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EXCHANGE RATE PASS-THROUGH IN ETHIOPIA: A VECTOR ERROR CORRECTION MODEL

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This is to certify that the thesis prepared by Nuguse Girma, entitled with: **Exchange rate pass-through in Ethiopia: A Vector error correction model**, and submitted in partial fulfillment of the requirements for the degree of Master of Science in Economics (International Economics) Complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Declaration

I hereby declare that this MSc. thesis entitled "**Exchange rate pass-through in Ethiopia: A vector error correction model"** was carried out by me for the masters of economics under the guidance and supervision of Dr. Girma Estifanos, Addis Ababa University, college of Business and Economics, Department of Economics.

The interpretation put forth are based on my reading and understanding of the original tests and they are not published anywhere in the form of books, articles and reports. The other books, articles and websites, which I have made use of are acknowledged at the respective place in the text.

For the present thesis, which I am submitting to the University, no degree or diploma or distinction has been conferred on me before, either in this or in any other university.

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List of Acronyms

ADF:	Augmented Dickey-Fuller
AIC:	Akaike information criterion
BOP:	Balance of Payment
CPI:	Consumer Price Index
CSA:	Central Statistics Agency
ERPT:	Exchange Rate Pass-Through
ETB:	Ethiopian Birr
IRF:	Impulse Response Function
FPE:	Final Prediction Error
IMP:	Import Price
HQIC:	Hannan-Quinn information criterion
MS:	Money Supply
NBE:	National Bank of Ethiopia
NEER:	Nominal Effective Exchange Rate
WCPI:	World commodity price index
PPI:	Producers Price Index
PPP:	Purchasing Power Parity
PCP:	Producer Currency Pricing
PTM:	Pricing to Market
LOP:	Law of One Price
USD:	United States dollar
VAR:	Vector Autoregressive
VECM:	Vector Error Correction Model

Abstract

Exchange rates pass through in Ethiopia

Nuguse Girma

Ethiopia is small open economy adapted managed floating exchange rate since 1992 and applied exchange rate devaluation as expenditure switching policy frequently. The domestic prices become further debatable following such change in exchange rate. The main focus of this research work was to investigate the theoretical and empirical impact of Exchange rate change in to domestic prices both on import and consumer price side. To this end, the study adapted Vector error correction model on quarterly data ranging from 2005 to 2022. Furthermore, this study utilized the impulse response function and variance decomposition analysis to discuss weather additional links between domestic price and exchange rate exists. Based on a Vector error correction model analysis the study found that import price and money supply have a significant positive impact on consumer price while the effect of exchange rate change and world commodity price index is positive but insignificant. The impulse response function further shows that ERPT in to domestic price is low, incomplete and higher for import price compared to consumer price (9.1 and 3.08 percent after two years respectively). On other hand the variance decomposition indicates that the higher variation in consumer price and import price arises from their own shock while world commodity price index is the second candidate to contribute higher variation to domestic price in the model. That can be considered as an evidence for the presence of imported inflation in Ethiopia. The factuality of low and incomplete exchange rate Pass through in Ethiopia gives a greater flexibility for policymakers to design independent optimal mix of economic policy.

Key words: Nominal effective exchange rate, consumer price, Import price

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

In light of the fact that most countries are involved in bilateral and multilateral trade agreements, exchange rate movement plays a crucial role. This is because the prices of traded goods and services in different market can be weighted (Lindert and Pugel, 1996). This underlying relationship between exchange rate movement and price of traded goods can be analyzed by exchange rate pass through. Campa and Goldberg (2002), explain Exchange rate pass-through (ERPT) as the scope at which exchange rate variation get absorbed in to the price of tradable products. ERPT simply refers to the impact of exchange rate change on consumer price, trade price and volumes. Depending on the degree of pass through economic literature categorized ERPT in to two folds[1].

Examining the degree of exchange rate change displayed in to overall price level is essential for a multiple reason. First, exchange rate change affects country's balance of payment position through its impact on the volume of trade both on export and import side Hossain (2002). The movement in exchange rate will lead to change in import price which in turn affects domestic inflation. Second, exchange rate movements have significant impact on the implementation of optimal mix of economic policy. For instance, Bettis and Devereux (2000) shows that the effect of both monetary and fiscal policies can be different depending on the degree of exchange rate pass through. Choudhri and Hakura (2001) further highlights the importance of lower exchange rate pass-through for a higher freedom it vests to the monetary authority to pursue and apply independent monetary policy.

