120.84	132.22	283.99
Western Africa	5.20	7.05	21.27	64.98	124.54	223.04
Middle Africa	1.74	3.37	7.04	39.09	47.91	99.15
Eastern Africa	1.26	1.51	7.49	36.60	134.80	181.66
Southern Africa	1.20	1.14	10.41	49.39	51.85	113.99

Source: Author's computations based on UNCTAD data.

Northern and Western Africa have received the highest amounts of FDI during the period 1970-2019, receiving a total of US$283.99 billion and US$223.04 billion, respectively. This is followed by Eastern Africa and Southern Africa with FDI inflows of US$181.66 billion and US$113.99 billion, respectively. Middle Africa received the least amount of FDI at US$99.15 billion. In Northern Africa, the higher level of FDI inflows in the 2000-2009 and 2010-2009 periods was related to FDI inflows in Egypt. However, there were notable increases in FDI inflows in Libya during the period 2000–2009 and in Morocco in the period 2010–2019. For Western Africa, the levels of FDI inflows in the periods 2000-2009 and 2010-2009 largely reflect the inflows into Nigeria and Ghana in the periods. Additionally, increases in FDI inflows were observed in Mauritania, Senegal, Mali, and Niger in the period 2000-2009 and in Mauritania, Niger, Togo, Sierra Leone, and Senegal for the period 2010-2019. For Eastern Africa, the large FDI inflow reflected in the period 2010–2019 is attributed to FDI inflows into Mozambique. Table 4.4 shows average annual FDI inflows of more than US$2.0 billion in all regions since the 2000s.

Table 4.4: Average FDI Inflows (US$ billion)

	1970-79	1980-89	1990-99	2000-09	2010-19
Northern Africa	0.18	0.89	2.01	12.08	13.22
Western Africa	0.52	0.71	2.13	6.50	12.45
Middle Africa	0.17	0.34	0.70	3.91	4.79
Eastern Africa	0.13	0.15	0.75	3.66	13.48
Southern Africa	0.12	0.11	1.04	4.94	5.19

Source: Author's computations based on UNCTAD data.

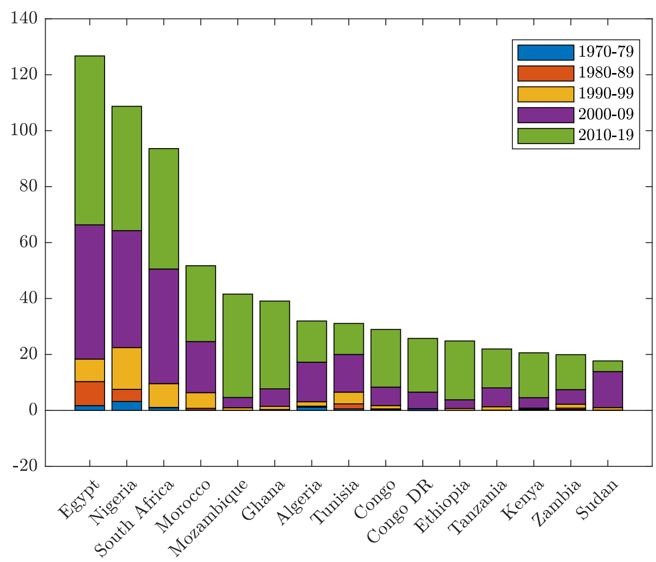
The 15 largest FDI recipient countries in Africa are shown in Figure 4.7. During the period 1970-2019, Egypt received the most amount of FDI at US$126.7 billion, followed by Nigeria at US$108.7 billion and then South Africa at US$93.6 billion. The other countries each received FDI in the range of US$17.7 billion to US$51.7 billion. In terms of the spread of FDI between time periods, it is shown that most countries received larger amounts of FDI in the period 2010–2019, preceded by the period 2000–2009. This is consistent with the pattern reflected at the region level in Table 4.4.

Table 4.5: Countries in Africa Regions

	North Africa		Eastern Africa (cont'd)		Western Africa
1	Algeria	15	Tanzania	1	Benin
2	Egypt	16	Uganda	2	Burkina Faso
3	Libya	17	Zambia	3	Cabo Verde
4	Morocco	18	Zimbabwe	4	Côte d'Ivoire
5	Sudan			5	Gambia
6	Tunisia		**Middle Africa**	6	Ghana
7	South Sudan	1	Angola	7	Guinea
		2	Cameroon	8	Guinea-Bissau
	Eastern Africa	3	Central African Republic	9	Liberia
1	Burundi	4	Chad	10	Mali
2	Comoros	5	Congo	11	Mauritania
3	Djibouti	6	Congo, Dem. Rep.	12	Niger
4	Eritrea	7	Equatorial Guinea	13	Nigeria
5	Ethiopia	8	Gabon	14	Senegal
6	Kenya	9	Sao Tome and Principe	15	Sierra Leone
7	Madagascar			16	Togo
8	Malawi		**Southern Africa**		
9	Mauritius	1	Botswana		
10	Mozambique	2	Eswatini		
11	Rwanda	3	Lesotho		
12	Seychelles	4	Namibia		
13	Somalia	5	South Africa		
14	South Sudan				

Source: Author's compilations based on UNCTAD data.

Figure 4.7: FDI inflows in top 15 African countries



Source: Author, UNCTAD data.

This analysis of the trend of FDI confirms a consistent increase in the level of FDI inflows over time. It also shows a pattern change, with the share of FDI inflows increasing in developing countries and falling in developed countries. However, developing countries still receive lower amounts of FDI than developed countries. It is also evident that the share of FDI inflows into Africa remains relatively low. The circumstances facing Africa are different from those of other developing countries. Therefore, drawing a sample that combines African countries and other developing regions may not be suitable, mainly if the estimation results are intended to guide policy recommendations to improve FDI inflows.

4.3 Literature Review

4.3.1 Foreign Direct Investments

4.3.1.1 Theoretical Perspectives

There are several theories that attempt to explain FDI and its determinants. However, none of them addresses FDI in its entirety (Dunning and Lundan, 2008; Faeth, 2009). Along these lines, Phillips and Ahmadi-Esfahani (2008) notes that with the complex and diverse nature of FDI, the development of a single theory is unlikely.

The theories are easier to understand with knowledge of the types of FDI, as they reflect the motives of foreign investors in undertaking investments in the host country. Dunning and Lundan (2008) identifies and describes four types of FDI: natural resource-seeking FDI, market-seeking FDI, efficiency-seeking FDI and strategic asset-seeking FDI. Natural resource-seeking FDI is motivated by access to natural resources, minerals, and agricultural products in the host country. These resources are not available in the source country. The implication is that buying these resources directly from the host country could be costly. Therefore, foreign investors set up operations in the host countries to gain access to these resources, which, after being extracted or minimally processed, are exported to developed countries, where they serve as production inputs. It should be noted that the resources that motivate this type of FDI can also include specialised technology and cheap labour.

The other type of FDI is market-seeking FDI, which aims to sell goods and services to the host country and sometimes to adjacent countries. The production facilities and processes present in the source countries are reproduced in the host country. Therefore, this type of FDI is also known as horizontal FDI (Shahmoradi and Baghbanyan, 2011). A subset of this type of FDI is tariff-jumping FDI. This relates to a group of foreign investors that previously served the host country with exports but decided to shift the production facility's location to avoid trade barriers and higher transportation costs to increase their profits. Market size, market growth, and trade barriers may be some of the attractions of market-seeking FDI to the host country. However, motivation can be varied, including protecting an existing market, promoting a new market, following major suppliers and clients, promoting product adaptation, and maintaining a physical presence in the top markets served by competitors.

Efficiency-seeking FDI is one in which a centrally managed system is set up to cover all operations, including natural resource-seeking FDI and market-seeking FDI. These operations can be in different host countries. Achieving economies-of-scale and risk diversification are some of the benefits, and it follows that a smaller number of production hubs service multiple markets. Strategic asset-seeking FDI refers to the situation where the investor acquires a specific asset in the host country that provides it with a competitive edge over competitors as part of a long-term strategic objective.

Turning to the theories, as indicated earlier, there are many, and no one theory exhaustively addresses FDI. Some of the theories include ownership advantages; aggregate variables; policy variables; knowledge capital models; and internalisation theory (see Faeth (2009) for a detailed review). However, the Ownership, Location, and Internalization (OLI) framework developed by Dunning (1988) is the most widely used, as it covers a greater part of the activities of FDI. Also, it includes certain elements drawn from other theories, and as such it is also known as the "eclectic paradigm," (Hill, 2008). This framework states that FDI flows to a host country if there are advantages in all three areas, including ownership, locational, and internalisation. The presence of advantages in only one or two of these areas does not encourage the flow of FDI. The ownership advantages relate to the foreign investor owning unique intangible assets such as technology, managerial skills, trademarks, and patents to achieve a competitive advantage in the host country. This area of ownership advantages draws from the work of Hymer (1976) and Kindleberger (1969), in which it is deemed that obtaining monopolistic advantages may be one of the driving factors of FDI activities. The locational advantages relate to the advantages presented by the host country that are unique and immovable in nature. These can include, among others, natural resources, cheaper labour, and skilled labour. Internalisation advantages are those that accrue to the investor by opening a subsidiary in the host country in order to maintain a physical presence. These advantages imply reduced transaction costs, since the investor does not have to engage third-party firms through franchising or licensing to maintain visibility in the host country. The opening of a subsidiary in the host country via FDI internalises the transaction costs facing the investor. The internalisation advantages are based on the internalisation theory of Buckley and Casson (1976). The ownership advantages of the framework and the internationalisation advantages are closely linked and are firm-specific, while the location advantages relate to the host country (Rugman, 2010). It is noteworthy that recently, Dunning and Lundan (2008) updated the OLI framework to include the role institutions play in influencing FDI flows.

Based on the OLI framework, the determinants of FDI at the country level are mainly locational advantages. Host countries can, through their policies, influence locational advantages and attract FDI inflows (Gastanaga et al., 1998; UNCTAD, 1998). These advantages include, among others, natural resources, market size, market growth, labour, openness, infrastructure, and institutions. All these can be influenced by the host countries, except for natural resources.

4.3.1.2 Empirical literature

Several empirical studies have explored the influence of locational advantages on FDI inflows. For developing countries, Asongu et al. (2018) in a joint sample comprising Brazil, Russia, India, China, and South Africa (BRICS) and Mexico, Indonesia, Nigeria, and Turkey (MINT), based on data for the period 2001-2011, established that market size, openness, and infrastructure encouraged FDI inflows, but natural resources and institution quality had no effect. In a study of six countries in the Gulf Cooperation Council[38] over the period 1990–2015, Eissa and Elgammal (2020) found evidence suggesting that market growth, openness, infrastructure, inflation, oil price, and infrastructure positively affected FDI inflows, while oil reserves had a negative influence. The study by Kumari and Sharma (2017) covering 20 Asian countries over the period 1990-2012 established evidence indicating that market size, interest rate, openness, and human capital are important for FDI and that market size was the most significant determinant. Peres et al. (2018) established evidence suggesting that institutional quality had no influence on FDI inflows in developing countries, while in developed countries its effect is positive and significant.

For FDI to Africa, Anyanwu (2011) in a study with data for the period 1980–2007 found evidence indicating that FDI inflows are positively influenced by market size, trade openness, high government expenditure and natural resources, but negatively affected by financial development. Along the same lines, the study by Asiedu (2006) in a panel study of 22 Sub-Sahara Africa (SSA) countries over the period 1984–2000 established that natural resources and large markets attracted greater FDI relative to other determinants. The study also established that factors such as macroeconomic stability, low corruption, infrastructure, labour force, and political stability were important in attracting FDI. Mijiyawa (2015), in a study involving 53 African countries based on unbalanced panel data for the 1970–2009 period, found that FDI was affected by openness, political stability, investment return and existing FDI in host countries, but that it responded more favourably to large countries. The findings obtained by Asiedu (2006) and Mijiyawa (2015) are consistent in that the size of the market is identified as the most signficant factor influencing FDI inflows into Africa. However, in the study by Bende-Nabende (2002), the long-term empirical finding in a study of 19 SSA countries indicated that market size, along with the exchange rate, preceded market growth, export orientation policies, and liberalisation in importance to attract FDI inflows, and that trade openness was the least important determinant of FDI inflows. Obuobi et al. (2022) established evidence showing the importance of liberalisation policies in attracting FDI flows in a study that covered 39 African countries over the period 2000–2017.

[38]The countries include Bahrain, Qatar, Saudi Arabia, Oman, Kuwait, and the United Arab Emirates

In a more recent study that involved SSA countries, Singh and Gal (2020) found evidence indicating that trade freedom and business freedom positively affect FDI inflows. Sooreea-Bheemul et al. (2020) in a study involving 40 SSA countries established evidence suggesting that economic freedom positively affects FDI inflows. A similar result is reported in a study by Dia and Ondoa (2023) that considers 41 SSA countries. Suliman and Mollick (2009), in a study involving 29 SSA countries for the period 1980–2003, found that FDI inflows respond positively to literacy rate and improvements in political rights and civil liberties and that FDI responds negatively to war.

Based on the above review of empirical results on the location advantages of FDI, the importance of market size, market growth, institutions, labour, and infrastructure are noted. These factors fall into the four categories of FDI determinants suggested by Dimitrova et al. (2020). The categories include macroeconomic and financial, institutional and regulatory, natural resource availability, and socio-cultural factors. After reviewing the theoretical and empirical literature on FDI in general, the study delves into the literature on the relationship between the exchange rate and FDI in the subsequent section.

4.3.2 Exchange rate and FDI

4.3.2.1 Theoretical Perspectives

Theoretical perspectives on the relationship between the exchange rate and FDI are ambiguous. One of the points of view is that the currency of the host country, whether it is appreciating or depreciating, has no effect on FDI inflows. The other view is that the depreciation of the currency of the host country encourages FDI inflows. There is also a view that suggests that the appreciation of the host country's currency promotes FDI inflows.

Despite the work of Aliber (1970) that attempted to link the exchange rate and FDI, the traditional theory, as expressed by McCulloch (1989), holds that there is no relationship between the two variables. Therefore, the exchange rate does not play a role in influencing FDI inflows. This view accounts for the randomness of exchange rate movements, which implies that the current exchange rate is the expected future exchange rate. In line with this, it is argued that the exchange rate does not present differences in the valuation of investments in the host country between indigenous and foreign investors. The value of investments is expected to be the same for both indigenous and foreign investors. This is because the exchange rate has the same effect on both investment costs and investment income streams. Keeping these lines in mind, while a currency depreciation (appreciation) of the host country at the time of the investment lowers (increases) the investment cost for the foreign investor, it also lowers (increases) the present value of the investment income streams such that there are no exchange rate-driven gains for foreign investors (see Chakrabarti and Scholnick, 2002).

However, despite the above argument, the relative wealth hypothesis developed by Froot and Stein (1991) suggests that changes in exchange rates have an influence on FDI. Specifically, the hypothesis shows that a currency depreciation of the host country encourages FDI inflows. The assumption of imperfect capital markets supports the hypothesis, without which the relationship that prevails between the exchange rate and FDI would no longer exist. With imperfect capital markets at play, information asymmetries on investment return ensue. This leads to higher monitoring costs, making external financing more costly than internal financing. This situation forces foreign investors to rely on their relative wealth to finance their investments in the host country, leading to a positive correlation between relative wealth and FDI. This means that the higher the relative wealth of foreign investors, the greater the potential to make an investment in the host country. The wealth of foreign investors is assumed to be held in their home country's currency. The depreciation of the host country's currency relative to the currency of the home country of the foreign investor increases their wealth position, increasing their ability to fund investments.

In line with the above, a depreciation of the host country's currency from the perspective of foreign investors lowers investment costs and thus provides an incentive for undertaking foreign investment activities. As a result, a currency depreciation of the host country translates into increased foreign investment activities. A limitation of the relative wealth hypothesis, in line with the traditional view, is that the established connection between the exchange rate and FDI only takes into account the investment costs and leaves out the investment income streams. This is because the relationship between the exchange rate and the income streams of the investments is not addressed by the hypothesis. However, Froot and Stein (1991) obtained empirical support for the hypothesis using quarterly data from 1973–1988 and a sample of 13 industries in the United States (US). The finding suggested that the depreciation of the US dollar resulted in an increase in FDI inflows.

Taking into account the relative wealth hypothesis, Blonigen (1997) developed a theoretical model suggesting that a depreciation of the host country's currency leads to increases in foreign investment activities, especially in acquisitions of firm-specific assets. Similarly to the relative wealth hypothesis, a depreciation in the currency of the host country reduces investment costs and provides an incentive for investing in the country. However, the theoretical model attempted to address the link between the exchange rate and investment returns. Therefore, it is assumed that the currency of investment or purchase of firm-specific assets in the host country is different from the currency in which investment income streams are generated. The implication of this is that currency depreciation reduces the investment costs but not the present value of the investment income streams. This presents a difference in investment valuations between indigenous and foreign investors, thereby dismissing the traditional theory argument that the exchange rate has no effect on FDI. This theoretical model was empirically tested on investments by Japanese firms in three-digit SIC industries in the United States over the period 1975-1992 and the results were consistent. It was shown that a real depreciation of the US dollar attracted FDI flows to the United States.

In relation to the work of Froot and Stein (1991) and Blonigen (1997) is the work of Chakrabarti and Scholnick (2002) that provides a theoretical contribution that supports a positive relationship between currency depreciation and FDI inflows in the host country. The exchange rate expectation channel is incorporated into the relationship between the exchange rate and FDI to address the effect of the exchange rate on investment income streams. Specifically, a mean reversion element was used in the theoretical model to reflect the exchange rate expectations. In line with this, the model showed that a currency depreciation now generated expectations of a currency appreciation in the future, while a currency appreciation was associated with expectations of a currency depreciation in the future. The mean reversion nature of the exchange rate, unlike its randomness under traditional theory, implied that the exchange rate produced differences in investment valuation between foreign and indigenous investors in the host country.

Similarly to the wealth hypothesis, the theoretical model projected that a currency depreciation of the host country would depress the investment cost, leading to increases in FDI inflows. Taking the expectation channel into account, a currency depreciation in the host country was expected to be followed by an appreciation, which might coincide with investment income streams, thereby amplifying the investment returns in the foreign investors' currency. This theoretical model is applicable in situations of excessive exchange rate movements because that is when the mean reversion process is most likely to occur. Therefore, this implies that moderate currency depreciation may not attract FDI inflows into the host country. The empirical test of the model on FDI flows in 20 OECD countries from the United States between 1982 and 1995 confirmed this. It was found that large currency depreciations in host countries led to FDI inflows, while average depreciations had no effect.

The work of Aliber (1970) can be seen as suggesting that a currency depreciation of the host country encourages FDI inflows. Aliber (1970) showed that firms from source countries with stable or strong currencies could raise funds cheaply both in the source and host countries. This is because the borrowing costs facing these firms included a lower or no premium to cover the exchange rate risk. In view of this, these firms could borrow at lower interest rates than indigenous firms in the host country. The implication of this is that investors from source countries with stronger currencies may be encouraged to make investments in host countries in which the currency is depreciating or is generally weaker.

A theoretical viewpoint, contrary to the ones highlighted above, suggesting that currency appreciation in the host country promotes FDI inflows, is obtained from the work of Campa (1993). The viewpoint is generated based on a framework built on the option pricing model. On the basis of the framework, it was shown that the exchange rate and the expectation of future profits were correlated. Specifically, appreciation of the host country's currency increased expectations of future profitability and, as a result, increased FDI inflows. However, this analysis assumed that the production inputs were obtained from the source country.

In relation to the above analysis, some sections of the literature suggest that the relationship between the exchange rate and FDI depends on where the production inputs are sourced, or rather the type of FDI (Cushman, 1988, 1985; Chen et al., 2006; Bénassy-Quéré et al., 2001). For the type of FDI where production inputs are sourced from the source country, as in the case of Campa (1993), an appreciation of the currency of the host country encourages FDI. An appreciation of the currency of the host country reduces the investment cost from the perspective of the host country and increases profitability. The appreciation in the currency of the host country then amplifies the profits returned to the source country. With the type of FDI, such as export-oriented FDI, where production inputs are sourced from the host country, a currency depreciation of the host country favours FDI inflows. The depreciation of the host country's currency first reduces investment costs, and second improves the competitiveness of the product in international markets.

As with the theoretical viewpoints, the empirical evidence on the effect of the exchange rate on FDI inflows is divided. In the US, empirical evidence suggesting that the US dollar depreciation leads to an increase in FDI inflows is established by Caves (1989), Cushman (1988), Klein and Rosengren (1994) and Swenson (1994), which is consistent with Froot and Stein (1991). Caves (1989) examined inflows from 15 developed countries during the period 1978-1986, Cushman (1988) considered inflows into the United States from Canada, France, Japan, Germany, and the United Kingdom during the period 1963-1986, and Klein and Rosengren (1994) investigated FDI inflows into the United States from seven developed countries, Canada, France, Germany, Japan, the Netherlands, and Switzerland, over the period 1979-1981. Evidence suggesting that the appreciation of the US dollar encourages FDI inflows is established by Campa (1993) as shown earlier. Empirical evidence suggesting that the exchange rate has no effect on the FDI is found by Ray (1989) and Healy and Palepu (1993).

With respect to other developed countries, empirical evidence of a positive effect of the depreciation of the currency of the host country on FDI flows is established by Goldberg and Kolstad (1994). This was found in a study that examined FDI flows between Canada, Germany, the United Kingdom, and the United States during the period 1978-1991. In contrast to these findings, Boateng et al. (2015) established evidence suggesting that the appreciation of the Norwegian currency attracted FDI inflows from 1986 to 2009. However, the study by Vita and Abbott (2007) that examined FDI inflows into the UK from seven major countries found evidence suggesting that the exchange rate had no significant effect on FDI inflows after controlling for endogeneity.

In terms of FDI inflows to developing countries, Sharifi-Renani and Mirfatah (2012) established evidence suggesting that currency depreciation in Iran over the period 1980–2006 attracted FDI inflows. A similar result was obtained by Ullah et al. (2012) in Pakistan, covering the period 1980–2010. However, Abbott et al. (2012) in a study covering 70 developing countries during the period 1985-2004 established that the exchange rate does not influence FDI. Instead, the evidence found suggested that exchange rate regimes were important determinants of FDI, with hard and intermediate regimes attracting more FDI inflows than flexible regimes based on non-IMF data. Durairaj and Nirmala (2012) also found evidence that the exchange rate had no influence on FDI in India during the period 1996–2010.

With respect to Africa, the empirical findings are also mixed. In Ghana, the study by Mensah et al. (2017) based on data for the period 1990-2012 found results suggesting that currency depreciation attracts FDI inflows, while a study by Kyereboah-Coleman and Agyire-Tettey (2008) using data for the period 1970-2002 established evidence indicating that the exchange rate does not encourage FDI inflows. For Nigeria, Osinubi and Amaghionyeodiwe (2009) established evidence suggesting that the depreciation of the domestic currency positively affected FDI inflows during the period 1970–2004, while a study by Oke et al. (2012) found evidence indicating an insignificant effect of the exchange rate on FDI. In Mauritius, studies by Babubudjnauth and Seetanah (2020), Moraghen et al. (2021), and Moraghen et al. (2023) found evidence indicating that FDI inflows respond positively to currency depreciation.

In Tunisia, Hniya et al. (2021) found that appreciation of the currency attracts FDI inflows in the short term but discourages FDI in the long term. The implication is that currency depreciation promotes FDI inflows in the long term. Suliman et al. (2015) established evidence in a panel study covering SSA countries indicating that currency depreciation in the host country favoured FDI inflows.

4.3.3 Mediating effects in the relationship between FDI and its determinants

The mediating effects on the relationship between FDI and its determinants examined by the existing literature are briefly reviewed in this section. As indicated earlier, mediating effects have mostly been examined using linear models by including an interaction term variable or a squared variable. The study first reviews research that addresses mediating effects or non-linearity by incorporating interaction terms, and thereafter followed by a review of studies employing squared variables for the same purpose. The studies that employ non-linear models on the reviewed mediating effects are also highlighted.

4.3.3.1 Analysis of mediating effects using interaction terms

Trade Openness

The role of trade openness has been explored in the relationship between exchange rate volatility and FDI. Furceri and Borelli (2008), in a study involving European countries and data over the period 1995–2005, established a threshold level of trade openness of 125%. In relation to this, the results suggested that the impact of the volatility of the exchange rate was negative for countries with a level of openness below 125% and positive, on average, for countries with a level of openness above 125%. Therefore, it was concluded that the more open countries had less adverse effects of exchange rate volatility on FDI inflows compared to the closed countries. Arratibel et al. (2011), in a study of European countries and data for the period 1995-2008, also found similar results. The hypothesis tested was whether the adverse effect of exchange rate volatility on FDI was worse in more open countries. The results suggested that an increased level of openness does not increase the adverse effect of exchange rate volatility on FDI inflows. Havi (2021) obtained different results in Ghana during the period 1970-2018. Using the dynamic ordinary least-squares method, the results obtained suggested that a higher level of openness amplified the adverse effects of exchange rate volatility on FDI.

Financial Development

The role of financial development on the relationship between exchange rate volatility and FDI has been investigated. Jehan and Hamid (2017) on a sample comprised of 114 developing countries with data for the period 1980–2013 and using the Generalised Method of Moments (GMM) estimation technique found results suggesting that countries with strong financial sectors may have less adverse effects on FDI inflows from exchange rate volatility. Asamoah et al. (2022) obtained a similar result in a study of 40 African countries over the period 1990–2018, although a different set of financial development indicators was used. The study used the GMM estimation technique in its analysis. Khraiche and Gaudette (2013) reports a different result in a study that used the GMM estimation technique and a sample composed of 39 emerging countries from Latin America and Asia with data for the period 1978–2009. The results suggested that a higher level of financial development led to the volatility of the exchange rate having a negative effect on FDI. The study also suggested that countries with low financial development are better able to attract FDI because the impact of exchange rate volatility was found to be positive and significant in the direct relationship. The explanation given for the negative influence of financial development on the exchange rate volatility - FDI relationship is that countries with higher financial development may require less FDI to hedge against exchange rate volatility.

The mediating role of financial development in the relationship between foreign aid and FDI was investigated by Aluko (2020) on a sample composed of 47 African countries during the period 1996-2016. In the study, a dynamic panel threshold model was used. The results suggested that foreign aid had a positive influence on FDI for countries with robust financial development. The mediating role of institutions on the foreign aid-FDI nexus was also examined. The findings suggested that foreign aid attracted FDI to countries with better institutions.

Institutions

The mediating role of institutions has also been considered in FDI-determinant relationships. Asamoah et al. (2016) examined the role of institutions on the relationship between exchange rate volatility and FDI in a sample of 40 SSA countries with data for the period 1996–2011. The study, using the GMM estimation technique, established evidence suggesting that institutional quality has the effect of reducing the adverse effect of exchange rate volatility on FDI. Asiedu (2013) examined the role of institutional quality in the relationship between natural resources and FDI based on a sample of 99 developing countries during the period 1984-2011. Using the GMM estimation technique, the results showed that FDI was negatively affected by natural resources and positively affected by the interaction of institutional quality and natural resources. These results suggest that institutional quality mitigates the adverse effects of natural resources on FDI and, as such, improving institutional quality would be beneficial for natural resource-rich countries. Magbondé and Konté (2022) examined the role of institutions in the relationships of FDI with financial development, human capital, and macroeconomic policies (captured by inflation rate) in a sample of 124 developing countries during the period 2002-2018. The results indicated that the institutions improved the allure of human capital for FDI inflows.

Ogbonna et al. (2022) examined the role of economic governance institutions in the relationship between global uncertainty and FDI in a study covering 46 African countries over the period 2010-2019. The GMM estimation technique was used, and the results showed that global uncertainty had a negative effect on FDI, while the interaction of economic governance institutions and global uncertainty had a positive effect on FDI. Therefore, the results suggested that the institutions helped moderate the adverse effect of global uncertainty on FDI. Along the same lines, Kurul (2017), unlike other researchers, employed a dynamic panel threshold model and examined whether institutional quality is associated with a threshold based on which it encourages FDI inflows. The study was carried out on a sample of 126 countries with data for the period 2002–2012. The results indicated that institutional quality encouraged FDI when its level was above a certain threshold.

Natural Resources

Asiedu and Lien (2011) investigated the role of natural resources in the democracy-FDI relationship on a sample of 112 developing countries during the period 1985–2007. The GMM modelling technique was used, and the estimation results showed that democracy positively affected FDI, while the interaction between democracy and natural resources had a negative effect on FDI. The study interpreted these results as implying that democracy in countries rich in natural resources deters FDI inflows, but encourages FDI in countries with low natural resources.

The study by Taşdemir (2022) employed a number of mediating effects, some of which include those reviewed above, to examine how FDI is impacted by domestic economic growth and global financial conditions. The study covered 11 Middle East and North Africa (MENA) using data for the period 1995-2017 and the static panel threshold regression model developed by Hansen (1999) in conjunction with the GMM modelling technique. The mediating effects were represented by natural resources, trade openness, financial openness, financial depth, and human capital, which were classified as structural domestic conditions. The results showed that higher financial depth, greater trade and financial openness, low human capital, and less natural resource endowment were associated with higher FDI inflows. It was also established that global financial conditions tended to hamper FDI inflows in countries with a higher level of trade and financial openness, higher financial depth, and fewer natural resources.

4.3.3.2 Analysis of mediating effects using squared variables

There are other studies that capture the role of a mediating effect, not with interaction terms as with most studies reviewed above, but by incorporating a square of an FDI determinant in the linear model. Asamoah et al. (2022) incorporated the square of exchange rate volatility in examining the relationship between exchange rate volatility and FDI. The results of the study, which involved 40 countries and used GMM modelling technique on data for the period 1980-2018, suggested that the relationship between exchange rate volatility and FDI is 'U-shaped'. This implied that at lower levels of exchange rate volatility, the impact of exchange rate volatility on FDI inflows is negative, while at higher levels of exchange rate volatility, the impact is positive. Therefore, the results suggested the existence of a threshold below which FDI inflows respond negatively to exchange rate volatility and positively above it. A similar result of a "U-shaped" relationship between exchange rate volatility and FDI is reported by Jeanneret (2007) in a study covering 27 OECD countries over the period 1982-2002 and using ordinary least squares and GMM modelling techniques.

Another mediating effect captured by including a squared variable in linear models is the growth domestic product per capita (GDPK). Asiedu and Lien (2004) in a study comprising 96 developing countries over the 1970-2000 period established evidence indicating that the relationship between GDPK and FDI was 'U-shaped'. Asiedu and Lien (2011) found a similar result in a study that involved 112 developing countries and data for the period 1997–2000. Contrary to these results, Cleeve et al. (2015) in a study covering 35 SSA countries with data over the period 1980–2012, found evidence suggesting an inverted "U-shaped" relationship between GDPK and FDI. This implied that GDPK, at its lower level below a certain threshold, attracted FDI, but ceased to do so when its level was above the threshold.

It is clear from the reviewed literature that the role of mediating effects in FDI-determinant relationships is mostly investigated using linear models. It is also evident that the threshold variables proposed for trade openness, natural resources, and institutions in this study have been used by previous studies to capture the mediating effects on FDI-determinant relationships. However, the exchange rate-FDI relationship has not previously been subjected to the mediating effects of these variables or any other.

4.3.4 Non-linear models

This section briefly reviews studies that have used non-linear models to examine the relationship between the exchange rate and the trade balance. Enisan (2017) employed the Markov switching model and data on Nigeria during the period 1986-2012. The study examined the impact of the exchange rate on FDI, taking into account the structural changes over time captured in the model by transitional probabilities. The results suggested that currency appreciation in Nigeria attracts FDI inflows in both the lower and higher regimes. The study by Qamruzzaman et al. (2019), using the Non-linear Autoregressive Distributed Lag (NARDL) model of Shin et al. (2014), investigated the asymmetric effect of the exchange rate on FDI inflows in Bangladesh during the period 1974–2016. The results of the study suggested that the relationship between the exchange rate and FDI is asymmetric and that, in the long-run, FDI reacts more strongly to currency depreciation than to appreciation. The results also showed that currency depreciation encourages FDI inflows.

Based on the previous work reviewed here, it is clear that the focus of these studies, though they employ non-linear models, is different from that of this study. This study aims to examine the mediating effects on the exchange rate-FDI relationship based on trade openness, natural resources, and institutions.

4.4 Methodology

The Dynamic Panel Threshold (DPT) model developed by Seo and Shin (2016) is used for empirical estimations to establish whether trade openness, natural resources, and institutional quality induce non-linearity effects on the exchange rate-FDI relationship. The analysis is extended to the relationship between FDI and its other determinants, in addition to the exchange rate, which enter the model as control variables.

Most studies exploring the relationship between FDI and its determinants use the Generalised Method of Moments (GMM) estimator because of its ability to handle the problem of endogneity. Some of these studies include Asiedu (2013), Ogbonna et al. (2022), Jeanneret (2007), Asamoah et al. (2022), Anyanwu (2011), among others. In line with this, the DPT model is appealing in that it is built on the first difference GMM estimator, which was introduced by Arellano and Bond (1991). The DPT model is also attractive relative to other non-linear models, such as the Panel Smooth Transition Regression model. This is because the regressors in the DPT model do not have to be strictly exogenous. The model is designed in such a way that regressors, including the threshold variable, can be endogenous (Seo and Shin, 2016). As with the GMM modelling technique, the DPT model best suits situations where N > T.

Following Seo and Shin (2016), the DPT model is specified as depicted below:

$$y_{it} = (1, x_{it}^{'})\psi_1 I(q_{it} \leq \gamma) + (1, x_{it}^{'})\psi_2 I(q_{it} > \gamma) + u_i + \epsilon_{it} \tag{4.1}$$

Where y_{it} is the vector of the dependent variable and represents the FDI inflows for $i = 1, \cdots, N$ and $t = 1, \cdots, T$. x_{it}' is an m-dimension vector of explanatory variables consisting of the exchange rate, control variables, and the lag of the dependent variable (y_{it-1}). u_i is the unobserved fixed effect and ϵ_{it} is the error term with distribution $(0, \sigma^2)$. ψ_1 and ψ_2 are coefficients for the lower and higher regimes, respectively. $I(\cdot)$ is the indicator function. q_{it} represents the threshold variable, while γ reflects the threshold parameter, which is the level of the threshold variable that defines the lower and higher regimes. The values of the threshold variable below the threshold reflect the lower regime, while the values above the threshold represent the higher regime.

Equation 4.1 is differenced to eliminate u_i due to its correlation with x'_{it}. This generates Equation 4.2 specified as follows:

$$\Delta y_{it} = \beta' \Delta x_{it} + \delta' X'_{it} I_{it} + \Delta \epsilon_{it} \tag{4.2}$$

where $\underset{m\times 1}{\beta'} = (\psi_{1,2}, \cdots, \psi_{1,m+1})\prime$, $\underset{m\times 1}{\delta'} = \psi_2 - \psi_1$,

$$\underset{2\times(1+m)}{\mathrm{X_{it}}} = \begin{pmatrix} (1, x'_{it}) \\ (1, x'_{it-1}) \end{pmatrix}, \ \underset{2\times 1}{\mathrm{I_{it}}} = \begin{pmatrix} I(q_{it} > \gamma) \\ I(q_{it-1} > \gamma) \end{pmatrix}$$

Given the correlation between Δx_{it} and $\Delta \epsilon_{it}$, an l-dimension vector of instrumental variables (z_{it}) is introduced and consists of the lags of x_{it} and q_{it}. The condition $E(\Delta \epsilon_{it}|Z_{it}) = 0$, for each $t = t_0, \cdots, T$ is satisfied. However, it should be noted that the model allows q_{it} to be treated endogenously such that $E(\Delta \epsilon_{it}|q_{it}) \neq 0$. In this case, the lagged values of q_{it} do not form part of Z_{it}.

The unknown parameters to be estimated by the DPT model are represented by θ, where $\theta = (\beta', \delta', \gamma)'$. The sample moment condition through which these parameters are estimated is defined as follows:

$$\bar{g}_n(\theta) = \frac{1}{n} \sum_{i=1}^{n} (g_i(\theta)) \tag{4.3}$$

$$\text{where } \underset{l\times 1}{\mathrm{g_i}}(\theta) = \begin{pmatrix} Z_{it0}(y_{ito} - \beta' \Delta x_{it0} - \delta' X'_{it0} I_{it0}(\gamma) \\ \vdots \\ Z_{iT}(y_{iT} - \beta' \Delta x_{iT} - \delta' X'_{iT} I_{iT}(\gamma) \end{pmatrix} = (Z'_{ito} \Delta \epsilon_{ito}, \cdots, Z'_{iT} \Delta \epsilon_{iT})'$$

$\Omega = E(g_i g'_i)$ and is positive definite. It is assumed that $E(g_n(\theta)) = 0$ for $\theta = \theta_0$. A weight matrix W_n as part of the GMM criterion function is incorporated where $W_n \xrightarrow{p} \Omega^{-1}$, resulting into the following:

$$\bar{J}_n(\theta) = \bar{g}_n(\theta)' W_n \bar{g}_n(\theta) \tag{4.4}$$

The estimation of θ by the GMM estimator is specified as follows:

$$\theta = \arg\min_{\theta \in \Theta} \bar{J}_n(\theta) \tag{4.5}$$

The DPT model estimation using two-step GMM is conducted in two steps. The first step involves minimising $\bar{J}_n(\theta)$ with $W_n = l_n$ so as to obtain $\Delta\epsilon_{it}$. The second step involves estimating θ by minimising with W_n defined as follows:

$$W_n = (\frac{1}{n}\sum_{i=1}^{n} \hat{g}_i \hat{g}_i' \frac{1}{n^2}\sum_{i=1}^{n} \hat{g}_i \sum_{i=1}^{n} \hat{g}_i')^{-1} \tag{4.6}$$

where $\hat{g}_i = (\Delta\epsilon_{it0} Z_{it0}', \cdots, \Delta\epsilon_{iT} Z_{iT}')'$.

The estimation of the DPT model is supported by the linearity test, which determines whether threshold effects exist or not. The null hypothesis indicates that there are no threshold effects, $H_0 : \delta = 0$, and the alternative hypothesis suggests the presence of threshold effects, $H_1 : \delta \neq 0$. The rejection of the null hypothesis provides justification for the use of the DPT model. In terms of linearity tests, there is an identification problem because the model is identified in the alternative hypothesis, and not in the null hypothesis. To address this, Seo et al. (2019) suggests using a supremum-type statistic, specified as follows:

$$SupW = supW_n(\gamma) = n\hat{\delta}(\gamma)' \sum \delta(\gamma)^{-1} \hat{\delta}(\gamma) \tag{4.7}$$

where $\hat{\delta}(\gamma)$ reflects the GMM estimator and $supW_n(\gamma)$ represents the Wald statistic.

4.5 Data

4.5.1 Data description

The study considers a sample of 44 African countries, depicted in Table 4.6. Variables considered include foreign direct investment, exchange rate, trade openness, natural resources, human capital, infrastructure, institutional quality, and economic growth. The dependent variable is foreign direct investment, and the variable of interest is the exchange rate. The other variables serve as control variables, and their selection is guided by the literature. Variables of trade openness, natural resources, and institutional quality also serve as candidate threshold variables in the DPT model. A balanced panel dataset is employed, with annual data, spanning the period 1996–2019. The availability of data influences this time frame, specifically institutional quality data that is available from 1996. As with previous studies such as Asiedu (2002) and Anyanwu (2011), cross-sectional time-series data is used to moderate cyclical fluctuations. Along these lines and following Asiedu and Lien (2011), the data is averaged over four-year non-overlapping periods. The variables used are described below.

Foreign Direct Investment is measured as net investment inflows divided by GDP. Foreign direct investment refers to investments in which foreign investors own 10% or more equity and thus reflect long-term management interest (OECD, 2008; UNCTAD, 2014). The data is obtained from the World Bank Group Databank for World Development Indicators.

Exchange rate is represented by the real effective exchange rate following Cambazoglu and Gunes (2016). The data on the real effective exchange rate is taken from the Bruegel datasets[39], and it is based on the work of Darvas (2021) and Darvas (2012). There are two real effective exchange rates published in annual format, a broader index that involves 170 trading partners, and a narrower index that captures 65 trading partners. Both exchange rates are used to ensure the robustness of the results. The real effective exchange rate is defined as the value of the currency against a basket of currencies for trading partners, adjusted by a price deflator. An increase in the exchange rate level reflects the appreciation of the currency of the host country[40], according to the data source. In this study, this definition is altered by taking the reciprocal, so a rise in the exchange rate level now denotes a depreciation of the host currency. The expected effect of the exchange rate on FDI inflows is positive. This implies that a currency depreciation of the host currency encourages FDI inflows, according to empirical evidence from Froot and Stein

[39]see footnote 8 for the web address to access the dataset

[40]Host country implies the country receiving FDI inflows

(1991) and others.

Natural resources as a variable is represented by the rent of natural resources, expressed as a percentage of GDP. Natural resource rent refers to the sum of rents on natural resources that include oil, coal, gas, mineral, and forest, as defined in the World Bank Group Databank for World Development Indicators from which it is taken. Natural resources are an important driver of FDI inflows, especially resource-seeking FDI (Dunning and Lundan, 2008). In Africa, natural resources are considered one of the key locational advantages of FDI (Onyeiwu and Shrestha, 2004; Cleeve et al., 2015; UNCTAD, 1993). However, the effect of natural resources on FDI inflows is ambiguous, as it can be positive or negative (Asamoah et al., 2016).

Trade openness is the sum of exports and imports at current national prices measured as a percentage of GDP at current national prices. The data is sourced from the World Penn Table, version 10.01, where it is available for all countries in the sample. This data is based on the work of Feenstra et al. (2015). The effect of trade openness is ambiguous and depends on the type of FDI. Lower levels of trade openness attract tariff-jumping FDI, which may previously have been serving the host country with exports. Export-oriented FDI may not be attracted by lower levels of openness, as it may lead to an escalation of production costs, especially if some inputs have to be imported. Therefore, a higher level of trade openness would be more appealing to export-oriented FDI. However, this may not be attractive to tariff-jumping FDI, and they prefer to serve the host country with exports (Blonigen, 2005). The implication of this is that the overall effect of trade openness on FDI inflows is likely to depend on the type of FDI that is dominant at an aggregate level. In this regard, the expected effect of trade openness on FDI is positive or negative.

Human capital is represented by life expectancy at birth, obtained from the World Bank Group Databank for World Development Indicators. According to the data source, life expectancy at birth is an estimate of the expected number of years that a newborn would live, assuming that the mortality rate existing at the time of birth remains unchanged. This proxy for human capital has been used in other studies, such as those of Anyanwu and Yameogo (2015) and Aluko (2020)[41]. However, it should be noted that there is a link

[41] Various studies have employed different proxies for human capital. Examples of these

between educational levels and life expectancy (see Kouladoum, 2023). In this regard, life expectancy also acts as a proxy for human capital in the form of education.

Human capital is an important influencer of FDI activities (Moraghen et al., 2021; Dunning and Lundan, 2008). A well-educated workforce makes the host country more attractive to FDI (Asiedu, 2004). This implies that the state of the workforce is of great importance, as the workforce can deter FDI if it lacks education or the necessary skills, and can encourage FDI if it is skilled. The effect of human capital on FDI flows is expected to be positive [42].

Infrastructure is, following Asiedu (2004), represented by the sum of telephone lines and mobile subscriptions per 100 people. The data is taken from World Bank Group Databank for World Development Indicators. It is of significant importance to attract FDI inflows (Shah et al., 2014; Asongu et al., 2018; Asiedu, 2006). Infrastructure plays a crucial role in facilitating the production of goods and services, making markets accessible, reducing transport costs, and lowering production costs (Horvat et al., 2021). This, in turn, forms the basis for attracting FDI inflows. The impact of infrastructure on FDI inflows varies depending on whether its state is good or poor. Poor infrastructure has deleterious effects on FDI inflows, while good or well-developed infrastructure has a positive impact (Kandiero and Chitiga, 2006; Reinikka and Svensson, 1999; Onyeiwu and Shrestha, 2004; Asiedu, 2006). Infrastructure in Africa has seen some development, but is lacking compared to other regions, such as Asia (Asiedu, 2004). The annual financing gap of US$100 billion (AfDB, 2018) demonstrates the critical need for infrastructure in Africa. The expected effect of infrastructure on FDI inflows is mixed.

Institutional quality is an unweighted composite constructed by taking averages of all governance indicators that include control of corruption, rule of law, government effectiveness, regulatory quality, voice and accountability, as well as political stability and absence of violence or terrorism. Several

proxies include the literacy rate (e.g., Suliman and Mollick, 2009), secondary school enrollment rate, tertiary enrollment rate, and average years of schooling (e.g., Cleeve et al., 2015). These proxies could not be used in this study, as they are not consistently available for all countries in the sample.

[42] It is noteworthy, however, that Anyanwu and Yameogo (2015), using life expectancy as a proxy for human capital, found a negative influence on FDI flows for West African countries, while Alsan et al. (2006) identified a positive effect in a study involving 74 advanced and developing countries.

studies use the unweighted composite, some of which include Asiedu (2013), Asamoah et al. (2016), and Daude and Stein (2007). The data is obtained from the World Bank Group databank for Worldwide Governance indicators[43] and based on the work of Kaufmann et al. (2010). Each of the governance indicators ranges from -2.5 to 2.5. In this study, the data is normalised to range from 0 to 1, following Asiedu (2006). A lower value reflects low levels of institutional quality, while a higher value indicates a higher level of institutional quality. Stronger institutions reduce the cost of doing business by lowering corruption levels, promoting political stability, strengthening protection of property rights, and improving the reliability of the legal system (Daude and Stein, 2007; Blonigen, 2005). The expected effect of institutional quality on FDI inflows is positive, which implies that institutional quality promotes FDI inflows.

Economic growth is represented by the growth of real Gross Domestic Product (GDP) defined in the World Bank Group Databank for World Development Indicators, from which it is obtained as the percentage increase in annual GDP based on a constant local currency. Economic growth reflects market growth and is important for FDI. With a rise in economic growth, there is an increase in income levels in the host country, resulting in increased demand conditions and a larger market size for goods and services (Abbott et al., 2012). Therefore, the expected effect of economic growth on FDI inflows is positive.