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1 Complete pass-through arises when the reaction of the prices of tradable commodities to a shift in exchange rates is 1 to 1 in the destination nation's currency. In other words, a change in the exchange rate results in an equal change in domestic prices (a change of 1% in the exchange rate results in a 1% change in home prices). On the other side, incomplete pass through occurs when the changes in the exchange rate are not aligned with the domestic price. Incomplete processes are frequently caused by factors like trade barriers, the inability of domestic and foreign items to be perfectly substituted, transactional and transportation expenses.

Once exchange rate shifts, an exporter has a following three possibilities. It may opt to fully incorporate the exchange rate change into the price of its destination currency (total pass-through), retain the change to keep the price of its destination currency fixed (zero pass-through), or a mixture of the two strategies (partial pass-through). For instance, in cases where domestic demand is highly elastic, foreign firms are compelled to internalize exchange rate variations in their profit margins, instead of passing them completely over local markets (Knetter, 1989 and Dornbusch, 1987).

Exchange rate pass-through represents one of the most investigated areas in the academic research. However, the bulk of theoretical and empirical studies are mostly concentrated in the context of developed countries and most of those studies identify ERPT as incomplete for developed Countries. See for instance Campa and Goldberg (2002); Yang (1997); Goldberg and Knetter (1997); Mumtaz et al (2006). Various empirical literatures on developed economy further reveal numerous evidences for complete ERPT; though complete pass-through could be a reality in less developed economies too. For instance, Helpman and Krugman (1989) proposes that regardless of the size of the country and its economy, countries can specialize in the production of certain products that no other country can efficiently produce and therefore small open economies can also be a price setter in terms of trade and ERPT can be complete for developing countries.

Even though little has been done in the past decades, considerable amount of research has recently been carried out in the context of developing countries. Choudhri and Hakura (2003); Frankel, et al (2005); Devereux and Yetman (2008); Razafimahefa (2012); Ragoobur and Chicooree (2013); Mwase (2006); Ogun (2000) are evident empirical works. ERPT studies conducted in Ethiopia are even scarcer and not investigated well. To the utmost of our information, an excellent research work by Helen (2012), Mohammednur (2012), Negasi (2014) and the study by Choudhri and Hakura (2006) on ERPT in sub-Saharan Africa and Ethiopia in particular worth to be mentioned. Therefore, this paper tries to discuss the underlying linkage between exchange rate and domestic price using recent data.

1.2. Statement of the Problem

In the contemporary world where most countries usually design economic policies to gain from their bilateral and multilateral trade performances, exchange rate is central mechanism in switching expenditure between foreign and domestic goods. The theoretical investigation on the impact of movement in exchange rate further reveals a multiple reasons why shift in exchange rate leads to change in import and consumer prices. Khundrakpam (2007), for instance, cited trade distortions, exchange rate volatility and the proportion of imports in the overall consumption pattern and the size of the imports in the nation's economy as major factors behind. These variables therefore, determines the pace and size of the exchange rate excursion into the price level.

According to Reinhart (1995) devaluation is considered as a policy measures by nations with a huge imbalance in external trade and low economic growth. When we look at the evidence of Ethiopia, in 1992 ETB was devalued by 141.5 percent, the largest in the history of the nation. Afterwards, in 2010 ETB devalued by 16.7 percent and most recently in 2017 by 15 percent[2]. Price level of almost every commodity have risen substantially following those changes in exchange rate. For instance, consumer price has increased by 3.4 percent and reached 15.6% in 2018[3]. The inflation rate also remains persistently high and reached more than 35 percent in 2022[4].