[43]Found at https://databank.worldbank.org/source/worldwide-governance-indicators

Table 4.6: Countries in the sample

1	Algeria	16	Eswatini	31	Mozambique
2	Angola	17	Ethiopia	32	Namibia
3	Benin	18	Gabon	33	Niger
4	Botswana	19	Gambia, The	34	Nigeria
5	Burkina Faso	20	Ghana	35	Rwanda
6	Burundi	21	Guinea	36	Senegal
7	Cabo Verde	22	Guinea-Bissau	37	Sierra Leone
8	Cameroon	23	Kenya	38	South Africa
9	Central African Republic	24	Lesotho	39	Sudan
10	Chad	25	Madagascar	40	Tanzania
11	Comoros	26	Malawi	41	Togo
12	Congo, Dem. Rep.	27	Mali	42	Tunisia
13	Congo, Rep.	28	Mauritania	43	Uganda
14	Cote d'Ivoire	29	Mauritius	44	Zambia
15	Egypt, Arab Rep.	30	Morocco		

Source: Author's compilations.

4.5.2 Unit Root Testing

Unit root analysis is conducted to determine whether unit roots exist in the variables. This is important because not handling unit roots can lead to biased results or spurious regression if some of the variables have unit roots. The unit root tests employed on panel data include the Levin-Lin-Chu (LLC), Augmented Dickey-Fuller Fisher (ADF), and the cross-sectionally augmented Im, Pesaran and Shin (CIPS) unit root tests. The LLC and ADF tests account for cross-sectional independence in the variables, while the CIPS test accounts for cross-sectional dependence (Baltagi, 2013). For all unit root tests, the null hypothesis indicates that there are unit roots in the variable, while the alternative hypothesis suggests that the variable has no unit roots. For LLC and ADF unit root tests, p-values are used to determine whether to reject the null hypothesis. A p-value less than 0.1, which reflects significance at the 10% level, suggests that the null hypothesis should be rejected. For the CIPS unit root test, the decision to reject the null hypothesis is based on the critical values. A CIPS test statistic greater than the CIPS critical values at 10%, 5%, or 1% level of significance in absolute terms suggests rejection of the null hypothesis.

The results of the unit root tests are reported in Table 4.7. It is shown that the p-values associated with the LLC and ADF unit root tests are all zero. This implies that the null hypothesis should be rejected at the 1% significance level. With respect to the CIPS unit root tests, it is observed that all variables have, in absolute terms, a CIPS statistic greater than 2.05 except for $INST_{it}$. This implies that the null hypothesis should be rejected for all variables except for $INST_{it}$

As the CIPS unit root tests, which account for cross-sectional dependence, show the presence of unit root in $INST_{it}$, further tests are conducted on this variable to establish whether it is cross-sectionally dependent. Two tests are carried out. The first test is developed by Pesaran (2004), and the test result is presented in Table 4.8. The null hypothesis indicates that the series is cross-sectionally independent. The result shows a p-value of 0.395, indicating that the null hypothesis should not be rejected. The second test is conducted, introduced by Pesaran (2015), and the result is reported in Table 4.9. The null hypothesis of the test indicates that the series is weakly cross-sectional dependent. As with the first test, the test results show a p-value of 0.395. This suggests that the null hypothesis should not be rejected. Given this result showing evidence that $INST_{it}$ is not cross-sectionally dependent, the results of the CIPS unit root tests are dismissed. Therefore, it is concluded that the series is stationary in level as indicated by the LLC and ADF unit roots results.

Table 4.7: Unit Root Tests

Variable	LLC	ADF	CIPS
FDI_{it}	0.0000	0.0000	-2.267
$REER170_{it}$	0.0000	0.0000	-2.316
$REER65_{it}$	0.0000	0.0000	-2.207
TOP_{it}	0.0000	0.0000	-2.302
NR_{it}	0.0000	0.0000	-2.102
HC_{it}	0.0000	0.0000	-2.667
$INFR_{it}$	0.0000	0.0000	-3.934
$INST_{it}$	0.0000	0.0000	-1.621
$GDPGR_{it}$	0.0000	0.0000	-2.279

Notes: The figures under LLC and IPS are p-values while those under CIPS are test statistics. The critical values of CIPS are -2.05, -2.16, and -2.36 at the 10%, 5%, and 1% levels of significance, respectively. FDI = foreign direct investment, REER170 = real effective exchange rate based on 170 trading partners, REER65 = real effective exchange rate based on 65 trading partners, TOP = trade openness, NR = natural resources, HC = human capital, INFR = infrastructure, INST = institutional quality, and GDPGR = economic growth.

.

Table 4.8: Cross-sectional dependence Test-Pesaran(2004)

Variable	CD-test	p-value	corr	abs(corr)
$INST_{it}$	-0.85	0.395	-0.011	0.517

Table 4.9: Pesaran (2015) test for weak cross-sectional dependence

Variable	CD-test	p-value
$INST_{it}$	-0.85	0.395

4.5.3 Descriptive statistics and preliminary analysis

The summary statistics are depicted in Table 4.10. Variables, $REER170_{it}$, $REER65_{it}$ and $INFR_{it}$ are converted into logarithmic units and multiplied by 100. The average level of FDI inflows, measured as a percentage of GDP, is 3%, with the highest level at 32% corresponding to Mozambique during the period 2012-2015 and the lowest level at -6% occurring in Angola in the period 2016-2019.

Table 4.10: Descriptive Statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
FDI_{it}	264	3.27	3.91	-6.32	31.60
$REER170_{it}$	264	-462.94	17.99	-525.38	-393.79
$REER65_{it}$	264	-463.85	18.18	-525.73	-393.77
TOP_{it}	264	65.86	30.58	11.22	183.97
NR_{it}	264	11.20	9.89	0.01	48.44
HC_{it}	264	405.50	13.30	373.48	433.10
$INFR_{it}$	264	269.42	192.29	-294.80	517.19
$INST_{it}$	264	38.13	11.49	11.74	67.08
$GDPGR_{it}$	264	4.33	2.74	-6.73	13.72

See notes below Table 4.7 for description of the variables.
Source: Author's compilations.

$REER170_{it}$ and $REER65_{it}$ share similar average levels and other statistics, indicating a strong correlation[44]. Trade openness averages 66% (i.e., as a

[44] According to the data source, a rise in REER170 and REER65 signifies a currency appreciation of the host country. The interpretation is altered here by taking the reciprocals so that a rise reflects a depreciation. Applying logs to their reciprocals results in negative values.

percentage of GDP), decreases to 11% in Sudan during the period 1996-1999, and peaks at 184% in the period 2000-2003 in Lesotho. The endowment of natural resources has an average level of 11% (that is, as a percentage of GDP) over the period, and its lowest level is zero, occurring in Mauritius generally in all periods. The maximum level of natural resources is at 48% and pertains to the Congo Republic in the period 2000-2003. Human capital, represented by life expectancy at birth, has an average level of 406, which corresponds to 58 years; its lowest level is 373 (42 years) in Rwanda in the period 1996-1999; and the highest level is 433 (76 years) recorded by Cabo Verde in the period 2016-2019. Infrastructure, proxied by the sum of telephones and mobile phones per 100 people, has an average of 269, a low of -295 corresponding to Congo DR in the period 1996-1999, and a maximum of 517 recorded in Mauritius in the period 2016-2019. The highest institutional quality level is 67, observed with Mauritius during the 2012-2015 period; the lowest level is 12, associated with the Democratic Republic of the Congo in the period 1996-1999; and the average level is 38. It should be noted that institutional quality typically ranges from -2.5 to 2.5 as obtained from the source. However, in this study, it has been normalised to range from 0 to 1 and then multiplied by 100. GDP growth averages 4% during the sample period. The highest level is 14%, registered by Chad in the period 2004-2007, and the minimum growth rate is -7%, recorded by the Central African Republic in the period 2012-2015.

4.5.4 Correlation

To provide insights on the correlation between the variables considered in the empirical analysis, the correlation matrix is constructed and reviewed. Table 4.11 depicts the correlation matrix. The first column provides information on the correlations between FDI, the dependent variable, and all variables that enter the analysis as regressors. As observed, the correlation coefficient is positive for all variables. This implies that FDI and its determinants are positively correlated, with an increase in determinants being associated with an increase in the level of FDI. However, the correlation coefficient is not statistically significant for all regressors and is just significant for exchange rate variables, trade openness, natural resources, infrastructure, and economic growth. The other columns of the correlation matrix provide information on the correlations between the explanatory variables. As observed, the two exchange rate variables have a correlation coefficient of 0.998, statistically significant at the 5% level and higher, indicating stronger correlations between them[45]. After the exchange rate variables, the highest correlated variables are institutions and natural resources, with a correlation coefficient of -0.44. However, this level of correlation is lower and as such cannot cause a multicollinearity problem. Generally, all correlation coefficients shown in the correlation matrix between pairs of variables are lower and do not raise concerns of multicollinearity.

[45]In empirical estimations, only one of these two exchange rates is used at a time. The purpose of considering both exchange rates is to ensure the reliability of the results. However, they are not used together in the model.

Table 4.11: Correlation Matrix

	FDI_{it}	$REER170_{it}$	$REER65_{it}$	TOP_{it}	NR_{it}	$INFR_{it}$	HC_{it}	$INST_{it}$	$GDPGR_{it}$
FDI_{it}	1								
$REER170_{it}$	0.1747*	1							
$REER65_{it}$	0.1725*	0.9976*	1						
TOP_{it}	0.3300*	0.2013*	0.2085*	1					
NR_{it}	0.2056*	-0.0312	-0.0156	0.1555*	1				
HC_{it}	0.0435	-0.0964	-0.12	0.0751	-0.0814	1			
$INFR_{it}$	0.1531*	-0.0426	-0.0699	0.2728*	-0.1169	0.6378*	1		
$INST_{it}$	0.0173	0.0982	0.0953	0.3549*	-0.4419*	0.3594*	0.2835*	1	
$GDPGR_{it}$	0.1803*	0.1223*	0.1239*	-0.0453	0.0318	-0.0394	-0.0413	0.1091	1

The asterisk * indicate the significance level at 5%. See the notes below Table 4.7 for a description of the variables.
Source: Author's compilations.

4.6 Empirical estimations and results

4.6.1 DPT model estimations

The DPT model is estimated in the subsections below to generate responses to the questions raised about whether the relationship between the exchange rate on FDI inflows is affected by trade openness, natural resources, and institutional quality. The STATA code provided by Seo et al. (2019) is used to estimate the DPT model. The model uses the candidate threshold variables sequentially, starting with trade openness, followed by natural resources, and finally institutions. Two models are estimated to analyse each candidate threshold variable: A and B. The difference between the models pertains to the exchange rate used. In model A, $REER170_{it}$ is used, while in model B, $REER65_{it}$ is used. Using the two exchange rates ensures that the analysis is more robust. The DPT model is estimated as specified in Equation 4.1.

4.6.2 Threshold variable - Trade openness

The threshold variable of trade openness is considered first in determining whether it exerts a non-linear influence on the relationship between the exchange rate and FDI, as well as between FDI and other determinants. The DPT model is estimated and the output is presented in Table 4.12. The upper section of the estimation output reports the linearity test results along with those of the threshold parameter (γ). The null hypothesis of the linearity test favours a linear panel model, while the alternative hypothesis supports the estimation of the DPT model. For both models A and B, the p-value associated with the test is zero, indicating that the null hypothesis should be rejected at the 1% significance level. The implication is that the DPT model aligns with the data and that trade openness induces a non-linear relationship between FDI and its determinants. This means that FDI is affected differently by its determinants at lower and higher levels of trade openness. The estimated threshold level of trade openness is 88.3% in both models and is statistically significant at the 1% level. This threshold level represents a point that defines the regimes in the model. Values of trade openness below the threshold level of 88.3% denote the lower regime, while those above reflect the higher regime. Based on the established evidence of non-linearity, the implication is that the determinants affect FDI differently in the lower and higher regimes.

The second panel of Table 4.12 shows the impact of the exchange rate and other explanatory variables on FDI in the lower and higher regimes. The lower regime (LR) corresponds to instances where trade openness falls below its threshold, while the higher regime (HR) pertains to situations where trade openness rises above the threshold level.

The lag of FDI, which reflects agglomeration effects, exhibits a negative and significant effect on FDI inflows in the lower and higher regimes of models A and B. This result suggests that existing foreign investments in the host country deter rather than encourage prospective foreign investment activities. Generally, existing foreign investment activities in the host country help bridge the information gap and uncertainty concerns of potential foreign investors, thus encouraging FDI (see Campos and Kinoshita, 2003; Anyanwu, 2011). However, this result aligns with that of the study of Asiedu and Lien (2011) that used a linear panel model on a sample of 112 developing countries and found that the lag of FDI exhibited a negative effect on current FDI inflows.

The effect of the exchange rate on the FDI is positive in all regimes but is only significant in the higher regime in both models. The implication of this result is that the exchange rate only affects FDI inflows at higher levels of trade openness. This result suggests that currency depreciation encourages FDI inflows into host countries that are more open to trade. The effect of the exchange rate on FDI is a subject of debate in the literature, with conflicting findings on its influence and the direction of its impact on FDI. This result aligns with the one found by Froot and Stein (1991), suggesting that currency depreciation leads to an increase in FDI levels.

Table 4.12: DPT model Estimation Output - Trade Openness

$y_{it} = (1, x_{it}^{'})\psi_1 I(q_{it} \leq \gamma) + (1, x_{it}^{'})\psi_2 I(q_{it} > \gamma) + u_i + \epsilon_{it}$

	Model A		**Model B**	
	REER170		REER65	
Linearity Test (p-value)	0.000		0.000	
Threshold (γ)	88.261***		88.261***	
	(7.041)		(6.917)	
Regressors	LR (ψ_1)	HR (ψ_2)	LR (ψ_1)	HR (ψ_2)
FDI_{it-1}	-0.241**	-0.203***	-0.265**	-0.198***
	(0.121)	(0.066)	(0.120)	(0.064)
$REER_{it}$	0.006	0.220***	0.006	0.212***
	(0.013)	(0.046)	(0.012)	(0.047)
TOP_{it}	0.066***	-0.241***	0.068***	-0.252***
	(0.023)	(0.054)	(0.023)	(0.054)
NR_{it}	-0.281***	0.101*	-0.286***	0.107*
	(0.057)	(0.059)	(0.056)	(0.062)
HC_{it}	-0.115***	-0.166	-0.103***	-0.164
	(0.039)	(0.123)	(0.038)	(0.128)
$INFR_{it}$	0.004**	-0.004	0.003**	-0.004
	(0.002)	(0.012)	(0.002)	(0.012)
$INST_{it}$	-0.008	0.707***	-0.013	0.750***
	(0.066)	(0.146)	(0.068)	(0.149)
$GDPGR_{it}$	0.295***	-0.250*	0.299***	-0.296***
	(0.054)	(0.140)	(0.055)	(0.143)
	$\delta = \psi_2 - \psi_1$		$\delta = \psi_2 - \psi_1$	
FDI_{it-1}	0.039		0.067	
	(0.092)		(0.093)	
$REER_{it}$	0.215***		0.206***	
	(0.046)		(0.048)	
TOP_{it}	-0.307***		-0.321***	
	(0.060)		(0.061)	
NR_{it}	0.383***		0.393***	
	(0.048)		(0.051)	
HC_{it}	-0.052		-0.061	
	(0.128)		(0.133)	
$INFR_{it}$	-0.007		-0.008	
	(0.012)		(0.012)	
$INST_{it}$	0.715***		0.763***	
	(0.143)		(0.145)	
$GDPGR_{it}$	-0.545***		-0.595***	
	(0.159)		(0.160)	
Higher regime (%)	20.8		20.8	

Figures in parenthesis are standard errors. The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. LR = lower regime and HR = higher regime.

The effect of trade openness on FDI is significantly positive in the lower regime for both models. This result implies that the low level of openness of the country influences the FDI inflows. This finding is consistent with the theory around tariff-jumping FDI investors, which indicates that these types of investors are motivated to invest in host countries with lower levels of openness or characterised by higher levels of trade barriers. These investors may have previously exported their goods to the host country, but now choose to relocate their production facilities to the host country to avoid tariff payments (Blonigen, 2005; Dunning and Lundan, 2008). In the higher regime, trade openness exhibits a negative and significant effect. This implies that greater trade openness discourages foreign investors. It should be noted that a greater openness to trade of the host country largely attracts export-oriented FDI (Blonigen, 1997). The negative effect implies that export-oriented FDI is not attracted but discouraged. This may be because export-oriented FDI perceives African countries to not be sufficiently open. The negative result could also reflect the behaviour of tariff-jumping FDI that is not attracted to shift production in host economies that are more open, as it makes economic sense to serve these markets with exports.

Natural resources significantly and negatively impact FDI in the lower regime for both models. This implies that when the level of openness in the host economy is very low or falls below a certain threshold, natural resources discourage FDI inflows. It should be noted that Asiedu and Lien (2011) and Asiedu (2013), based on linear models, also find that natural resources have a negative effect. In the higher regime, natural resources positively and significantly affect FDI inflows. Dunning and Lundan (2008) notes that natural resources-seeking FDI investors export most of their output to developed countries. Therefore, the openness of the host country attracts more of these investors.

With respect to human capital, it exerts a negative influence on FDI in both the lower and higher regimes for both models, but the effect is only significant in the lower regime. Generally, human capital is expected to have a positive effect on FDI if the workforce is educated (Asiedu, 2004). The implication, therefore, is that the levels of skills possessed by the workforce may not be adequate and, as such, are not appealing to FDI. It should be noted that Anyanwu and Yameogo (2015) also finds that human capital negatively influences FDI inflows in countries in West Africa. The impact of infrastructure on FDI is positive in the lower regime, but is insignificant in the higher regime. The implication of the results in the lower regime is that infrastructure attracts FDI inflows into host economies that are less open. This means that the available infrastructure is adequate to support tariff-jumping FDI that aim to serve the host country with produced goods in the host country. It is noteworthy that Jaiblai and Shenai (2019) finds infrastructure to attract FDI inflows in SSA countries. The insignificant influence of infrastructure in the higher regime implies that the state of infrastructure in open economies is not adequate to support the inflow of FDI that is export-orientated.

The influence of institutions on FDI is negative and insignificant in the lower regimes for both models. However, it is positive and significant in the higher regime in all models. This means that institutional quality encourages FDI in more open economies. This suggests that institutions in more open economies are stronger and protect the interests of not only domestic investors but also foreign investors. Concerning economic growth, its impact on FDI is positively significant in the lower regime in all models. This implies that economic growth attracts FDI in less open economies and influences tariff-jumping FDI investors. It is noteworthy that previous research, based on linear models, also finds that economic growth has a favourable influence on FDI inflows (e.g., Babubudjnauth and Seetanah, 2020; Cleeve et al., 2015; Asiedu, 2013). In the higher regime, economic growth is found to harm FDI inflows, as it exhibits a significant negative effect. One possible reason is that foreign investors may not view African economies as attractive markets, mainly because many of them are engaged in extractive industries and their primary markets are their output are located abroad.

The third panel of Table 4.12 reflects the change in the impact of the regressors from the lower to higher regimes. A positive and significant coefficient reflects an increase in the impact of the variable, and the converse is true. The fourth panel provides information on the distribution of observations across the lower and higher regimes. In both models, 21% of the total observations fall within the higher regime. This figure suggests that most observations predominantly belong to the lower regime, where trade openness is below the thresholds.

4.6.3 Threshold variable - Natural Resources

The natural resource endowment is considered next for the threshold variable in the relationship between FDI and its determinants. The estimation output of the DPT model is presented in Table 4.13. The results of the linearity test displayed in the upper section of the table show that the p-value associated with the test is zero in models A and B. This suggests rejecting the null hypothesis of the test that favours the linear panel model at the significance level of 1%. This result justifies the estimation of the DPT model with natural resources as a threshold variable. The threshold level of the natural resource is estimated at 13.6% for both models and is significant at the 1% level. This evidence of linearity and threshold effects implies that the exchange rate and other regressors in the model impact FDI differently depending on whether the level of natural resources is above or below 13.6%. 29% of the total observations, as reflected in the lower section of the table, fall in the higher regime. This implies that most observations fall into the lower regime.

The lag of FDI exhibits a significant and positive effect in the lower regime in both models. This implies that existing foreign investment activities in the host country encourage FDI in countries with less natural resources. In the higher regime, the effect of the FDI lag is significant and negative in both models. The implication is that existing FDI activities deter FDI inflows to host countries with abundant natural resources. This finding may be related to the curse of natural resources and the finding of Poelhekke and Van Der Ploeg (2013) in which the presence of existing foreign investment activities does not attract FDI whose activities are not related to natural resources.

For the exchange rate, its effect on FDI is insignificant in the lower regime, but is significantly positive in the higher regime in both models. This finding suggests that currency depreciation attracts FDI inflows into countries with abundant natural resources. According to the relative wealth hypothesis of Froot and Stein (1991), currency depreciation in the host country reduces the investment cost for foreign investors. As investments in the extraction of natural resources require huge sums of funds (Asiedu and Lien, 2011), it follows that currency depreciation improves the financial capacity of foreign investors.

With respect to natural resources, it exhibits a negative effect in the lower regime but is not statistically significant. In the higher regime, for both models, the effect of natural resources is negative and significant. This implies that when abundant in the host country, natural resources discourage FDI inflows. This finding is consistent with that of previous research and could be an indication of a curse of natural resources. For example, Mina (2007) finds in the study involving countries in the Gulf Cooperation Council that oil reserves have an unexpected adverse impact on FDI, in contrast to the expected positive effect. Furthermore, the study by Poelhekke and Van Der Ploeg (2013) provided evidence suggesting that higher levels of natural resources are correlated with a decrease in FDI inflows in the host country. This was because increases in the level of natural resources led to a decrease in non-resource-seeking FDI that was more significant than the increase in resource-seeking FDI[46].

Human capital negatively and significantly affects FDI inflows in the lower regime in both models. However, the effect is positive and significant in the higher regime. The implication is that human capital deters FDI in host countries with fewer natural resources, but attracts FDI in countries with abundant natural resources. The possible reason for this finding may be that in countries with low natural resources, the available labour is not skilled enough, thus deterring FDI. In countries with abundant natural resources, labour may also not be sufficiently skilled, but it meets the requirements of the FDI, as the nature of the operations is labour-intensive and does not require highly skilled labour.

[46]The specific findings of the study of Poelhekke and Van Der Ploeg (2013) were that the discovery of a resource in a country that previously was not a producer of a resource resulted in the fall in FDI in non-resource sectors by 16% in the short term and by 68% in the long term. In addition, the study found that when the rent of the resources doubles in a country that is a resource producer, FDI in non-resource sectors falls by 12.4%. Furthermore, the study found that if the resource boom doubles, the overall FDI drops by 4%. Asiedu and Lien (2011) provides reasons for the adverse effect of natural resources on FDI inflows. First, a resource boom is associated with currency appreciation in the host country, which disadvantages FDI in non-resource sectors due to the loss of competitiveness of their exports. Second, the booms and busts characterising natural resources imply higher exchange rate variability in the host country. Third, the abundance of natural resources denotes a lower diversification of trade and a greater susceptibility of the host country to external shocks.

Table 4.13: DPT model Estimation Output - Natural Resources

$$y_{it} = (1, x_{it}^{'})\psi_1 I(q_{it} \leq \gamma) + (1, x_{it}^{'})\psi_2 I(q_{it} > \gamma) + u_i + \epsilon_{it}$$

	Model A		**Model B**	
	REER170		REER65	
Linearity Test (p-value)	0.000		0.000	
Threshold (γ)	13.604***		13.604***	
	(2.015)		(1.206)	
Regressors	LR	HR	LR	HR
FDI_{it-1}	0.362***	-0.146**	0.312**	-0.129**
	(0.136)	(0.062)	(0.145)	(0.050)
$REER_{it}$	-0.011	0.249***	-0.009	0.231***
	(0.027)	(0.046)	(0.018)	(0.027)
TOP_{it}	0.032**	0.145***	0.035**	0.142***
	(0.013)	(0.030)	(0.013)	(0.029)
NR_{it}	-0.163	-0.214***	-0.207	-0.199***
	(0.135)	(0.048)	(0.134)	(0.064)
HC_{it}	-0.217***	0.658***	-0.216***	0.651***
	(0.060)	(0.176)	(0.035)	(0.113)
$INFR_{it}$	0.011***	-0.017***	0.011***	-0.018***
	(0.003)	(0.005)	(0.002)	(0.003)
$INST_{it}$	0.080**	-0.067	0.062	-0.073
	(0.048)	(0.131)	(0.055)	(0.124)
$GDPGR_{it}$	0.245**	0.100	0.277***	0.076
	(0.103)	(0.063)	(0.091)	(0.065)
	$\delta = \psi_2 - \psi_1$		$\delta = \psi_2 - \psi_1$	
FDI_{it-1}	-0.508***		-0.441***	
	(0.140)		(0.130)	
$REER_{it}$	0.260***		0.240***	
	(0.046)		(0.036)	
TOP_{it}	0.113***		0.107***	
	(0.036)		(0.038)	
NR_{it}	-0.051		0.007	
	(0.165)		(0.178)	
HC_{it}	0.875***		0.867***	
	(0.163)		(0.115)	
$INFR_{it}$	-0.030***		-0.029***	
	(0.006)		(0.003)	
$INST_{it}$	-0.147		-0.135	
	(0.154)		(0.154)	
$GDPGR_{it}$	-0.145		-0.201	
	(0.138)		(0.133)	
Higher regime (%)	29.2		29.2	

Figures in parenthesis are standard errors. The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. LR = lower regime and HR = higher regime.

The effect of infrastructure on FDI is significantly positive in the lower regime and significantly negative in the higher regime. This suggests that infrastructure appeals more to FDI in countries with fewer natural resources. This finding aligns with Onyeiwu and Shrestha (2004), who demonstrated that, while Angola and Nigeria received substantial amounts of FDI due to their large oil endowments, the state of the infrastructure in these countries is not well developed. Therefore, this situation appears to suggest that the interest in natural resources by foreign investors compensates for the shortfall in infrastructure.

With respect to institutions, the effect is significant only in model A, where it is positive in the lower regime. In the higher regime, the result appears to align with the study of Asiamah et al. (2022), which finds that dependence on natural resources weakens the institutions in the SSA countries. With economic growth, its impact on FDI inflows is only significant in the lower regime, which has a positive effect. This appears to suggest that economic growth tends to attract FDI inflows in countries with low natural resources.

4.6.4 Threshold variable - Institution quality

In this section, institutional quality, also referred to as institutions, is used as the threshold variable in the estimation of the DPT model to provide an understanding of whether it non-linearly influences the relationship between the exchange rate and FDI. The estimation output of the DPT model is presented in Table 4.14. The upper section of the table shows the results of the linearity test, which reveal that the p-value associated with the test is zero. This suggests that the null hypothesis, which favours the linear model, should be rejected at a significance level of 1%. The threshold level of institutions is estimated at 29.2 for both models and is significant at the 1% level. The threshold level is equivalent to -1.04135 in the original institutional data range. The lower section of the table indicates that the higher regime encompasses 75% of the total observations, which implies that the lower regime observations account for the remaining 25% of the total observations.

Table 4.14: DPT model Estimation Output - Institutions

$y_{it} = (1, x_{it}^{'})\psi_1 I(q_{it} \leq \gamma) + (1, x_{it}^{'})\psi_2 I(q_{it} > \gamma) + u_i + \epsilon_{it}$

	Model A		**Model B**	
	REER170		REER65	
Linearity Test (p-value)	0.000		0.000	
Threshold (γ)	29.173***		29.173***	
	(2.455)		(1.850)	
Regressors	LR	HR	LR	HR
FDI_{it-1}	-0.244***	-0.603***	-0.073	-0.683***
	(0.057)	(0.179)	(0.063)	(0.168)
$REER_{it}$	0.225***	-0.156***	0.221***	-0.166***
	(0.046)	(0.031)	(0.041)	(0.029)
TOP_{it}	0.005	0.168***	0.085	0.146***
	(0.057)	(0.026)	(0.069)	(0.023)
NR_{it}	0.094	-0.092	-0.076	-0.023
	(0.076)	(0.072)	(0.077)	(0.067)
HC_{it}	1.132***	0.008	0.494	0.077
	(0.211)	(0.083)	(0.336)	(0.077)
$INFR_{it}$	-0.036***	0.009***	-0.017**	0.004
	(0.005)	(0.003)	(0.007)	(0.004)
$INST_{it}$	0.223	-0.001	1.296****	-0.143
	(0.243)	(0.166)	(0.266)	(0.201)
$GDPGR_{it}$	-0.009	0.350***	-0.220***	0.410***
	(0.071)	(0.105)	(0.072)	(0.135)
	$\delta = \psi_2 - \psi_1$		$\delta = \psi_2 - \psi_1$	
FDI_{it-1}	-0.359**		-0.610***	
	(0.163)		(0.166)	
$REER_{it}$	-0.382***		-0.387***	
	(0.053)		(0.058)	
TOP_{it}	0.163***		0.061	
	(0.055)		(0.077)	
NR_{it}	-0.186		0.052	
	(0.118)		(0.128)	
HC_{it}	-1.124***		-0.417	
	(0.213)		(0.376)	
$INFR_{it}$	0.045***		0.022**	
	(0.006)		(0.009)	
$INST_{it}$	-0.224		-1.439***	
	(0.328)		(0.417)	
$GDPGR_{it}$	0.359***		0.631***	
	(0.128)		(0.152)	
Higher regime (%)	75.0		75.0	

Figures in parenthesis are standard errors. The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. LR = lower regime and HR = higher regime.

The FDI lag negatively affects the lower regime, but is only significant in model A. In the higher regime, the effect of the lag of FDI is negative and significant in all models. This finding suggests that higher levels of institutions cause past FDI to deter current FDI inflows. With respect to the exchange rate, its influence is shown to be positive in the lower regime in both models. This implies that at lower levels of institutional quality, currency depreciation attracts FDI inflows. This finding aligns with Froot and Stein (1991). However, in the higher regime, the exchange rate is insignificant in both models. The finding suggests that the exchange rate discourages FDI inflows when institutions are stronger.

With respect to trade openness, the results show that its impact on FDI is positive, but insignificant, in the lower regimes of all models. In the higher regime, the effect is positive and indicates that trade openness encourages FDI when institutions are strong. The impact of the endowment of natural resources on FDI is insignificant in all regimes for both models. Human capital is only significant in the lower regime of model A, where it has a positive effect.

Infrastructure has a negative influence on FDI inflows in the lower regime. This result implies that in host countries with weaker institutions, the state of infrastructure may be poor, thereby acting as a deterrent to FDI inflows. In the higher regime, the effect of infrastructure is positive, but only significant in Model A. This result suggests that host countries with stronger institutions may be associated with better infrastructure, capable of attracting FDI inflows.

The effect of institutions in the lower regime is insignificant in model A and significant in model B. These mixed results make it difficult to discern the exact effect. Therefore, the finding here is not in line with that of Kurul (2017), which showed that institutional quality at levels above a certain threshold favours FDI inflows. The influence of economic growth on FDI is negative in the lower regimes, but positive and significant in the higher regimes. The implication is that economic growth in the presence of stronger institutions encourages FDI inflows.

4.7 Conclusion

The chapter explores the relationship between the exchange rate and FDI, which is a topic of debate with regard to the role of the exchange rate on FDI inflows. There is no consensus on whether currency depreciation influences FDI, whether currency appreciation does, or if there is even any relationship between the exchange rate and FDI. This controversy leads to uncertainty among policymakers about the importance of the exchange rate in impacting FDI inflows.

Previous research has explored this topic in the context of a direct relationship using linear models. Unlike previous research, this study makes a novel contribution to the literature by considering the indirect relationship and employing a non-linear model. Based on this approach, the study seeks to determine the environment in which the relationship between the exchange rate and FDI would hold. Therefore, the study asks whether the relationship between the exchange rate and FDI is affected by trade openness, natural resources, and institutional quality, referred to as threshold variables. The non-linear econometric model used for estimation is the dynamic panel threshold model, which allows for a regime-switching environment induced by the threshold variables. In line with this, the study seeks to determine whether non-linearity exists and how the relationship between the exchange rate and FDI behaves at low and higher levels of the threshold variables. This analysis is extended to other determinants of FDI in the model, another contribution.

The chapter uses a sample of 44 African countries as a case study, and the reason for this choice is that Africa presents distinct features that are reflected in low FDI receipts relative to other continents. For the robustness of the results, two models are estimated; one uses a broad real effective exchange rate index, while the other uses a narrower one. The two models produce largely similar results. The study establishes evidence of non-linearity based on all three threshold variables, endorsing the DPT model's application. This finding suggests that the exchange rate and other variables in the model affect FDI differently at lower and higher levels of the threshold variables. The study also finds threshold levels of 88.3% for trade openness, 13.6% for natural resources and 29.2 for institutions, which are all statistically significant at the 1% level.

The study establishes evidence suggesting that the exchange rate significantly and positively affects FDI inflows at levels of trade openness greater than 88.3%. Additionally, the study finds that the exchange rate positively and significantly affects FDI when the level of natural resources is higher, specifically when the level of natural resources is greater than 13.6%. Furthermore, the study finds that the effect of the exchange rate on FDI is positive at lower levels of institutions, specifically below the threshold of 29.2. The impact of the exchange rate is found to have an insignificant effect at higher levels of institutions. Based on these results, it is evident that currency depreciation encourages FDI inflows, as projected by the relative wealth hypothesis of Froot and Stein (1991). This study confirms the hypothesis and makes available new evidence suggesting that currency depreciation encourages FDI in the host country in the presence of greater economic openness, abundant natural resources, and weaker institutions.

With respect to other key non-linear results, the study establishes evidence suggesting that economic growth encourages FDI in host countries characterised by low economic openness, fewer natural resources, and stronger institutions. The study also finds that trade openness has a stronger influence on FDI inflows in countries that are less open, have abundant natural resources, and have stronger institutions. Additionally, the study finds that natural resources and institutions promote FDI inflows in more open host countries. Furthermore, it is established that human capital tends to encourage FDI in countries with abundant natural resources, whereas infrastructure promotes FDI inflows in low-natural-resource countries.

The policy implications arising from the findings call for the implementation of policies that promote greater openness, stronger institutions, better infrastructure, a skilled workforce, and economic diversification. Greater openness would attract export-orientated FDI, thus increasing avenues for earning foreign exchange. Stronger institutions would help reduce corruption, strengthen the rule of law, and improve the protection of property rights, making host countries more attractive to FDI. Upscaling the level of infrastructure would attract more FDI, as infrastructure reduces the cost of doing business. Investing in education and skill development would translate into having a workforce capable of attracting FDI. Lastly, but not least, fostering economic diversification would help mitigate the curse of natural resources.

It should be noted that the implementation of some of the suggested policies would not be without challenges for African countries. For example, achieving greater economic openness could raise concerns about the increased exposure of these countries to external shocks, although this could be addressed by promoting macroeconomic stability through effective monetary and fiscal policies. Strengthening institutions can also be challenging, especially in the presence of abundant natural resources. Investing in infrastructure is already challenging due to financial constraints reflected in a financing gap of about US$100 billion per year, possibly partially perpetuated by larger external debt servicing.

Chapter 5

Conclusion

5.1 Main Findings and Policy Implications

The thesis uses non-linear econometric models to explore the relationships involving the exchange rate and selected macroeconomic variables. It specifically explores the relationships between globalisation and the Exchange Rate Pass-Through (ERPT), the exchange rate and the trade balance, and the exchange rate and foreign direct investments. These relationships are subject to controversy, as different viewpoints are held in the literature. This serves as motivation for the thesis to provide insight that could help resolve the controversy. The main findings and policy implications are presented here.

In Chapter 2, the thesis provides greater insight into the relationship between globalisation and ERPT, a subject of controversy regarding whether globalisation causes an increase or decrease in the level of ERPT. Based on a review of the literature, it is noted that previous research has approached this relationship using linear models. The thesis, unlike previous research, employs the PSTR model, a non-linear model, and this approach provides a novel contribution. The objective of the thesis is to examine the relationship between globalisation and ERPT, specifically to establish whether globalisation causes ERPT to rise or to decline. In view of this, the thesis asks whether globalisation non-linearly influences the ERPT. This allows a determination of whether ERPT levels are associated with globalisation levels and, subsequently, how ERPT behaves with the rise in the level of globalisation. The thesis also aims to determine whether the globalisation and ERPT relationship varies with different exchange rate regimes. Three globalisation indicators are employed: the economic globalisation index, trade openness, and import penetration. Notably, the economic globalisation index as an indicator of globalisation has not been previously considered in the literature, so its use is novel.

The thesis uses a sample of 16 African countries where the exchange rate regime is fixed in 10 countries and flexible in 6 countries. The limited existing research covering Africa guides the sample selection. Empirical estimation is carried out with the PSTR model of González et al. (2017) and González et al. (2005), on data for the period 1994–2019. The PSTR model provides a regime-switching environment in which ERPT behaviour is assessed at lower and higher levels of globalisation. In addition, the PSTR model allows for the determination of threshold levels.

The empirical estimation results establish evidence suggesting that globalisation exhibits non-linear influence on ERPT. Specifically, the degree of ERPT is found to vary with the level of globalisation. This implies that ERPT behaves differently at the level of globalisation below and above a certain threshold. The threshold levels determined are 40.6 for economic globalisation, 80.5% for trade openness, and 36.5% for import penetration. This finding of non-linear influence of globalisation on the ERPT is novel.

In line with the above, it is also established that higher levels of globalisation are associated with higher levels of ERPT based on the results of the whole sample. The implication is that globalisation positively influences the level of ERPT. The positive association between globalisation and ERPT suggests that globalisation causes an increase in the level of ERPT. Therefore, this finding is consistent with Benigno and Faia (2016) and Barhoumi (2006).

The thesis uncovers further evidence on the relationship between globalisation and the ERPT when exchange rate regimes are taken into account. Evidence suggests that the exchange rate regime may play a significant role in explaining the relationship between globalisation and ERPT. Specifically, it is established that countries with fixed exchange rate regimes tend to experience lower levels of ERPT as globalisation increases, whereas countries with flexible exchange rate regimes exhibit higher levels of ERPT with greater globalisation. One possible reason underlying the difference in results is that the level of globalisation is lower for fixers than for floaters. Robust checks support these results.

The thesis in Chapter 3 focuses on the relationship between the exchange rate and the trade balance, in which it provides insights with respect to non-linearity, asymmetry and J-curve effects. It should be noted that the question of whether currency depreciation improves trade balance is controversial, partly based on mixed empirical findings. Bahmani-Oskooee et al. (2019a) and Bahmani-Oskooee et al. (2018), for example, highlight that the support for the J-curve is, at best, ambiguous on the basis of empirical evidence. Zambia is used as a case study due to its unique trade elements, where a few trading partners dominate the trade. This consideration is motivated by the literature suggesting that each country has a different literature (see Bahmani-Oskooee et al., 2019b). The thesis uses data on Zambia's bilateral trade with 17 trading partners. The estimations are conducted with the Logistic Vector Smooth Transition Regression (LVSTR) model and the non-linear Panel Autoregressive Distributed Lag (PARDL) model. The LVSTR model has not been previously explored and, as such, constitutes one of the novel contributions to the literature. The objective of the thesis involves determining the existence of non-linearity, asymmetry, and J-curve effects in the relationship between the exchange rate and the trade balance.

Several findings emerge from model estimations. Based on the linearity tests relating to the LVSTR model, one of the findings is that the trade balance exhibits non-linearity when exchange rate changes are permitted to influence regime shifts. This evidence is supported by plots of the logistic function, representing the trade balance equation in the model, that depict non-linear trade balance adjustments in almost all trading partners. The finding, based on the estimation results of the non-linear PARDL model, show the presence of asymmetry effects, implying that currency depreciation and appreciations lead to uneven responses in the trade balance. This finding confirms the evidence of the effects of asymmetry reported by Bahmani-Oskooee and Fariditavana (2015, 2016) and others.

The thesis also identifies evidence of the J-curve, but it is limited, especially in individual trading partners. It is only observed in the trade balance with one trading partner, India. The limited evidence aligns with the literature, as highlighted in the study of Bahmani-Oskooee et al. (2018) that the evidence of the J-curve is largely mixed. However, evidence of the J-curve emerges when all trading partners are collectively analysed as a sample, using the definition provided by Bahmani-Oskooee and Fariditavana (2015, 2016). Short-run support for the J-curve pattern arises from the impact of currency depreciation on the trade balance, while long-run support stems from the effect of currency appreciation. Currency depreciation is found to have an insignificant long-run effect on the trade balance. This finding implies that currency depreciation cannot be relied upon to improve the trade balance, even if the relationship between the exchange rate and the trade balance may have improved with the discovery of asymmetry effects. This finding may reflect a low level of elasticities in exports and imports.

The fourth chapter of the thesis provides insight into the relationship between the exchange rate and foreign direct investments (FDI). In this area, the literature is divided on whether FDI inflows react positively to currency depreciation or appreciation or whether FDI inflows even react at all to exchange rate changes. Previous studies have predominantly examined the relationship between exchange rates and FDI using linear models, especially the Generalized Method of Moments (GMM) modelling technique, with a focus on the direct relationship. The possibility of non-linearity has not previously been explored. This thesis contributes to the literature by considering the indirect relationship using a non-linear econometric model, specifically the Dynamic Panel Threshold (DPT) model of Seo and Shin (2016) and Seo et al. (2019). The thesis examines the relationship between the exchange rate and FDI inflows, taking into account the role of trade openness, natural resources, and institutions, which is novel in the literature. Specifically, the thesis seeks to establish whether trade openness, natural resources, and institutions, referred to as threshold variables, induce non-linearity in the relationship between the exchange rate and FDI. In addition, the thesis aims to establish whether currency depreciation attracts FDI at lower and higher levels of the threshold variables. Furthermore, the thesis investigates how FDI responds to other determinants at varying levels of the threshold variables, another contribution made by the thesis.

A sample comprising 44 African countries is used in the estimations. The selection of the sample is influenced by the limited literature on Africa and the fact that the continent exhibits unique characteristics reflected in low FDI receipts relative to other continents. Data for the period 1996-2019 is used to carry out the estimations. Two models are used to carry out the estimations. One model uses a broad real effective exchange rate index, while the other uses a narrower one. The estimation results are broadly similar, indicating the robustness of the results.

The thesis finds stronger evidence of the non-linearity in the relationship between FDI and its determinants, induced by trade openness, natural resources, and institutional quality. This finding implies that FDI responds non-linearly to its determinants at varying levels of trade openness, natural resources and institutions. The thesis further establishes evidence of threshold levels of threshold variables, that is 88.3% for trade openness, 13.6% for natural resources, and 29.2 for institutions.

The thesis establishes compelling evidence suggesting that the exchange rate exerts a significant and positive impact on FDI inflows at levels of trade openness above 88.3%. Moreover, the research finds that the exchange rate has a positive and significant influence on FDI when the level of natural resources is greater than 13.6%. Furthermore, the effect of the exchange rate on FDI is positive at levels of institutional quality below the threshold of 29.2. These findings imply that currency depreciation encourages FDI inflows. This aligns with Froot and Stein (1991) who projected that currency depreciation promotes FDI inflows. However, the thesis provides new evidence suggesting that currency depreciation encourages FDI inflows in countries characterised by greater openness, abundant natural resources, and weaker institutions.

The thesis also finds evidence concerning the effects of other FDI determinants on the model. Economic growth, which is a measure of market growth, is found to have a stronger influence on FDI inflows in countries that are less open, have few natural resources and have stronger institutions. Evidence has also been found to suggest that trade openness has a stronger influence on FDI inflows in countries that are less open, have abundant natural resources and have stronger institutions. In addition, natural resources and institutions are found to have significant positive influences in more open economies, while human capital has a strong influence in natural resource rich countries. Furthermore, infrastructure is found to have a positive influence on FDI in non-natural resource countries.

The findings of the thesis generate important policy implications. First, the empirical findings of all chapters indicate that policy decisions should account for the non-linear effects of the exchange rate. Overlooking these factors can result in incorrect policy actions. Second, Chapter 2 reveals that globalisation poses an upside risk to ERPT. Therefore, policies aimed at strengthening macroeconomic stability should be implemented to reduce the vulnerability of the economy to external shocks. Specifically, these policies can aim to maintain low and stable price levels, promote robust financial regulation and supervision, and maintain prudent fiscal management. Third, Chapter 3 shows that the exchange rate alone cannot improve the trade balance given the limited evidence of the J-curve found, especially in individual trading partners. The implication of this finding is that it is essential to decrease dependence on the export of primary commodities. This could involve implementing structural reforms that promote economic diversification. Furthermore, reducing dependence on imports is crucial, and this can be accomplished by fostering domestic production and investing in research and development to establish alternatives for certain imported goods. However, it is crucial to acknowledge that putting the proposed structural changes into effect is a time-consuming process. Consequently, addressing the excessive trade deficit in the short run would involve tightening monetary and fiscal policies to limit import demand.

Lastly, Chapter 4 indicates the greater importance of trade openness, natural resources, institutions, human capital, infrastructure, economic growth, and currency depreciation in attracting FDI inflows. Subsequently, several important policy implications emerge. One of the implication is to design and promote policies that support economic openness and reduce trade barriers. The other implication is the design of policies, such as economic diversification, to potentially mitigate the challenges related to the abundance of natural resources. Another implication is the strengthening of institutions by designing and promoting policies that aim to reduce corruption, strengthen the rule of law, and protect property rights. Finally, the implication is that deliberate policies should be implemented to encourage education and skill development to establish a human capital workforce capable of attracting FDI. It should be noted that implementing some of the suggested policies poses challenges for African countries. For example, pursuing greater economic openness raises concerns of vulnerability to external shocks.

5.2 Further Research

Future research could use sectoral data to explore the relationship between the exchange rate and the trade balance covered in Chapter 3. This could generate further insights, especially since the literature favours disaggregated data because it is less subject to aggregation bias.

Appendix A

Table A.1: Unit Root test for NEER65

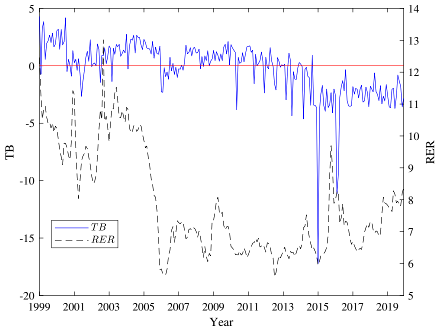
Samples	Level			First Difference		
	LLC	ADF	CIPS	LLC	ADF	CIPS
Whole Sample	0.000	0.967	-2.257	0.000	0.000	-4.555
Fixers	0.000	0.960	-1.513	0.000	0.000	-3.616
Floaters	0.000	0.745	-2.399	0.000	0.000	-4.813

The figures under LLC and ADF Fisher are p-values while those under CIPS are test statistics. The critical values of CIPS for the whole sample are -2.11, -2.20, and -2.38 at the 10%, 5%, and 1% levels of significance, respectively. For fixers and floaters, the critical values of CIPS are -2.21, -2.33, and -2.57 at the 10%, 5%, and 1% levels of significance, respectively. The null hypothesis for all tests is that there is unit root in $NEER65_{it}$.

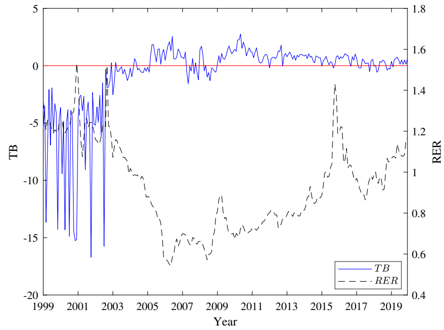
Appendix B

Appendix B

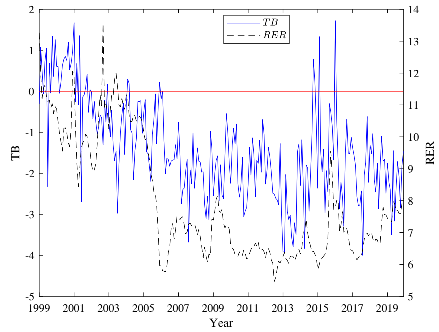
Figure B.1: Plots of Zambia's exchange rates and trading balances with trading partners



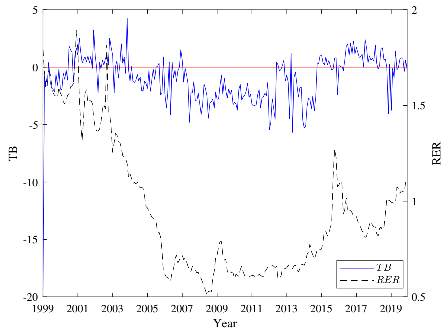
(a) Zambia-Belgium



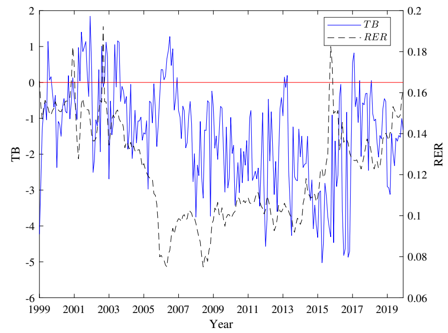
(b) Zambia-China



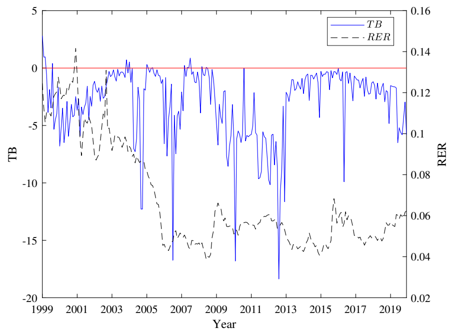
(c) Zambia-Germany



(d) Zambia-Hong Kong

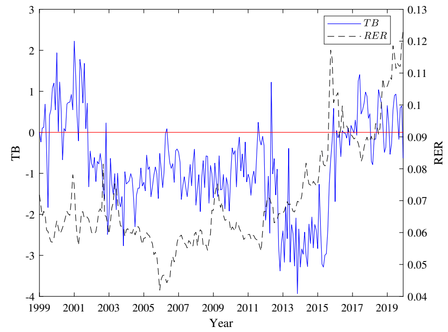


(e) Zambia-India

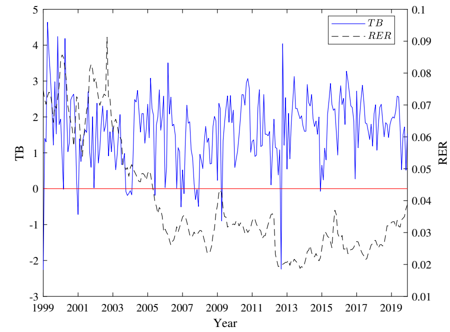


(f) Zambia-Japan

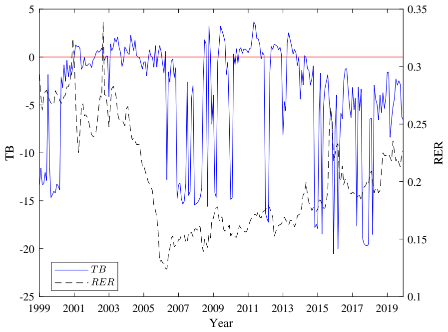
(g) Zambia-Kenya



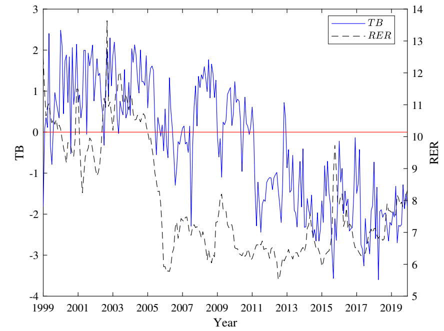
(h) Zambia-Malawi



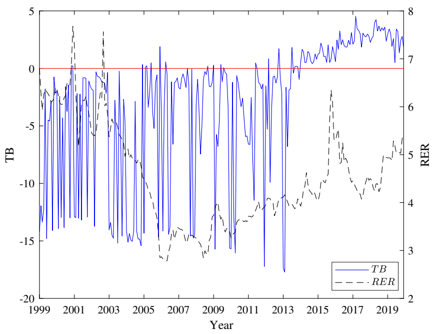
(i) Zambia-Mauritius



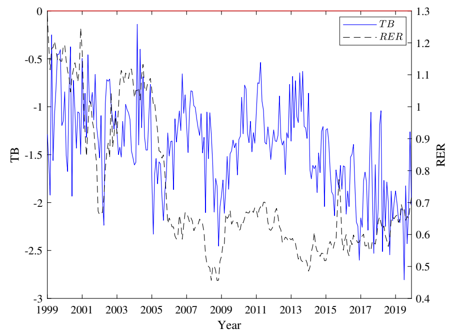
(j) Zambia-Netherlands



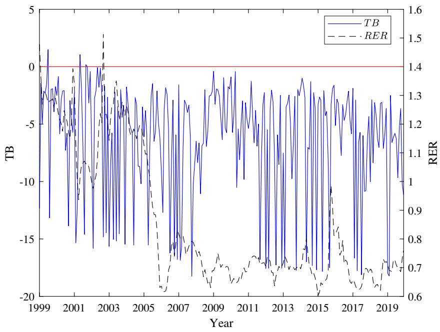
(k) Zambia-Singapore



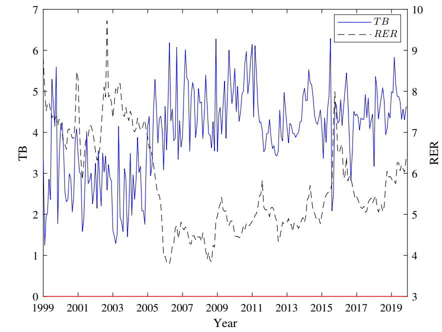
(l) Zambia-South Africa



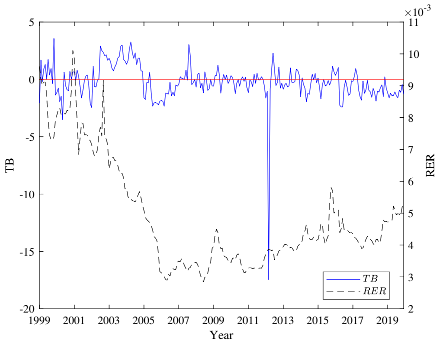
(m) Zambia-Sweden



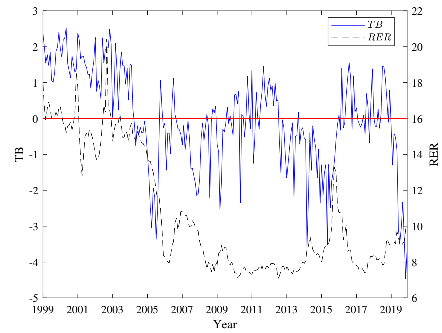
(n) Zambia-Switzerland



(o) Zambia-Tanzania



(p) Zambia-UK



(q) Zambia-USA

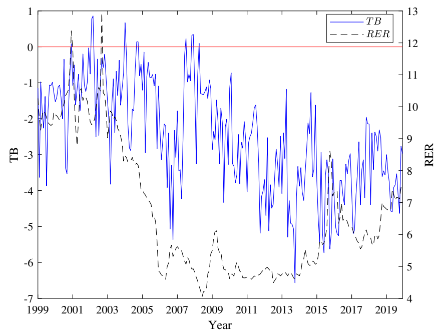


Figure B.2: Lag length determination by SBIC

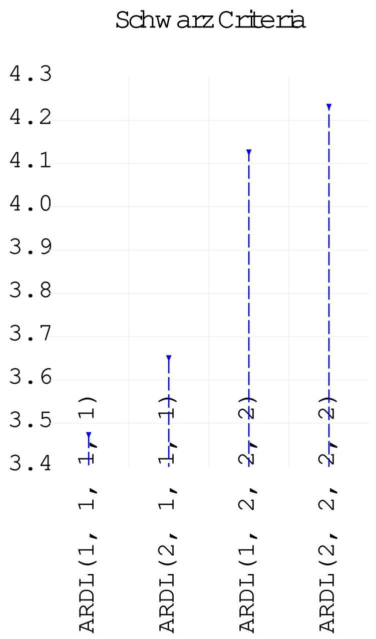


Figure B.3: Lag length determination by AIC

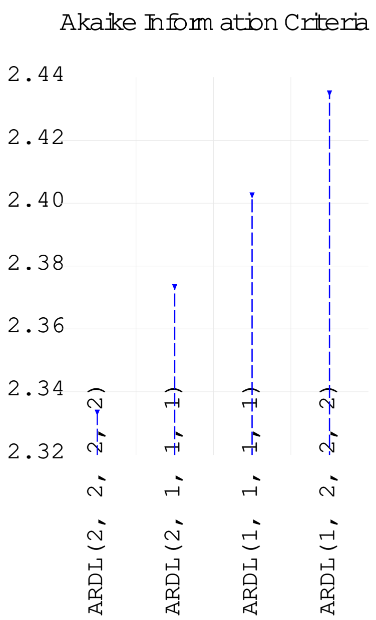


Table B.1: Zambia's main exports to its trading partners based on 2019 data (US$ million)

Country	Main Products	US$	Percent	Total Exports (US$)
Switzerland	Copper and articles thereof	2843.7	97.9	2905.4
	Tobacco and manufactured tobacco substitutes	22.5	0.8	
	Ores, slag and ash	14.4	0.5	
	Natural/Cultured Pearls, Precious stones & metals	12.6	0.4	
South Africa	Natural/Cultured Pearls, Precious stones & metals	73.0	24.6	296.9
	Other base metals, cermets, articles thereof	40.8	13.8	
	Nuclear reactors and boilers	26.7	9.0	
	Copper and articles thereof	25.4	8.6	
China	Copper and articles thereof	1458.3	97.0	1502.7
	Wood and articles of wood	16.5	1.1	
	Ores, slag and ash	14.5	1.0	
	Iron and Steel	2.6	0.2	
United Kingdom	Copper and articles thereof	28.6	87.6	32.6
	Edible Vegetables and certain roots and tubers	1.5	4.5	
	Live tree & other plant	1.0	3.0	
	Dairy products, birds' eggs, natural honey	0.4	1.3	
India	Natural/Cultured Pearls, Precious stones & metals	39.2	71.5	54.9
	Lead and articles thereof	10.9	19.8	
	Aluminium and articles thereof	1.2	2.2	
	Art of stone, plater, cement, asbestos, mica/mat	0.8	1.5	
Singapore	Copper and articles thereof	499.9	86.3	579.4
	Natural/Cultured Pearls, Precious stones & metals	68.4	11.8	
	Cotton	6.1	1.1	

Table B.1 continued from previous page

Country	Main Products	US$	Percent %	Total Exports (US$)
	Raw Hides and Skins and Leather	3.5	0.6	
Kenya	Sugars and Sugar Confectioneriy	28.9	45.6	63.3
	Residues & Waste from the Food Industry	12.5	19.7	
	Copper and articles thereof	7.5	11.8	
	Cereals	7.3	11.5	
Tanzania	Copper and articles thereof	14.3	22.1	64.6
	Cereals	11.8	18.2	
	Electrical machinery	8.9	13.7	
	Preperations of Cereals, Flour, Starch/Milk	6.5	10.1	
Mauritius	Cotton	9.3	89.9	10.4
	Sugars and Sugar Confectioneriy	0.4	4.1	
	Nuclear reactors and boilers	0.2	1.7	
	Ores, slag and ash	0.1	1.3	
Japan	Copper and articles thereof	13.7	91.9	14.9
	Iron and Steel	0.5	3.6	
	Coffee, Tea Mate and Spices	0.3	2.1	
	Miscellaneous chemical products	0.2	1.3	
USA	Natural/Cultured Pearls, Precious stones & metals	0.8	16.9	5.0
	Works of art, collectors pieces and antiques	0.6	11.4	
	Coffee, Tea Mate and Spices	0.4	8.8	
	Art of stone, plater, cement, asbestos, mica/mat	0.4	8.8	
Malawi	Tobacco and manufactured tobacco substitutes	32.9	33.2	99.2
	Nuclear reactors and boilers	21.2	21.3	
	Iron and Steel	9.0	9.1	

Table B.1 continued from previous page

Country	Main Products	US$	Percent %	Total Exports (US$)
	Soap, Organic Surface-active agents, Washing preperations	5.7	5.7	
	Beverages, Spirits and Vinegar	5.4	5.5	
Hong Kong	Copper and articles thereof	51.0	67.3	75.8
	Natural/Cultured Pearls, Precious stones & metals	20.3	26.8	
	Tobacco and manufactured tobacco substitutes	2.9	3.8	
	Ores, slag and ash	0.8	1.0	
Germany	Tobacco and manufactured tobacco substitutes	3.5	29.6	11.9
	Live tree & other plant	1.9	16.1	
	Edible Vegetables and certain roots and tubers	1.8	15.3	
	Iron and Steel	1.0	8.6	
Belgium	Tobacco and manufactured tobacco substitutes	1.9	32.8	5.7
	Nuclear reactors and boilers	1.8	32.0	
	Copper and articles thereof	0.6	11.1	
	Iron and Steel	0.3	4.5	
Netherlands	Live tree & other plant	5.2	66.0	8.0
	Nuclear reactors and boilers	1.2	15.5	
	Edible Vegetables and certain roots and tubers	0.5	6.2	
	Copper and articles thereof	0.3	4.2	
Sweden	Coffee, Tea Mate and Spices	0.3	55.4	0.6
	Nuclear reactors and boilers	0.2	30.5	
	Additional Zambian special transactions tariff	0.0	6.1	
	Optical, Photo, Cine, Meas, Checking, Precision, etc	0.0	3.3	

The column labelled "US$" depicts the value of exports for each of the products in US dollars. The column labelled "Total Exports" represents the total value of exports, covering all products. The column labelled "Percent" captures the share of the products in total exports to the trading partner. This table is constructed using trade data for 2019, and it should be noted that the distribution of these products among trading partners changes and, as such, may not be the same every year. Source: Bank of Zambia compilations, Zambia Statistics Agency data.

Table B.2: Zambia's main imports from its trading partners based on 2019 data (US$ million)

Country	Main Products	US$	Percent %	Total Exports (US$)
Switzerland	Fertilizers	14.2	59.2	24.0
	Salt, sulphur, plastering material, lime & cement	2.7	11.3	
	Nuclear reactors and boilers	1.1	4.6	
	Miscellaneous chemical products	1.1	4.5	
South Africa	Nuclear reactors and boilers	323.1	14.5	2,222.7
	vehicles and vehicle accessories	212.3	9.6	
	Plastics and articles thereof	146.7	6.6	
	Salt, sulphur, plastering material, lime & cement	133.6	6.0	
	Fertilizers	125.9	5.7	
China	Electrical machinery	195.8	19.2	1,020.9
	Nuclear reactors and boilers	182.9	17.9	
	Articles of Iron and Steel	116.2	11.4	
	vehicles and vehicle accessories	103.3	10.1	
United Kingdom	Nuclear reactors and boilers	46.3	35.5	130.7
	vehicles and vehicle accessories	37.5	28.7	
	Articles of Iron and Steel	7.9	6.1	
	Electrical machinery	7.3	5.6	
India	Pharmaceutical products	106.4	30.2	351.9
	Nuclear reactors and boilers	86.1	24.5	
	Plastics and articles thereof	29.4	8.4	
	Vehicles and vehicle accessories	16.5	4.7	
Singapore	Fertilizers	21.1	38.0	55.4
	Natural/Cultured Pearls, Precious stones & metals	8.8	15.8	

Table B.2 continued from previous page

Country	Main Products	US$	Percent	Total Imports (US$)
	Electrical machinery	4.6	8.3	
	Mineral fuels, oils & product of other distillation	4.6	8.2	
Kenya	Pharmaceutical products	6.8	16.1	42.3
	Animal/Vegetabel Fats & Oils	5.4	12.9	
	Mineral fuels, oils & product of other distillation	4.3	10.2	
	Plastics and articles thereof	4.1	9.7	
Tanzania	Mineral fuels, oils & product of other distillation	166.1	81.2	204.5
	Ceramic products	5.3	2.6	
	Plastics and articles thereof	5.0	2.5	
	Other made up textile articles, sets, clothing etc.	4.1	2.0	
Mauritius	Mineral fuels, oils & product of other distillation	105.8	52.8	200.2
	Fertilizers	51.3	25.6	
	Nuclear reactors and boilers	16.1	8.0	
	Miscellaneous chemical products	10.3	5.2	
Japan	Vehicles and vehicle accessories	120.8	55.3	218.5
	Nuclear reactors and boilers	58.1	26.6	
	Printed books, Newspapers & Pictures	20.2	9.3	
	Rubber and articles thereof	6.7	3.1	
USA	Nuclear reactors and boilers	57.4	30.8	186.5
	Articles of Iron and Steel	53.4	28.6	
	Miscellaneous chemical products	16.8	9.0	
	Rubber and articles thereof	11.9	6.4	
Malawi	Electrical machinery	4.4	20.6	21.2
	Plastics and articles thereof	3.5	16.6	

Table B.2 continued from previous page

Country	Main Products	US$	Percent	Total Imports (US$)
	Other made up textile articles, sets, clothing etc.	3.3	15.6	
	Wood and articles of wood	1.8	8.6	
Hong Kong	Mineral fuels, oils & product of other distillation	17.7	32.1	55.1
	Electrical machinery	12.1	22.0	
	Inorganic chemicals, compounds of precious metals and radioactive elements	4.5	8.2	
	Nuclear reactors and boilers	3.9	7.0	
Germany	Nuclear reactors and boilers	66.6	58.9	113.2
	Miscellaneous chemical products	5.6	5.0	
	vehicles and vehicle accessories	5.6	4.9	
	Electrical machinery	5.3	4.7	
Belgium	Miscellaneous chemical products	11.7	28.8	40.8
	Nuclear reactors and boilers	8.0	19.7	
	Iron and Steel	4.3	10.6	
	Pharmaceutical products	2.1	5.3	
Netherlands	Nuclear reactors and boilers	20.9	36.9	56.7
	Rubber and articles thereof	7.8	13.7	
	Meat and edible meat offal	6.4	11.4	
	Pharmaceutical products	4.6	8.1	
Sweeden	Nuclear reactors and boilers	34.8	51.5	67.5
	Vehicles and vehicle accessories	16.2	24.1	
	Electrical machinery	4.3	6.3	
	Tool, Implement, Cutlery, Spoon & Fork, of base metal	2.1	3.2	

Notes: The column labelled "US$" depicts the value of imports for each of the products in US dollars. The column labelled "Total Imports" represents the total value of imports, covering all products. The column labelled "Percent" captures the share of the products in total imports from the trading partner. This table is constructed using trade data for 2019, and it should be noted that the distribution of these products among trading partners changes and, as such, may not be the same every year. Source: Bank of Zambia compilations, Zambia Statistics Agency data.

Table B.3: Descriptive Statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
TB	340	-0.553	1.943	-5.474	5.023
RER^{+}_{it}	340	0.327	0.265	0.000	1.150
RER^{-}_{it}	340	-0.740	0.431	-1.839	0.000
GDP_{it}	340	3.384	2.204	-1.217	7.442

Notes: All variables are expressed in logs. "TB" = Trade balance, $ln(X_{it}/M_{it})$, "RER^{+}_{it}" = real currency depreciation, "RER^{-}_{it}" = real currency appreciation, and "GDP" = ratio of real foreign GDP to real domestic GDP.

Table B.4: Nonlinear PARDL Estimation output - with lagged long run variables (SBIC)

$$\Delta y_{it} = \omega_i(y_{it-1} - \eta X_{it}) + \sum_{j=1}^{p-1} \Phi_{ij}^{*} \Delta y_{it-j} + \sum_{j=0}^{q-1} \phi_{ij}^{*} \Delta X_{it-j} + u_i + \epsilon_{it}$$

Variables	**Coefficients**
Long run	
RER_{it-1}^{+}	0.142
	(0.562)
RER_{it-1}^{-}	0.794**
	(0.379)
GDP_{it-1}	2.446***
	(0.454)
Short run	
ECT_{it-1}	-0.488***
	(0.085)
ΔRER_{it}^{+}	-2.543**
	(1.054)
ΔRER_{it}^{-}	0.966
	(0.824)
ΔGDP_{it}	-3.262
	(3.305)
$CONST.$	-4.310***
	(1.196)
Diagnostics Tests	
LR wald	2.060
	[0.151]
SR Wald	4.370**
	[0.037]
Hausman	2.560
	[0.465]

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. Figures in round brackets are standard errors, while those in square brackets are p-values. The lag length of the model is determined by SBIC.

Table B.5: PMG Cross Section Estimation results - with lagged long run variables (SBIC)

Country	ECT_{it-1}	ΔRER^{+}_{it}	ΔRER^{-}_{it}	ΔGDP_{it}	$CONST.$	Wald Test
Belgium	-0.922***	-0.229	2.505	-21.161**	-8.237***	0.140
	(0.259)	(5.528)	(2.699)	(8.470)	(2.729)	[0.709]
China	-0.347***	0.525	-3.427**	-17.565**	-4.513**	1.530
	(0.073)	(1.948)	(1.686)	(7.723)	(1.744)	[0.216]
Germany	-0.476**	-0.430	2.429	6.664	-6.342**	0.280
	(0.214)	(3.939)	(1.945)	(5.138)	(3.058)	[0.597]
Hong Kong	-0.193	3.024	0.688	-0.983	-1.424	0.240
	(0.190)	(3.014)	(2.719)	(9.223)	(1.203)	[0.624]
India	-0.733***	-4.172**	-2.892	5.335	-8.760***	0.150
	(0.187)	(1.992)	(1.945)	(6.458)	(2.518)	[0.696]
Japan	-0.528***	-0.952	1.748	23.042**	-6.602**	0.180
	(0.172)	(4.924)	(2.761)	(9.843)	(2.984)	[0.670]
Kenya	-0.329**	-1.738	-4.150	14.585**	-1.095	0.160
	(0.161)	(2.608)	(4.007)	(6.121)	(0.690)	[0.686]
Malawi	-0.262*	-0.309	0.275	8.560**	1.504*	0.060
	(0.141)	(1.489)	(1.234)	(4.224)	(0.783)	[0.806]
Mauiritius	-0.532***	-14.871**	8.649*	-32.807	0.383***	5.450**
	(0.180)	(7.861)	(4.016)	(19.431)	(0.614)	[0.012]
Netherlands	-1.279***	-6.265**	1.170	-14.669***	-12.416***	4.820**
	(0.180)	(2.419)	(1.311)	(3.722)	(3.031)	[0.028]
Singapore	-0.100	3.143	-0.920	-0.854	-0.614	0.340
	(0.121)	(4.913)	(3.335)	(7.664)	(0.904)	[0.561]
South Africa	-0.209	-0.897	0.814	-2.684	-1.717	0.770
	(0.131)	(1.254)	(0.970)	(3.737)	(1.091)	[0.379]
Sweden	-0.301*	-8.478**	2.922	-6.999*	-3.279*	4.210**
	(0.167)	(4.113)	(2.019)	(3.981)	(1.759)	[0.040]
Switzerland	-0.039	-1.701	-1.984	1.105	-0.087	0.010
	(0.092)	(2.620)	(1.782)	(5.491)	(0.503)	[0.940]
Tanzania	-0.942***	-3.838	6.460**	-11.367	-0.673	3.300*
	(0.195)	(3.807)	(2.513)	(8.436)	(0.706)	[0.069]
UK	-0.219	-1.981	-1.495	-0.500	-2.865	0.000
	(0.269)	(4.866)	(3.347)	(7.884)	(2.961)	[0.947]
USA	-0.880***	-4.066	3.640*	-5.158	-16.539**	3.750*
	(0.242)	(2.566)	(1.951)	(5.378)	(5.535)	[0.053]

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. Figures in round brackets are standard errors, while those in square brackets are p-values.

Table B.6: Nonlinear PARDL Estimation output - with lagged long run variables(AIC)

$$\Delta y_{it} = \omega_i(y_{it-1} - \eta X_{it}) + \sum_{j=1}^{p-1} \Phi^*_{ij}\Delta y_{it-j} + \sum_{j=0}^{q-1} \phi^*_{ij}\Delta X_{it-j} + u_i + \epsilon_{it}$$

Variables	Coefficients
Long run	
RER^+_{it-1}	-0.134
	(0.339)
RER^-_{it-1}	0.855***
	(0.276)
GDP_{it-1}	2.197***
	(0.328)
Short run	
ECT_{it-1}	-0.644***
	(0.139)
ΔTB_{it-1}	0.011
	(0.102)
ΔRER^+_{it}	-2.268**
	(1.015)
ΔRER^+_{it-1}	0.475
	(1.353)
ΔRER^-_{it}	1.023
	(0.844)
ΔRER^-_{it-1}	-0.345
	(1.043)
ΔGDP_{it}	-2.050
	(3.428)
ΔGDP_{it-1}	-5.770
	(4.359)
$CONST.$	-5.668***
	(2.104)
Diagnostics Tests	
LR wald	15.710***
	[0.000]
SR Wald	4.270**
	[0.039]
Hausman	1.810
	[0.612]

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. Figures in round brackets are standard errors, while those in square brackets are p-values. The lag length of the model is determined by AIC.

Table B.7: PMG Short Run Cross-section estimation results - with lagged long run variables (AIC)

	ECT_{it-1}	ΔTB_{it}	ΔRER^{+}_{it}	ΔRER^{+}_{it-1}	ΔRER^{-}_{it}	ΔRER^{-}_{it-1}	ΔGDP_{it}	ΔGDP_{it-1}	$CONST.$s	Wald Test
Belgium	-0.964**	0.016	-4.802	1.194	4.335	-2.663	-20.279**	-3.425	-7.602**	0.230
	(0.407)	(0.270)	(6.420)	(5.820)	(3.061)	-3.027	(8.508)	(12.136)	(3.389)	[0.632]
China	-0.609***	-0.182	1.689	2.349**	-4.678***	-0.575	-15.201***	-16.688***	-7.039***	1.730
	(0.066)	(0.111)	(1.054)	(1.047)	(1.052)	-1.153	(4.923)	(5.148)	(1.809)	[0.188]
Germany	-0.592**	0.143	0.865	-1.820	2.363	2.007	9.234	-1.948	-6.894**	0.060
	(0.295)	(0.259)	(4.691)	(4.291)	(2.308)	-2.294	(5.650)	(5.608)	(3.511)	[0.813]
Hong Kong	-0.455***	0.462*	3.838	2.391	-0.776	3.105	-5.713	22.166***	-2.455**	0.980
	(0.165)	(0.244)	(2.487)	(2.492)	(2.258)	-2.114	(7.877)	(7.219)	(0.998)	[0.322]
India	-1.173***	0.237	-4.665**	-1.515	-1.917	-2.847	7.958	-3.052	-12.562***	0.020
	(0.232)	(0.194)	(2.153)	(2.038)	(2.373)	-2.191	(8.785)	(9.384)	(2.671)	[0.898]
Japan	-0.516*	-0.096	0.132	-2.236	1.704	-1.880	29.492**	-7.796	-5.774	0.050
	(0.282)	(0.225)	(5.961)	(6.858)	(2.800)	-2.938	(14.099)	(18.164)	(3.921)	[0.830]
Kenya	-0.364***	0.406**	0.037	6.956***	-4.364	-0.843	12.307**	-2.720	-1.665***	0.850
	(0.135)	(0.176)	(1.882)	(1.832)	(3.416)	-2.744	(5.488)	(6.538)	(0.496)	[0.358]
Malawi	-0.178	-0.418**	0.165	2.147*	1.681	-2.217**	-3.128	2.144	0.768	0.090
	(0.122)	(0.182)	(1.346)	(1.280)	(1.299)	-1.109	(5.935)	(4.226)	(0.745)	[0.767]
Mauiritius	-0.926***	-0.009	-4.682	-6.168***	5.166	12.458***	-30.306*	-63.520***	-0.515	0.260
	(0.162)	(0.186)	(6.786)	(6.727)	(3.445)	-3.911	(16.971)	(16.740)	(0.581)	[0.611]
Netherlands	-1.375***	0.335**	-6.348***	7.148***	0.796	-1.384	-14.463***	0.820	-12.033***	0.160
	(0.316)	(0.154)	(2.370)	(2.488)	(1.162)	-1.233	(3.365)	(4.980)	(3.239)	[0.690]
Singapore	-0.118	-0.047	1.246	-2.904	0.644	3.091	0.732	17.100**	-0.022	0.190
	(0.131)	(0.266)	(4.619)	(4.692)	(3.630)	-2.969	(7.773)	(6.627)	(0.882)	[0.663]
South Africa	-0.045	-0.706***	-1.069	1.188	0.846	-1.453*	3.544	-7.473***	-0.596	0.060

Table B.7 continued from previous page

	ECT_{it-1}	ΔTB_{it}	ΔRER^{+}_{it}	ΔRER^{+}_{it-1}	ΔRER^{-}_{it}	ΔRER^{-}_{it-1}	ΔGDP_{it}	ΔGDP_{it-1}	$CONST$.s	Wald Test
	(0.152)	(0.197)	(1.495)	(1.295)	(1.175)	-0.750	(3.126)	(2.841)	(0.939)	[0.808]
Sweden	-0.543***	0.318*	-12.524***	-10.112***	5.648***	0.433	-9.574***	3.112	-4.839***	2.620
	(0.149)	(0.166)	(3.390)	(3.326)	(1.543)	-1.654	(3.304)	(3.378)	(1.493)	[0.105]
Switzerland	0.015	-0.680**	-0.401	-2.885	-4.625**	-1.068	3.727	-3.264	0.057	0.850
	(0.093)	(0.283)	(2.752)	(2.524)	(2.182)	-1.603	(5.752)	(5.954)	(0.466)	[0.355]
Tanzania	-1.225***	0.195	-3.758	-2.944	6.417*	0.045	-8.211	-4.165	-0.478	0.340
	(0.274)	(0.241)	(4.879)	(4.041)	(3.319)	-2.786	(8.923)	(9.251)	(0.874)	[0.558]
UK	0.128	-0.578*	-8.262*	14.377***	0.546	-8.927***	9.116	-11.963	0.303	0.240
	(0.272)	(0.305)	(4.492)	(4.235)	(2.737)	-3.106	(9.497)	(8.075)	(2.571)	[0.621]
USA	-2.007***	0.785***	-0.023	0.916	3.603**	-3.146*	-4.089	-17.416***	-35.004***	0.000
	(0.322)	(0.192)	(2.122)	(1.992)	(1.495)	-1.739	(5.906)	(5.857)	(7.302)	[0.978]

Notes: The asterisks ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. Figures in round brackets are standard errors, while those in square brackets are p-values.

Bibliography

Abbott, A., Cushman, D. O., and De Vita, G. (2012). Exchange rate regimes and foreign direct investment flows to developing countries. *Review of International Economics*, 20(1):95–107.

Adekunle, W. and Tiamiyu, A. (2018). Exchange rate pass-through to consumer prices in Nigeria: An asymmetric approach. *(MPRA Paper No. 88797)*, University Library of Munich, Germany.

AfDB (2018). African Economic Outlook. *African Development Bank*.

Akofio-Sowah, N. A. (2009). Is there a link between exchange rate pass-through and the monetary regime: Evidence from Sub-Saharan Africa and Latin America. *International Advances in Economic Research*, 15(3):296–309.

Akram, F., Chileshe, P., Zgambo, P., Mbao, F., and Muma, F. (2015). The Zambian Quarterly Macroeconometric Model(ZQM). *The BoZ Reader*, 2(1):56–90.

Aleem, A. and Lahiani, A. (2014). A threshold vector autoregression model of exchange rate pass-through in Mexico. *Research in International Business and Finance*, 30(C):24–33.

Alege, P. O. and Osabuohien, E. S. (2015). Trade-exchange rate nexus in Sub-Saharan African countries: Evidence from panel cointegration analysis. *Foreign Trade Review*, 50(3):151–167.

Alexander, S. S. (1952). Effects of a Devaluation on a Trade Balance. *Staff Papers-International Monetary Fund*, 2(2):263–278.

Alfaro, L. (2005). Inflation, openness, and exchange-rate regimes: The quest for short-term commitment. *Journal of Development Economics*, 77(1):229–249.

Alfaro, L. and Chauvin, J. (2020). Foreign direct investment, finance, and economic development. *Encyclopedia of International Economics and Global Trade*, 1:231–58.

Aliber, R. (1970). A Theory of Foreign Direct Investment. *in Kindleberger, C.P. (ed.). The International Corporation*, Cambridge, MA: MIT Press.

Alsan, M., Bloom, D. E., and Canning, D. (2006). The effect of population health on foreign direct investment inflows to low-and middle-income countries. *World development*, 34(4):613–630.

Aluko, O. A. (2020). The foreign aid–foreign direct investment relationship in Africa: The mediating role of institutional quality and financial development. *Economic affairs*, 40(1):77–84.

Anderson, T. W. and Hsiao, C. (1981). Estimation of dynamic models with error components. *Journal of the American Statistical Association*, 76(375):598–606.

Anju, G.-K. and Uma, R. (1999). Is there a J-curve? A new estimation for Japan. *International Economic Journal*, 13(4):71–79.

Anyanwu, J. C. (2011). Determinants of foreign direct investment inflows to Africa, 1980-2007. *African Development Bank Group*, Working Paper series number 136, Abidjan, Côte d'Ivoire.

Anyanwu, J. C. and Yameogo, N. D. (2015). What drives foreign direct investments into west africa? an empirical investigation. *African Development Review*, 27(3):199–215.

Ardalan, K. (2009). The monetary approach to balance of payments: A review of the seminal short-run empirical research. *Journal of Economics and Economic Education Research*, 10:47–99.

Arellano, M. and Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2):277–297.

Arize, A. C., Malindretos, J., and Igwe, E. U. (2017). Do exchange rate changes improve the trade balance: An asymmetric nonlinear cointegration approach. *International Review of Economics & Finance*, 49:313–326.

Aron, J., Macdonald, R., and Muellbauer, J. (2014). Exchange rate pass-through in developing and emerging markets: A survey of conceptual, methodological and policy issues, and selected empirical findings. *Journal of Development Studies*, 50(1):101–143.

Arratibel, O., Furceri, D., Martin, R., and Zdzienicka, A. (2011). The effect of nominal exchange rate volatility on real macroeconomic performance in the CEE countries. *Economic Systems*, 35(2):261–277.

Asamoah, M. E., Adjasi, C. K., and Alhassan, A. L. (2016). Macroeconomic uncertainty, foreign direct investment and institutional quality: Evidence from Sub-Saharan Africa. *Economic Systems*, 40(4):612–621.

Asamoah, M. E., Alagidede, I. P., and Adu, F. (2022). Exchange rate uncertainty and foreign direct investment in Africa: Does financial development matter? *Review of Development Economics*, 26(2):878–898.

Asiamah, O., Agyei, S. K., Bossman, A., Agyei, E. A., Asucam, J., and Arku-Asare, M. (2022). Natural resource dependence and institutional quality: Evidence from Sub-Saharan Africa. *Resources Policy*, 79:102967.

Asiedu, E. (2002). On the determinants of foreign direct investment to developing countries: Is Africa different? *World Development*, 30(1):107–119.

Asiedu, E. (2004). Policy reform and foreign direct investment in Africa: Absolute progress but relative decline. *Development Policy Review*, 22(1):41–48.

Asiedu, E. (2006). Foreign direct investment in Africa: The role of natural resources, market size, government policy, institutions and political instability. *World Economy*, 29(1):63–77.

Asiedu, E. (2013). Foreign direct investment, natural resources and institutions. *International Growth Centre*, 3:1–38.

Asiedu, E. and Lien, D. (2004). Capital controls and foreign direct investment. *World Development*, 32(3):479–490.

Asiedu, E. and Lien, D. (2011). Democracy, foreign direct investment and natural resources. *Journal of International Economics*, 84(1):99–111.

Asongu, S., Akpan, U. S., and Isihak, S. R. (2018). Determinants of foreign direct investment in fast-growing economies: Evidence from the BRICS and MINT countries. *Financial Innovation*, 4(1):1–17.

Asteriou, D., Pilbeam, K., and Pratiwi, C. E. (2021). Public debt and economic growth: panel data evidence for asian countries. *Journal of Economics and Finance*, 45:270–287.

Babubudjnauth, A. and Seetanah, B. (2020). An empirical investigation of the relationship between the real exchange rate and net FDI inflows in Mauritius. *African Journal of Economic and Management Studies*, 11(1):63–74.

Bacchetta, P. and Van Wincoop, E. (2003). Why do consumer prices react less than import prices to exchange rates? *Journal of the European Economic Association*, 1(2-3):662–670.

Bacchetta, P. and van Wincoop, E. (2005). A theory of the currency denomination of international trade. *Journal of International Economics*, 67(2):295–319.

Baharumshah, A. Z., Sirag, A., and Mohamed Nor, N. (2017). Asymmetric exchange rate pass-through in Sudan: Does inflation react differently during periods of currency depreciation? *African Development Review*, 29(3):446–457.

Bahmani-Oskooee, M. (1985). Devaluation and the J-curve: Some evidence from LDCs. *The Review of Economics and Statistics*, pages 500–504.

Bahmani-Oskooee, M. (1991). Is there a long-run relation between the trade balance and the real effective exchange rate of LDCs? *Economics letters*, 36(4):403–407.

Bahmani-Oskooee, M. and Arize, A. C. (2019). US-Africa trade balance and the J-curve: An asymmetry analysis. *The International Trade Journal*, 33(4):322–343.

Bahmani-Oskooee, M. and Arize, A. C. (2020). Asymmetry cointegration and the J-curve: New evidence from Africa. *Journal of Economic Studies*, 47(5):969–984.

Bahmani-Oskooee, M., Bose, N., and Zhang, Y. (2018). Asymmetric cointegration, nonlinear ARDL, and the J-Curve: A bilateral analysis of China and its 21 trading partners. *Emerging Markets Finance and Trade*, 54(13):3131–3151.

Bahmani-Oskooee, M., Bose, N., and Zhang, Y. (2019a). An asymmetric analysis of the J-curve effect in the commodity trade between China and the US. *The World Economy*, 42(10):2854–2899.

Bahmani-Oskooee, M. and Brooks, T. J. (1999). Bilateral J-curve between US and her trading partners. *Weltwirtschaftliches Archiv*, 135:156–165.

Bahmani-Oskooee, M., Economidou, C., and Goswami, G. G. (2006). Bilateral J-curve between the UK vis-à-vis her major trading partners. *Applied Economics*, 38(8):879–888.

Bahmani-Oskooee, M. and Fariditavana, H. (2015). Nonlinear ARDL approach, asymmetric effects and the J-curve. *Journal of Economic Studies*, 42(3):519–530.

Bahmani-Oskooee, M. and Fariditavana, H. (2016). Nonlinear ARDL approach and the J-curve phenomenon. *Open Economies Review*, 27:51–70.

Bahmani-Oskooee, M. and Gelan, A. (2012). Is there J-Curve effect in Africa? *International Review of Applied Economics*, 26(1):73–81.

Bahmani-Oskooee, M. and Gelan, A. (2020). The South Africa-US trade and the real exchange rate: Asymmetric evidence from 25 industries. *South African Journal of Economics*, 88(2):186–203.

Bahmani-Oskooee, M., Goswami, G. G., and Kumar Talukdar, B. (2005). The bilateral J-curve: Australia versus her 23 trading partners. *Australian Economic Papers*, 44(2):110–120.

Bahmani-Oskooee, M., Goswami, G. G., and Talukdar, B. K. (2008). The bilateral J-curve: Canada versus her 20 trading partners. *International Review of Applied Economics*, 22(1):93–104.

Bahmani-Oskooee, M. and Halicioglu, F. (2017). Asymmetric effects of exchange rate changes on Turkish bilateral trade balances. *Economic Systems*, 41(2):279–296.

Bahmani-Oskooee, M., Halicioglu, F., and Hegerty, S. W. (2016). Mexican bilateral trade and the J-curve: An application of the nonlinear ARDL model. *Economic Analysis and Policy*, 50:23–40.

Bahmani-Oskooee, M. and Harvey, H. (2009). The J-curve: Indonesia vs. her major trading partners. *Journal of Economic Integration*, pages 765–777.

Bahmani-Oskooee, M. and Hegerty, S. W. (2010). The J-and S-curves: A survey of the recent literature. *Journal of Economic Studies*.

Bahmani-Oskooee, M. and Kanitpong, T. (2017). Do exchange rate changes have symmetric or asymmetric effects on the trade balances of Asian countries? *Applied Economics*, 49(46):4668–4678.

Bahmani-Oskooee, M. and Karamelikli, H. (2021). Estimating a bilateral J-curve between the UK and the Euro area: An asymmetric analysis. *The Manchester School*, 89(2):223–237.

Bahmani-Oskooee, M., Rahman, M. O., and Abdul Kashem, M. (2019b). Bangladesh's trade partners and the J-curve: An asymmetry analysis. *Macroeconomics and Finance in Emerging Market Economies*, 12(2):174–189.

Bahmani-Oskooee, M. and Ratha, A. (2004). The J-curve: A literature review. *Applied Economics*, 36(13):1377–1398.

Bahmani-Oskooee, M. and Saha, S. (2017). Asymmetric response of the US–India trade balance to exchange rate changes: Evidence from 68 industries. *The World Economy*, 40(10):2226–2254.

Bailliu, J., Dong, W., and Murray, J. (2010). Has exchange rate pass-through really declined? Some recent insights from the literature. *Bank of Canada Review*, 2010(Autumn):1–8.

Bailliu, J. and Fujii, E. (2004). Exchange rate pass-through and the inflation environment in industrialized countries: An empirical investigation. *Bank of Canada*, Working Paper 2004-21.

Bala, U., Songsiengchai, P., and Chin, L. (2017). Asymmetric behavior of exchange rate pass-through in Thailand. *Economics Bulletin*, 37(2):1289–1297.

Balcilar, M., Roubaud, D., Usman, O., and Wohar, M. E. (2021). Testing the asymmetric effects of exchange rate pass-through in BRICS countries: Does the state of the economy matter? *The World Economy*, 44(1):188–233.

Ball, D. A., McCulloch, W. H., Frantz, P. L., Geringer, J. M., and Minor, M. S. (2004). *International business: The challenge of global competition.* McGraw-Hill/Irwin.

Baltagi, B. H. (2013). *Econometric Analysis of Panel Data.* Springer, 6th Edition, ISBN/ISSN:978-3-030-53952-8.

Bank of Zambia (2019). *"Annual Report 2019".* Lusaka, Zambia.

Barhoumi, K. (2006). Differences in long run exchange rate pass-through into import prices in developing countries: An empirical investigation. *Economic modelling*, 23(6):926–951.

Barkat, K., Jarallah, S., and Alsamara, M. (2022). Do Exchange Rate Changes Improve the Trade Balance in GCC Countries: Evidence from Nonlinear Panel Cointegration. *The International Trade Journal*, pages 1–17.

Ben Doudou, M., Nouira, R., Saafi, S., and Belhadj, A. (2020). Do exchange rate changes have threshold effects on the trade balance? Evidence from Tunisia. *Economic Change and Restructuring*, pages 1–27.

Bénassy-Quéré, A., Fontagné, L., and Lahrèche-Révil, A. (2001). Exchange-rate strategies in the competition for attracting foreign direct investment. *Journal of the Japanese and International Economies*, 15(2):178–198.

Bende-Nabende, A. (2002). Foreign direct investment determinants in Sub-Sahara Africa: A co-integration analysis. *Economics Bulletin*, 6(4):1–19.

Benigno, P. and Faia, E. (2016). Globalization, Pass-Through, and Inflation Dynamics. *International Journal of Central Banking*, 12(4):263–306.

Bhattacharya, R., Patnaik, I., and Shah, A. (2008). Exchange rate pass-through in India. *New Delhi: National Institute of Public Finance and Policy.*

Bianchi, F. and Civelli, A. (2015). Globalization and inflation: Evidence from a time-varying VAR. *Review of Economic Dynamics*, 18(2):406–433.

Blackburne III, E. F. and Frank, M. W. (2007). Estimation of nonstationary heterogeneous panels. *The Stata Journal*, 7(2):197–208.

Bleaney, M. and Tian, M. (2014). Exchange rates and trade balance adjustment: A multi-country empirical analysis. *Open Economies Review*, 25:655–675.

Blonigen, B. A. (1997). Firm-specific assets and the link between exchange rates and foreign direct investment. *The American Economic Review*, pages 447–465.

Blonigen, B. A. (2005). A review of the empirical literature on FDI determinants. *Atlantic Economic Journal*, 33:383–403.

Boateng, A., Hua, X., Nisar, S., and Wu, J. (2015). Examining the determinants of inward FDI: Evidence from Norway. *Economic Modelling*, 47:118–127.

Bolboaca, M. and Fischer, S. (2019). News shocks: Different effects in boom and recession? *Swiss National Bank, Study Center Gerzensee*, Working Paper, No. 19.01.

Borio, C. E. and Filardo, A. J. (2007). Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation. *BIS working paper*, 227.

Bošnjak, M., Novak, I., and Krišto, A. (2018). Monetary and absorption approach to explain the Croatian current account. *Zbornik Radova Ekonomski Fakultet u Rijeka*, 36(2):929–946.

Boyd, D., Caporale, G. M., and Smith, R. (2001). Real exchange rate effects on the balance of trade: Cointegration and the Marshall–Lerner condition. *International Journal of Finance & Economics*, 6(3):187–200.

Brun-Aguerre, R., Fuertes, A.-M., and Greenwood-Nimmo, M. (2017). Heads I win; tails you lose: asymmetry in exchange rate pass-through into import prices. *Journal of the Royal Statistical Society. Series A, Statistics in society*, 180(2):587–612.

Bucci, A., Palomba, G., and Rossi, E. (2019). *Does Macroeconomics Help in Predicting Stock Markets Volatility Comovements?: A Nonlinear Approach.* Università Politecnica delle Marche, Dipartimento Economia, Research paper 440.

Bucci, A., Palomba, G., and Rossi, E. (2022). Starvars: An R Package for Analysing Nonlinearities in Multivariate Time Series. *THE R JOURNAL*, 14:208–226.

Buckley, P. and Casson, M. (1976). *The Future of the Multinational Enterprise.* Macmillan, London.

Burstein, A. T., Neves, J. C., and Rebelo, S. (2003). Distribution costs and real exchange rate dynamics during exchange-rate-based stabilizations. *Journal of Monetary Economics*, 50(6):1189–1214.

Bussière, M. (2007). Exchange rate pass-through to trade prices: The role of non-linearities and asymmetries. *ECB*, Working Paper series, No. 822.

Bussière, M. (2013). Exchange rate pass-through to trade prices: The role of nonlinearities and asymmetries. *Oxford Bulletin of Economics and Statistics*, 75(5):731–758.

Bussière, M. and Peltoven, T. (2007). Export and import prices in emerging markets: What role for exchange rate pass-through? *European Central Bank, Frankfurt.*

Bwire, T., Anguyo, F. L., and Opolot, J. (2013). Exchange rate pass-through to domestic prices in Uganda: evidence from a Structural Vector Auto-Regression (SVAR). *Journal of Statistical and Econometric Methods*, 2(4):41–68.

Caggiano, G., Castelnuovo, E., and Figueres, J. M. (2020). Economic policy uncertainty spillovers in booms and busts. *Oxford Bulletin of Economics and Statistics*, 82(1):125–155.

Camacho, M. (2004). Vector smooth transition regression models for US GDP and the composite index of leading indicators. *Journal of Forecasting*, 23(3):173–196.

Cambazoglu, B. and Gunes, S. (2016). The relationship between foreign exchange rate and foreign direct investment in Turkey. *Economics, Management, and Financial Markets*, 11(1).

Campa, J. M. (1993). Entry by foreign firms in the United States under exchange rate uncertainty. *The Review of Economics and Statistics*, pages 614–622.

Campa, J. M. and Goldberg, L. S. (2005). Exchange rate pass-through into import prices. *Review of Economics and Statistics*, 87(4):679–690.

Campos, N. F. and Kinoshita, Y. (2003). Why Does FDI Go Where it Goes?: New Evidence from the Transition Economies. *IMF working paper*, WP/03/228.

Caporale, G. M., Gil-Alana, L. A., and Mudida, R. (2015). Testing the Marshall–L erner Condition in Kenya. *South African Journal of Economics*, 83(2):253–268.

Carney, M. (2017). [De] Globalisation and inflation', 2017 IMF Michel Camdessus Central Banking Lecture. *Bank of England*, Available at https://www.bankofengland.co.uk/speech/2017/de-globalisation-and-inflation.

Caves, R. E. (1989). Exchange-Rate Movements and Foreign Direct Investment in the United States. *in David B. Audretsch and Michael P. Claudon, eds., The internationalization of U.S. markets*, New York: New York University Press:199–228.

Ca'Zorzi, M., Hahn, E., and Sánchez, M. (2007). Exchange rate pass-through in emerging markets. *European Central Bank*, Working paper series(739).

Chakrabarti, R. and Scholnick, B. (2002). Exchange rate expectations and foreign direct investment flows. *Weltwirtschaftliches Archiv*, 138(1):1–21.

Cheikh, N. B. (2012a). Asymmetric exchange rate pass-through in the Euro area: New evidence from smooth transition models. *Economics*, 6(1).

Cheikh, N. B. (2012b). Non-linearities in exchange rate pass-through: Evidence from Smooth Transition Models. *Economics Bulletin*, 32(3):2530–2545.

Cheikh, N. B. and Louhichi, W. (2016). Revisiting the role of inflation environment in exchange rate pass-through: A panel threshold approach. *Economic Modelling*, 52:233–238.

Cheikh, N. B., Younes, B. Z., and Nguyen, P. (2018). Nonlinear Exchange Rate Transmission in the Euro Area: A Multivariate Smooth Transition Regression Approach. *Economics Bulletin*, 38(3):1590–1602.

Cheikh, N. B. and Zaied, Y. B. (2020). Revisiting the pass-through of exchange rate in the transition economies: New evidence from new EU member states. *Journal of International Money and Finance*, 100:102093.

Chen, C.-N. (1975). IS, LM, BT, and a Simplified Synthesis of the Elasticity, Absorption, and Monetary Approaches to Devaluation. *Southern Economic Journal*, pages 132–136.

Chen, K.-M., Rau, H.-H., and Lin, C.-C. (2006). The impact of exchange rate movements on foreign direct investment: Market-oriented versus cost-oriented. *The Developing Economies*, 44(3):269–287.

Chipili, J. M. (2010). *Macroeconomic effects of exchange rate volatility in Zambia*. PhD thesis, University of Leicester.

Chipili, J. M. (2013). Exchange rate volatility and trade flows in Zambia. *African Development Review*, 25(1):55–66.

Chipili, J. M. (2016). Copper price and exchange rate dynamics in Zambia. *Journal of International Development*, 28(6):876–886.

Chong Tee, O. (2013). An exchange-rate-centred monetary policy system: Singapore's experience. *BIS Paper*, 73w.

Choudhri, E. U. and Hakura, D. S. (2006). Exchange rate pass-through to domestic prices: does the inflationary environment matter? *Journal of international Money and Finance*, 25(4):614–639.

Chudik, A., Mohaddes, K., Pesaran, M. H., and Raissi, M. (2016). Long-run effects in large heterogeneous panel data models with cross-sectionally correlated errors. In *Essays in Honor of man Ullah*, pages 85–135. Emerald Group Publishing Limited.

Cleeve, E. A., Debrah, Y., and Yiheyis, Z. (2015). Human capital and FDI inflow: An assessment of the African case. *World Development*, 74:1–14.

Colclough, C. (1988). Zambian adjustment strategy—with and without the IMF. *Institute of Development Studies*.

Colletaz, G. and Hurlin, C. (2006). Threshold effects of the public capital productivity: An International Panel Smooth Transition Approach. *Document de Recherche LEO*, LEO Working Papers / DR LEO 1669, Orleans Economics Laboratory.

Correa, A. d. S. and Minella, A. (2010). Nonlinear mechanisms of the exchange rate pass-through: A Phillips curve model with threshold for Brazil. *Revista Brasileira de Economia*, 64:231–243.

Coulibaly, D. and Kempf, H. (2010). Does Inflation Targeting decrease Exchange Rate Pass-through in Emerging Countries? *Banque de France*, Working papers(303).

Cushman, D. O. (1985). Real exchange rate risk, expectations, and the level of direct investment. *The Review of Economics and Statistics*, pages 297–308.

Cushman, D. O. (1988). US bilateral trade flows and exchange risk during the floating period. *Journal of International Economics*, 24(3-4):317–330.

Darvas, Z. (2012). Real effective exchange rates for 178 countries: a new database. *Bruegel*, Working Paper(6).

Darvas, Z. M. (2021). Timely measurement of real effective exchange rates. *Bruegel Working Paper*.

Daude, C. and Stein, E. (2007). The quality of institutions and foreign direct investment. *Economics & Politics*, 19(3):317–344.

De Vries, M. G. (1987). *Balance of payments adjustment, 1945 to 1986: The IMF experience*. International Monetary Fund, ISBN/ISSN: 9780939934935.

Delatte, A.-L. and López-Villavicencio, A. (2012). Asymmetric exchange rate pass-through: Evidence from major countries. *Journal of Macroeconomics*, 34(3):833–844.

Devereux, M. B. and Engel, C. (2001). Endogenous currency of price setting in a dynamic open economy model. *National Bureau of Economic Research*, NBER Working Papers 8559, Cambridge, Mass., USA.

Di Mauro, F., Rüffer, R., and Bunda, I. (2008). The changing role of the exchange rate in a globalised economy. *European Central Bank*, Occasional Paper(94).

Dia, I. and Ondoa, H. A. (2023). Does Economic Freedom Improve FDI Inflows in Sub-Saharan Africa? *Journal of Economic Integration*, 38(3):383–410.

Dimitrova, A., Rogmans, T., and Triki, D. (2020). Country-specific determinants of FDI inflows to the MENA region: A systematic review and future research directions. *Multinational Business Review*, 28(1):1–38.

Doğan, B. Ş. (2013). Asymmetric behavior of the exchange rate pass-through to manufacturing prices in Turkey. *Emerging Markets Finance and Trade*, 49(3):35–47.

Donayre, L. and Panovska, I. (2016). State-dependent exchange rate pass-through behavior. *Journal of International Money and Finance*, 64:170–195.

Dongfack, L. P. S. and Ouyang, H. (2019). The Impact of Real Exchange Rate Depreciation on Cameroon's Trade Balance. *Journal of Economic Integration*, 34(1):189–213.

Dornbusch, R. (1985). Exchange rates and prices. *National Bureau of Economic Research*, NBER Working Papers 1769, Cambridge, Mass., USA.

Dreher, A., Gaston, N., and Martens, P. (2008). Measuring globalisation. *Gauging its Consequences Springer, New York*.

Duarte, M. (2001). International pricing in new open-economy models. *FRB Richmond Economic Quarterly*, 87(4):53–70.

Duasa, J. (2007). Determinants of Malaysian trade balance: An ARDL bound testing approach. *Global Economic Review*, 36(1):89–102.

Dunning, J. H. (1988). The theory of International Production. *The International Trade Journal*, 3(1):21–66.

Dunning, J. H. and Lundan, S. M. (2008). *Multinational Enterprises and the Global economy*. Edward Elgar Publishing, Cheltenham.

Durairaj, K. and Nirmala, V. (2012). Do Exchange Rate and its Volatility Deter Foreign Direct Investment (FDI) to India? *The Indian Economic Journal*, 60(1):130–144.

Edwards, S. (1986). Are Devaluation Contractionary? *The Review of Economics and Statistics*, 68(3):501–508.

Eissa, M. A. and Elgammal, M. M. (2020). Foreign direct investment determinants in oil exporting countries: Revisiting the role of natural resources. *Journal of Emerging Market Finance*, 19(1):33–65.

Eita, J. H. (2013). Estimation of the Marshall-Lerner condition for Namibia. *International Business & Economics Research Journal (IBER)*, 12(5):511–518.

El bejaoui, H. J. (2013). Asymmetric effects of exchange rate variations: An empirical analysis for four advanced countries. *International Economics*, 135-136:29–46.

El Hamiani Khatat, M., Buessings-Loercks, M., and Fleuriet, V. (2020). Monetary Policy Under an Exchange Rate Anchor. *IMF working paper*, WP/20/180.

Engel, C. (2000). Local-currency pricing and the choice of exchange-rate regime. *European Economic Review*, 44(8):1449–1472.

Engle, R. F. and Granger, C. W. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica*, pages 251–276.

Enisan, A. A. (2017). Determinants of foreign direct investment in Nigeria: A Markov regime-switching approach. *Review of Innovation and Competitiveness: A Journal of Economic and Social Research*, 3(1):21–48.

Evans, R. W. (2012). Is openness inflationary? Policy commitment and imperfect competition. *Journal of Macroeconomics*, 34(4):1095–1110.

Faeth, I. (2009). Determinants of foreign direct investment–a tale of nine theoretical models. *Journal of Economic Surveys*, 23(1):165–196.

Fandamu, H., Ndulo, M., and Fandamu, M. (2021). Globalization and Exchange Rate Pass Through: Evidence from Zambia. *African Journal of Economic Review.*

Feenstra, R. C., Inklaar, R., and Timmer, M. P. (2015). The next generation of the Penn World Table. *American Economic Review*, 105(10):3150–3182.

Fouquau, J., Hurlin, C., and Rabaud, I. (2008). The Feldstein–Horioka puzzle: A panel smooth transition regression approach. *Economic Modelling*, 25(2):284–299.

Frankel, J., Parsley, D., and Wei, S.-J. (2012). Slow pass-through around the world: A new import for developing countries? *Open Economies Review*, 23(2):213–251.

Frenkel, R. and Taylor, L. (2006). Real exchange rate, monetary policy and employment. *UN Department of Economic and Social Affairs*, DESA working paper No. 19, New York.

Froot, K. A. and Klemperer, P. D. (1988). Exchange rate pass-through when market share matters. *American Economic Review*, 79(4):637–654.

Froot, K. A. and Stein, J. C. (1991). Exchange rates and foreign direct investment: An imperfect capital markets approach. *The Quarterly Journal of Economics*, 106(4):1191–1217.

Furceri, D. and Borelli, S. (2008). Foreign direct investments and exchange rate volatility in the EMU neighborhood countries. *Journal of International and Global Economic Studies*, 1(1):42–59.

Gagnon, J. E. and Ihrig, J. (2004). Monetary policy and exchange rate pass-through. *International Journal of Finance & Economics*, 9(4):315–338.

Gamber, E. N. and Hung, J. H. (2001). Has the rise in globalization reduced US inflation in the 1990s? *Economic Inquiry*, 39(1):58–73.

Gastanaga, V. M., Nugent, J. B., and Pashamova, B. (1998). Host country reforms and FDI inflows: How much difference do they make? *World Development*, 26(7):1299–1314.

Gefang, D. and Strachan, R. (2009). Nonlinear Impacts of International Business Cycles on the UK–A Bayesian Smooth Transition VAR Approach. *Studies in Nonlinear Dynamics & Econometrics*, 14(1).

Ghartey, E. E. (2019). Asymmetries in exchange rate pass-through and monetary policy principle: Some Caribbean empirical evidence. *The North American Journal of Economics and Finance*, 47:325–335.

Ghosh, A. (2013). Exchange rate pass through, macro fundamentals and regime choice in Latin America. *Journal of Macroeconomics*, 35:163–171.

Goldberg, L. S. and Kolstad, C. D. (1994). Foreign direct investment, exchange rate variability and demand uncertainty. *National Bureau of Economic Research*, NBER Working Paper No. 4815, Cambridge, Mass., USA.

Goldberg, L. S. and Tille, C. (2006). The Internationalization of the Dollar and Trade balance adjustment. *FRB of New York Staff Report*, 255.

González, A., Terasvirta, T., and van Dijk, D. (2005). Panel Smooth Transition Regression Models. *University of Technology Sydney*, Quantitative Finance Research Centre(165).

González, A., Teräsvirta, T., Van Dijk, D., and Yang, Y. (2017). Panel smooth transition regression models. *SSE/EFI Working Paper Series in Economics and Finance 604*, Stockholm School of Economics.

Goswami, G. G. and Junayed, S. H. (2006). Pooled Mean Group Estimation of the Bilateral Trade Balance Equation: USA vis-à-vis Her Trading Partners. *International Review of Applied Economics*, 20(4):515–526.

Gruben, W. C. and McLeod, D. (2004). The openness–inflation puzzle revisited. *Applied Economics Letters*, 11(8):465–468.

Gust, C., Leduc, S., and Vigfusson, R. (2010). Trade integration, competition, and the decline in exchange-rate pass-through. *Journal of monetary economics*, 57(3):309–324.

Hahn, E. (2003). Pass-through of external shocks to euro area inflation. *European Central Bank*, Working Paper Series(243).

Halicioglu, F. (2007). The J-curve dynamics of Turkish bilateral trade: A cointegration approach. *Journal of Economic Studies*, 34(2):103–119.

Halicioglu, F. (2008). The bilateral J-curve: Turkey versus her 13 trading partners. *Journal of Asian Economics*, 19(3):236–243.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, 93(2):345–368.

Havi, E. D. K. (2021). The impact of exchange rate volatility on foreign direct investment inflows in Ghana. *African Journal of Economic Review*, 9(4):183–199.

Healy, P. M. and Palepu, K. G. (1993). International corporate equity associations: who, where, and why? In *Chapter 8 - Foreign Direct Investment*, pages 231–254. University of Chicago Press, edited by K. A. Froot.

Hill, C. (2008). International business: Competing in the global market place. *Strategic Direction*, 24(9).

Hniya, S., Boubker, A., Mrad, F., and Nafti, S. (2021). The impact of real exchange rate volatility on foreign direct investment inflows in Tunisia. *International Journal of Economics and Financial Issues*, 11(5):52.

Holmes, M. J. (2008). Long-run pass-through from the exchange rate to import prices in african countries. *Journal of Economic Development*, 33(1).

Horvat, T., Bendix, H., Bobek, V., and Skoko, H. (2021). Impacts of investments in infrastructure projects on emerging markets' growth: the case of East African countries. *Economic research-Ekonomska istraživanja*, 34(1):2135–2161.

Hubrich, K. and Teräsvirta, T. (2013). Thresholds and Smooth Transitions in Vector Autoregressive Models. In *VAR Models in Macroeconomics–New*

Developments and Applications: Essays in Honor of Christopher A. Sims, volume 32, pages 273–326. Emerald Group Publishing Limited.

Hüfner, F. (2004). *Foreign exchange intervention as a monetary policy instrument*, volume 23. Springer Science & Business Media.

Hymer, S. H. (1976). The international operations of national firms: A study of foreign direct investment. *MIT PhD thesis*, Cambridge, MA: MIT Press, Available at https://api.semanticscholar.org/CorpusID:166877002.

Ihrig, J., Kamin, S. B., Lindner, D., and Marquez, J. (2010). Some simple tests of the globalization and inflation hypothesis. *International Finance*, 13(3):343–375.

Ihrig, J. E., Marazzi, M., and Rothenberg, A. D. (2006). Exchange-rate pass-through in the G-7 countries. *Federal Reserve Board*, International Finance Discussion Paper(851).

IMF (2009). *Balance of Payments and International Investment Position Manual*. Washington, D.C.

Ito, T. and Sato, K. (2008). Exchange rate changes and inflation in post-crisis Asian Economies: Vector Autoregression Analysis of the exchange rate pass-through. *Journal of Money, Credit and Banking*, 40(7):1407–1438.

Iyke, B. N. and Ho, S.-Y. (2017). The real exchange rate, The Ghanaian trade balance, and the J-curve. *Journal of African Business*, 18(3):380–392.

Jaiblai, P. and Shenai, V. (2019). The determinants of fdi in sub-saharan economies: A study of data from 1990–2017. *International Journal of Financial Studies*, 7(3):43.

Jarrett, U., Mohaddes, K., and Mohtadi, H. (2019). Oil price volatility, financial institutions and economic growth. *Energy Policy*, 126:131–144.

Jeanneret, A. (2007). Foreign Direct Investment and Exchange Rate Volatility: A Non-Linear Story. *National Centre of Competence in Research Financial Valuation and Risk Management*, Working Paper No. 399.

Jehan, Z. and Hamid, A. (2017). Exchange rate volatility and capital inflows: Role of financial development. *Portuguese Economic Journal*, 16:189–203.

Jiménez-Rodríguez, R. and Morales-Zumaquero, A. (2016). A new look at exchange rate pass-through in the G-7 countries. *Journal of Policy Modeling*, 38(5):985–1000.

Johnson, H. G. (1972). The monetary approach to balance-of-payments theory. *Journal of financial and quantitative analysis*, 7(2):1555–1572.

Johnson, H. G. (1977). The monetary approach to balance of payments theory and policy: Explanation and policy implications. *Economica*, 44(175):217–229.

Junttila, J. and Korhonen, M. (2012). The role of inflation regime in the exchange rate pass-through to import prices. *International Review of Economics & Finance*, 24:88–96.

Junz, H. B. and Rhomberg, R. R. (1973). Price competitiveness in export trade among industrial countries. *The American Economic Review*, 63(2):412–418.

Kandiero, T. and Chitiga, M. (2006). Trade openness and foreign direct investment in Africa. *South African Journal of Economic and Management Sciences*, 9(3):355–370.

Kara, H. and Öğünç, F. (2008). Inflation targeting and exchange rate pass-through: The Turkish experience. *Emerging Markets Finance and Trade*, 44(6):52–66.

Karoro, T. D., Aziakpono, M. J., and Cattaneo, N. (2009). Exchange rate pass-through to import prices in South Africa: is there asymmetry? *South African Journal of Economics*, 77(3):380–398.

Kassi, D. F., Rathnayake, D. N., Edjoukou, A. J. R., Gnangoin, Y. T., Louembe, P. A., Ding, N., and Sun, G. (2019). Asymmetry in exchange rate pass-through to consumer prices: New perspective from sub-Saharan African countries. *Economies*, 7(1):5.

Kaufmann, D., Kraay, A., and Mastruzzi, M. (2010). The worldwide governance indicators: Methodology and analytical issues. *World Bank Policy Research Working Papers*, 5430.

Kaya, A. I. (2021). Real exchange rate and trade balance in Turkey: Evidence from heterogeneous panel data. *Panoeconomicus*, 68(5):699–715.

Khan, M. Z. S. and Hossain, M. I. (2010). A model of bilateral trade balance: Extensions and empirical tests. *Economic Analysis and Policy*, 40(3):377–391.

Khatoon, R., Hasan, M. E., Ibon, M. W. F., Islam, S., Mehareen, J., Murshed, R., Pabon, M. N. F., Rahman, M. J., and Shuchi, M. S. (2021). Aggregation, asymmetry, and common factors for Bangladesh's exchange rate–trade balance relation. *Empirical Economics*, pages 1–32.

Khraiche, M. and Gaudette, J. (2013). FDI, exchange rate volatility and financial development: regional differences in emerging economies. *Economics Bulletin*, 33(4):3143–3156.

Khundrakpam, J. K. (2008). Have economic reforms affected exchange rate pass-through to prices in India? *Economic and political weekly*, pages 71–79.

Kindleberger, C. (1969). *American Business Abroad: Six Lectures on Foreign Direct Investment*. New Haven, Yale University Press.

Kiyota, K. and Urata, S. (2004). Exchange rate, exchange rate volatility and foreign direct investment. *World Economy*, 27(10):1501–1536.

Klein, M. W. and Rosengren, E. (1994). The real exchange rate and foreign direct investment in the United States: Relative wealth vs. relative wage effects. *Journal of international Economics*, 36(3-4):373–389.

Knetter, M. M. (1992). International comparisons of pricing-to-market behavior. *National Bureau of Economic Research*, NBER Working Papers 4098, Cambridge, Mass., USA.

Kodongo, O. and Ojah, K. (2013). Real exchange rates, trade balance and capital flows in Africa. *Journal of Economics and Business*, 66:22–46.

Koengkan, M., Fuinhas, J. A., and Marques, A. C. (2020). The role of financial openness and China's income on fossil fuels consumption: Fresh evidence from Latin American countries. *GeoJournal*, 85(2):407–421.

Kohlscheen, E. (2010). Emerging floaters: pass-throughs and (some) new commodity currencies. *Journal of International Money and Finance*, 29(8):1580–1595.

Koop, G. and Potter, S. (2000). Nonlinearity, structural breaks, or outliers. In *Nonlinear Econometric Modeling in Time Series: Proceedings of the Eleventh International Symposium in Economic Theory*, volume 11, page 61. Cambridge University Press.

Kouladoum, J.-C. (2023). Inclusive education and health performance in sub Saharan Africa. *Social Indicators Research*, 165(3):879–900.

Krugman, P. R. (1986). Pricing to market when the exchange rate changes. *National Bureau of Economic Research*, NBER Working Papers 1926, Cambridge, Mass., USA.

Krugman, P. R., Obstfeld, M., and Melitz, M. J. (2018). *International Economics: Theory & Policy*. Harlow: Pearson Education Limited.

Kulkarni, K. G. (1996). The J-curve hypothesis and currency devaluation: Cases of Egypt and Ghana. *Journal of Applied Business Research (JABR)*, 12(2):1–8.

Kumari, R. and Sharma, A. K. (2017). Determinants of foreign direct investment in developing countries: A panel data study. *International Journal of Emerging Markets*.

Kurul, Z. (2017). Nonlinear relationship between institutional factors and FDI flows: Dynamic panel threshold analysis. *International Review of Economics & Finance*, 48:148–160.

Kwalingana, S., Simwaka, K., Munthali, T., and Chiumia, A. (2012). The short-run and long-run trade balance response to exchange rate changes in Malawi. *Journal of Development and Agricultural Economics*, 4(8):221–232.

Kwame Akosah, N. and Omane-Adjepong, M. (2017). Exchange Rate and External Trade Flows: Empirical Evidence of J-Curve Effect in Ghana. MPRA Paper 86640, University Library of Munich, Germany.

Kyereboah-Coleman, A. and Agyire-Tettey, K. F. (2008). Effect of exchange-rate volatility on foreign direct investment in Sub-Saharan Africa: The case of Ghana. *The Journal of Risk Finance*, 9(1):52–70.

Lal, A. K. and Lowinger, T. C. (2002). The J-curve: Evidence from East Asia. *Journal of Economic Integration*, pages 397–415.

Lane, P. R. (1997). Inflation in open economies. *Journal of International Economics*, 42(3-4):327–347.

Leonard, G. and Stockman, A. C. (2002). Current accounts and exchange rates: A new look at the evidence. *Review of International Economics*, 10(3):483–496.

Levin, A., Lin, C.-F., and Chu, C.-S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108(1):1–24.

López-Villavicencio, A. and Mignon, V. (2018). Globalization and Exchange-Rate Pass-Through in Europe: Is There a Link? *Journal of Economic Integration*, 33(4):773–786.

López-Villavicencio, A. and Saglio, S. (2014). Is globalization weakening the inflation–output relationship? *Review of International Economics*, 22(4):744–758.

Luukkonen, R., Saikkonen, P., and Teräsvirta, T. (1988). Testing linearity against smooth transition autoregressive models. *Biometrika*, 75(3):491–499.

Magbondé, G. K. and Konté, M. A. (2022). Developing countries' economic fundamentals and FDI inflows: The moderating role of institutions. *Cogent Economics & Finance*, 10(1).

Magee, S. P. (1973). Currency contracts, pass-through, and devaluation. *Brookings Papers on Economic Activity*, 1973(1):303–325.

Mann, C. L. (1986). Prices, profit margins, and exchange rates. *Federal Reserve Bulletin*, 72:366.

Manopimoke, P. (2015). Globalization and international inflation dynamics: the role of the global output gap. *Puey Ungphakorn Institute for Economic Research*, PIER Discussion Papers, 8.

Marazzi, M. and Sheets, N. (2007). Declining exchange rate pass-through to US import prices: The potential role of global factors. *Journal of International Money and Finance*, 26(6):924–947.

María-Dolores, R. (2009). Exchange Rate Pass-Through in Central and East European Countries: Do Inflation and Openness Matter? *Eastern European Economics*, 47(4):42–61.

Matesanz, D. and Fugarolas, G. (2009). Exchange rate policy and trade balance: A cointegration analysis of the Argentine experience since 1962. *Applied Economics*, 41(20):2571–2582.

McCarthy, J. (2007). Pass-through of exchange rates and import prices to domestic inflation in some industrialized economies. *Eastern Economic Journal*, 33(4):511–537.

McCulloch, R. (1989). Japanese Investment in the United States. *in David B. Audretsch and Michael P. Claudon, eds., The internationalization of U.S. markets*, New York: New York University Press:171–197.

Menon, J. (1995). Exchange rate pass-through. *Journal of Economic Surveys*, 9(2):197–231.

Mensah, L., Bokpin, G. A., and Fosu-Hene, E. D. (2017). Foreign exchange rate moments and FDI in Ghana. *Journal of Economics and Finance*, 41:136–152.

Mijiyawa, A. (2015). What drives foreign direct investment in Africa? An empirical investigation with panel data. *African Development Review*, 27(4):392–402.

Mina, W. (2007). The location determinants of FDI in the GCC countries. *Journal of Multinational Financial Management*, 17(4):336–348.

Mishkin, F. S. (2001). The transmission mechanism and the role of asset prices in monetary policy. *National Bureau of Economic Research*, NBER Working Papers 8617, Cambridge, Mass., USA.

Moffett, M. H. (1989). The J-curve revisited: An empirical examination for the United States. *Journal of International Money and Finance*, 8(3):425–444.

Moraghen, W., Seetanah, B., and Sookia, N. (2021). Impact of exchange rate and exchange rate volatility on foreign direct investment inflow for Mauritius: A dynamic time series approach. *African Development Review*, 33(4):581–591.

Moraghen, W., Seetanah, B., and Sookia, N. U. H. (2023). The impact of exchange rate and exchange rate volatility on Mauritius foreign direct investment: A sector-wise analysis. *International Journal of Finance & Economics*, 28(1):208–224.

Moura, G. and Da Silva, S. (2005). Is there a Brazilian J-curve. *Economics Bulletin*, 6(10):1–17.

Mudenda, D. (2005). Zambia's trade situation: Implications for debt and poverty reduction. *Jesuit Centre for Theological Reflection*, Lusaka, Zambia.

Mungule, O. (2004). The Determinants of the Real Exchange Rate in Zambia. *African Economic Research Consortium*, Research Paper No. 146.

Musawa, N. (2014). Relationship between Zambia's exchange rates and the trade balance-J-curve hypothesis. *International Journal of Finance and Accounting*, 3(3):192–196.

Mushendami, P., Manuel, V., Shifotoka, H., and Nakusera, F. (2017). Empirical analysis of the monetary approach to the balance of payment in Namibia. *International Review of Research in Emerging Markets and the Global Economy (IRREM)*, 3(1):1088–1104.

Musila, J. W. (2002). Exchange rate changes and trade balance adjustments in Malawi. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, 23(1):69–85.

Musila, J. W. and Newark, J. (2003). Does currency devaluation improve the trade balance in the long run? Evidence from Malawi. *African Development Review*, 15(2-3):339–352.

Musonda, A. (2008). Exchange rate volatility and non-traditional exports performance: Zambia, 1965–1999. *African Economic Research Consortium (AERC).*

Mwase, N. (2006). An empirical investigation of the exchange rate pass-through to inflation in Tanzania. *International Monetary Fund*, 06(150).

Mwito, M. M., Mkenda, B. K., and Luvanda, E. (2021). The asymmetric J-curve phenomenon: Kenya versus her trading partners. *Central Bank Review*, 21(1):25–34.

Narayan, P. K. (2006). Examining the relationship between trade balance and exchange rate: The case of China's trade with the USA. *Applied Economics Letters*, 13(8):507–510.

Nathaniel, S. P. (2020). Does exchange rate have asymmetric impact on trade balance? Fresh insights from combined cointegration. *Studies in Business and Economics*, 15(1):259–269.

Ndlela, D. and Ndlela, T. (2002). Exchange rate policy and trade facilitation in regional integration agreements: The case of Southern African economies. In *Trade and Industrial Policy Strategies, Annual Forum*.

Neves, J. P. B. and Semmler, W. (2022). Credit, output and financial stress: A non-linear LVSTAR application to Brazil. *Metroeconomica*, 73(3):900–923.

Nkoro, E. and Uko, A. K. (2016). Autoregressive Distributed Lag (ARDL) cointegration technique: Application and interpretation. *Journal of Statistical and Econometric methods*, 5(4):63–91.

Nogueira, R. and Leon-Ledesma, M. (2008). Exchange rate pass-through into inflation: The role of asymmetries and nonlinearities. *School of Economics, University of Kent*, 08,01.

Noland, M. (1989). Japanese trade elasticities and the J-curve. *The Review of Economics and Statistics*, pages 175–179.

Nusair, S. A. (2017). The J-Curve phenomenon in European transition economies: A nonlinear ARDL approach. *International Review of Applied Economics*, 31(1):1–27.

Obadan, M. I. (2006). Overview of exchange rate management in Nigeria. *CBN Bullion*, 30(3):1–9.

Obstfeld, M. (2002). Exchange rates and adjustment: perspectives from the new open economy macroeconomics. *National Bureau of Economic Research*, NBER Working Paper Series(9118).

Obuobi, N. K., Gatsi, J. G., Appiah, M. O., Kawor, S., Amoah, E. K., and Abeka, M. J. (2022). Trade liberalization policies and foreign direct investment inflows in Africa: Evidence from new measures of trade liberalization. *The Journal of International Trade & Economic Development*, 31(3):394–409.

OECD (2008). *OECD benchmark definition of foreign direct investment 2008*. Organisation for Economic Co-operation and Development.

Ogbonna, O. E., Ogbuabor, J. E., Manasseh, C. O., and Ekeocha, D. O. (2022). Global uncertainty, economic governance institutions and foreign direct investment inflow in Africa. *Economic Change and Restructuring*, 55(4):2111–2136.

Oke, B. O., Ezike, J. E., and Ojogbo, S. O. (2012). Locational determinants of foreign direct investments in Nigeria. *International Business Research*, 5(4):103–111.

Oladipupo, A. O. (2011). Impact of exchange rate on balance of payment in Nigeria. *African Research Review*, 5(4).

Olivei, G. P. (2002). Exchange rates and the prices of manufacturing products imported into the United States. *New England Economic Review*, pages 3–18.

Onyeiwu, S. and Shrestha, H. (2004). Determinants of foreign direct investment in Africa. *Journal of Developing Societies*, 20(1-2):89–106.

Osinubi, T. S. and Amaghionyeodiwe, L. A. (2009). Foreign direct investment and exchange rate volatility in Nigeria. *International Journal of Applied Econometrics and Quantitative Studies*, 6(2):83–116.

Ozkan, I. and Erden, L. (2015). Time-varying nature and macroeconomic determinants of exchange rate pass-through. *International Review of Economics & Finance*, 38:56–66.

Parrado, E. (2004). Singapore's unique monetary policy: How does it work? *IMF working paper*, WP/04/10.

Parray, W. A., Bhat, J. A., Yasmin, E., and Bhat, S. A. (2023). Exchange Rate Changes and the J-curve Effect: Asymmetric Evidence from a Panel of Five Emerging Market Economies. *Foreign Trade Review*, page 00157325221145432.

Peltzman, S. (2000). Prices rise faster than they fall. *Journal of Political Economy*, 108(3):466–502.

Peres, M., Ameer, W., and Xu, H. (2018). The impact of institutional quality on foreign direct investment inflows: evidence for developed and developing countries. *Economic research-Ekonomska istraživanja*, 31(1):626–644.

Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. *University of Cambridge*, Faculty of Economics(0435).

Pesaran, M. H. (2015). Testing weak cross-sectional dependence in large panels. *Econometric reviews*, 34(6-10):1089–1117.

Pesaran, M. H., Shin, Y., and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3):289–326.

Pesaran, M. H., Shin, Y., and Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American statistical Association*, 94(446):621–634.

Pesaran, M. H. and Smith, R. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, 68(1):79–113.

Phillips, S. and Ahmadi-Esfahani, F. Z. (2008). Exchange rates and foreign direct investment: theoretical models and empirical evidence. *Australian Journal of Agricultural and Resource Economics*, 52(4):505–525.

Poelhekke, S. and Van Der Ploeg, F. (2013). Do natural resources attract nonresource FDI? *Review of Economics and Statistics*, 95(3):1047–1065.

Polak, J. J. (1998). The IMF monetary model at 40. *Economic Modelling*, 15(3):395–410.

Pollard, P. S. and Coughlin, C. C. (2004). Size matters: asymmetric exchange rate pass-through at the industry level. *University of Nottingham Research Paper*, 2004/13, Available at SSRN: https://ssrn.com/abstract=716001.

Potrafke, N. (2015). The evidence on globalisation. *The World Economy*, 38(3):509–552.

Przystupa, J. and Wróbel, E. (2011). Asymmetry of the exchange rate pass-through: An exercise on Polish data. *Eastern European Economics*, 49(1):30–51.

Qamruzzaman, M., Karim, S., and Wei, J. (2019). Does asymmetric relation exist between exchange rate and foreign direct investment in Bangladesh? Evidence from nonlinear ARDL analysis. *The Journal of Asian Finance, Economics and Business*, 6(4):115–128.

Rawlins, G. and Praveen, J. (1993). *Devaluation and the trade balance: The recent experience of selected African countries.* Center for Economic Research on Africa, Department of Economics and Finance, Montclair State University.

Ray, E. J. (1989). The determinants of foreign direct investment in the United States, 1979-85. In *Trade Policies for International Competitiveness*, pages 53–84. University of Chicago Press.

Razafimahefa, M. I. F. (2012). Exchange rate pass-through in Sub-Saharan African economies and its determinants. *International Monetary Fund*, 06(141).

Reinikka, R. and Svensson, J. (1999). How inadequate provision of public infrastructure and services affects private investment. *The World Bank*, Policy Reserach Working Paper 2262.

Riti, J. S., Shu, Y., and Kamah, M. (2021). Institutional quality and environmental sustainability: The role of freedom of press in most freedom of press countries. *Environmental Impact Assessment Review*, 91:106656.

Rogoff, K. (2003). Globalization and global disinflation. *Economic Review-Federal Reserve Bank of Kansas City*, 88(4):45–80.

Romer, D. (1993). Openness and inflation: theory and evidence. *The Quarterly Journal of Economics*, 108(4):869–903.

Rose, A. K. (1990). Exchange rates and the trade balance: Some evidence from developing countries. *Economics letters*, 34(3):271–275.

Rose, A. K. (1991). The role of exchange rates in a popular model of international trade: Does the 'Marshall–Lerner'condition hold? *Journal of International Economics*, 30(3-4):301–316.

Rose, A. K. and Yellen, J. L. (1989). Is there a J-curve? *Journal of Monetary Economics*, 24(1):53–68.

Rothman, P., van Dijk, D., and Franses, P. (2001). Multivariate Star Analysis of Money-Output Relationship. *Macroeconomic Dynamics*, Vol.5:506—532.

Rugman, A. M. (2010). Reconciling internalization theory and the eclectic paradigm. *Multinational Business Review*, 18(2):1–12.

Sano, H.-O. (1988). The IMF and Zambia: the contradictions of exchange rate auctioning and de-subsidization of agriculture. *African Affairs*, 87(349):563–577.

Schaling, E. and Kabundi, A. (2014). The exchange rate, the trade balance and the J-curve effect in South Africa. *South African Journal of Economic and Management Sciences*, 17(5):601–608.

Schleer, F. and Semmler, W. (2015). Financial sector and output dynamics in the euro area: Non-linearities reconsidered. *Journal of Macroeconomics*, 46:235–263.

Sekine, T. (2006). Time-varying exchange rate pass-through: experiences of some industrial countries. *Bank for International Settlements*, Working Paper(202).

Seo, M. H., Kim, S., and Kim, Y.-J. (2019). Estimation of dynamic panel threshold model using Stata. *The Stata Journal*, 19(3):685–697.

Seo, M. H. and Shin, Y. (2016). Dynamic panels with threshold effect and endogeneity. *Journal of Econometrics*, 195(2):169–186.

Shah, M. H. et al. (2014). The significance of infrastructure for FDI inflow in developing countries. *Journal of Life Economics*, 1(2):1–16.

Shahmoradi, B. and Baghbanyan, M. (2011). Determinants of foreign direct investment in developing countries: A panel data analysis. *Asian Economic and Financial Review*, 1(2):49–56.

Sharifi-Renani, H. and Mirfatah, M. (2012). The impact of exchange rate volatility on foreign direct investment in Iran. *Procedia Economics and Finance*, 1:365–373.

Shin, Y., Yu, B., and Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. *Festschrift in honor of Peter Schmidt: Econometric methods and applications*, pages 281–314.

Shintani, M., Terada-Hagiwara, A., and Yabu, T. (2013). Exchange rate pass-through and inflation: A nonlinear time series analysis. *Journal of international Money and Finance*, 32:512–527.

Shuaibu, M. I. and Isah, A. (2020). Exchange rate dynamics and trade balance in selected African countries. *Journal of African Trade*, 7(1/2):69–83.

Singh, D. and Gal, Z. (2020). Economic freedom and its impact on foreign direct investment: Global overview. *Review of Economic Perspectives*, 20(1):73–90.

Singh, T. (2004). Testing J-curve hypothesis and analysing the effect of exchange rate volatility on the balance of trade in India. *Empirical Economics*, 29:227–245.

Sooreea-Bheemul, B., Rasool, U. S., and Sooreea, R. (2020). Does economic freedom matter to foreign direct investment in Sub-Saharan Africa. *International Journal of Economics and Financial Issues*, 10(3).

Suliman, A., Elmawazini, K., and Shariff, M. Z. (2015). Exchange rates and foreign direct investment: Evidence for sub-Saharan Africa. *The Journal of Developing Areas*, pages 203–226.

Suliman, A. H. and Mollick, A. V. (2009). Human capital development, war and foreign direct investment in Sub-Saharan Africa. *Oxford Development Studies*, 37(1):47–61.

Swenson, D. L. (1994). The impact of US tax reform on foreign direct investment in the United States. *Journal of Public Economics*, 54(2):243–266.

Talani, L. S. (2019). What is globalisation? *The Palgrave Handbook of Contemporary International Political Economy*, pages 413–428.

Taşdemir, F. (2022). Endogenous thresholds for the determinants of FDI inflows: Evidence from the MENA countries. *International Journal of Emerging Markets*, 17(3):683–704.

Tatom, J. A. (2017). Globalization and Inflation: A Swiss Perspective. *Open Economies Review*, 28(3):523–545.

Taylor, J. B. (2000). Low inflation, pass-through, and the pricing power of firms. *European Economic Review*, 44(7):1389–1408.

Teräsvirta, T. and Yang, Y. (2014). Specification, estimation and evaluation of vector smooth transition autoregressive models with applications. *Aarhus University*, CREATES Research Paper 2014-8.

Tootell, G. M. (1998). Globalization and US inflation. *New England Economic Review*, page 21.

Uchendu, O. (1996). The transmission of monetary policy in Nigeria. *Economic and Financial Review*, 34(2):4.

Ullah, S., Haider, S. Z., and Azim, P. (2012). Impact of exchange rate volatility on foreign direct investment: A case study of Pakistan. *Pakistan Economic and Social Review*, pages 121–138.

UNCTAD (1991). *World Investment Report*. Available at https://unctad.org/topic/investment/world-investment-report.

UNCTAD (1993). *World Investment Report*. Available at https://unctad.org/topic/investment/world-investment-report.

UNCTAD (1998). *World Investment Report*. Available at https://unctad.org/topic/investment/world-investment-report.

UNCTAD (1999). *World Investment Report*. Available at https://unctad.org/topic/investment/world-investment-report.

UNCTAD (2014). *World Investment Report*. Available at https://unctad.org/topic/investment/world-investment-report.

UNCTAD (2019). Comprehensive Study of the Interrelationship between Foreign Direct Investment (FDI) and Foreign Portfolio Investment (FPI). *UNCTAD*, UNCTAD/GDS/DFSB/5.

Upper, C. (2016). Inflation mechanisms, expectations and monetary policy-overview. *Bank For Internal Settlements*, 89a.

Viswanathan, H. and Mishra, A. (2020). India-Africa Partnership for Food Security: Beyond Strategic. *Observer Research Foundation (ORF)*, Occasional Paper, 242.

Vita, G. D. and Abbott, A. (2007). Do exchange rates have any impact upon UK inward foreign direct investment? *Applied Economics*, 39(20):2553–2564.

Williamson, J. (2009). Exchange rate economics. *Open Economies Review*, 20:123–146.

Wulf, J. (1988). Zambia under the IMF Regime. *African affairs*, 87(349):579–594.

Yanamandra, V. (2015). Exchange rate changes and inflation in India: What is the extent of exchange rate pass-through to imports? *Economic Analysis and policy*, 47:57–68.

Yang, Y. (2012). Modelling nonlinear Vector economic time series. *CREATES Research*, Aarhus University, Aarhus, Denmark, Phd Thesis.

Yaya, K. (2022). Real Exchange Rate Dynamics and Trade Balance in WAEMU Countries: Evidence from Panel Nonlinear ARDL Approach. *Journal of Economics and Financial Analysis*, 5(2):1–22.

Yiheyis, Z. and Musila, J. (2018). The dynamics of inflation, exchange rates and the trade balance in a small economy: The case of Uganda. *International Journal of Development Issues*, 17(2):246–264.

Yol, M. A. and Baharumshah, A. Z. (2007). Estimating exchange rate and bilateral trade balance relationships: The experience of Sub-Saharan African Countries. *South African Journal of Economics*, 75(1):35–51.

Zhang, C., Song, K., and Wang, F. (2015). Economic globalization and inflation in China: A multivariate approach. *China & World Economy*, 23(3):79–96.

Zhang, Z., Hu, W., and Chang, T. (2019). Nonlinear effects of P2P lending on bank loans in a Panel Smooth Transition Regression model. *International Review of Economics & Finance*, 59:468–473.

Ziramba, E. and Chifamba, R. T. (2014). The J-curve dynamics of South African trade: Evidence from the ARDL approach. *European Scientific Journal*, 10(19):346–358.

Zombe, C., Daka, L., Phiri, C., Kaonga, O., Chibwe, F., and Seshamani, V. (2017). Investigating the causal relationship between inflation and trade openness using Toda–Yamamoto approach: Evidence from Zambia. *Mediterranean Journal of Social Sciences*, 8(6):171.