Following those aforementioned truths above, the transmission of exchange rate movement in to overall price level is not unreasonable reality for many. However, the magnitude of the shock in exchange rate that has absorbed by domestic price remain inconclusive. Using sample data from 1970 to 2007, Devereux and Yetman (2008) highlight 0.35 percent pass through in Ethiopia while Helen (2012), illustrates fluctuating ERPT on import price which accounts for 0.26 percent after three years and nearly zero for consumer price in subsequent periods, demonstrating persistently diminishing ERPT to import price and considerably lower to consumer price. Negasi

[2] World bank (2018)
[3] Central statistical agency CSA (2018)
[4] Afterwards, Price level of almost every commodity has raised substantially, following the shift in exchange rate, for instance, consumer prices surged by 77.2 percent throughout the course of a five-year span following the devaluation of 16.7 percent in 2010. Whereas import price shows a 27.8 percent increment compared to base year. CPI further soared by 117.1 percent in five years after devaluation in 2017.

(2014) further reported modest exchange rate impact of 34 percent in the long run. Choudhri and Hakura (2006) in other hand shows that the pass-through for import price in majority of the country the study covered including Ethiopia is incomplete.

Ethiopia had a frequent experience of deliberate change in exchange rate. However, the link between exchange rate movement via import and consumer price is not studied well. Therefore, this study will provide additional empirical analysis through employing recent quarterly data and different methodology than (Helen, 2012). In terms of quarterly data utilized; this study appears to be more beneficial than Mohammednur (2012). This is because, given poor infrastructure in small open economy like Ethiopia with lower economic interaction in global market, the delay in trade adjustment sounds to be inevitable. This further causes the sluggish response of the overall economies to the monthly exchange rate variation.

Unlike Mohammednur (2012) and Negasi (2014), who actually employed oil price inflation as a proxy for supply shock, this study takes into account world commodity price index. Even though Ethiopia depends heavily on imported oil and changes in oil prices have a considerable impact on the overall economy, the price of oil is closely monitored and subsidized by the government for its purchase and consumption, which further complicate to grasp the sole impact of the oil price. Moreover, Choudhri and Hakura and Devereux and Yetman (2008) were not focused solely on Ethiopia and failed to suggest possible policy implication specifically for Ethiopia. Taking these differences into consideration, this study tries to investigate the relation between exchange rate and domestic price of Ethiopia, while more emphasis is given for long run impact of change in exchange rate. This is because; inflation rate become highly serious issue as galloping trend reaches a double fold.

1.3. Objective of the Study

The principal goal of this study is to address the overall impact of exchange rate change on domestic prices. The study further aims to accomplish the following specific objectives.

i. To investigate the effect of exchange rate change on domestic prices of Ethiopia both on import and consumer price side.
ii. To assess the magnitude and speed of ERPT in to consumer and import price.
iii. To reveal the impact of other macro-economic variables on domestic prices.
iv. Make policy recommendations.

1.4. Research Questions

Thus, based on the foregoing backdrop, the study will try to evaluate the key research queries presented below.

- **i.** Does exchange rate movement significantly affect import and consumer prices of Ethiopia?
- **ii.** What is the magnitude of ERPT on domestic prices? Is a pass- through larger for import price or consumer price?
- **iii.** Do other macro-economic variables affect domestic price of Ethiopia?

1.5. Significance of the Study

The theoretical foundations along with empirical findings on the effect of ERPT on domestic prices are inconclusive. Thus, the researcher believes that the study contributes in identifying the effect and the magnitude of the pass-through on domestic price of Ethiopia using recent data. Furthermore, the outcome of the study is also expected to be an input for decision making with regard of devising policies about exchange rate movement and to alleviate the unwanted exchange rate shock transfer. The last but not the least importance of the study is that it paves the way for future researchers on this topic and it's further expected to contribute as an additional literature.

1.6. Organization of the Study

The rest of the paper have ordered in the following sequences: the second chapter presents the relevant theoretical and empirical works that has done before in the field of exchange rate pass through. This chapter further delivers history of exchange rate fluctuations and domestic price in Ethiopia. Chapter three provides data description and research methods. Descriptive and econometric analysis, result and evidence are discussed in chapter four and lastly chapter five renders a conclusive remark with policy implications.

CHAPTER TWO

2. REVIEW OF THE LITERATURE

2.1. Theoretical Literature

The notion “pass-through” was initially introduced in economics terminology by Stephen Magee (1973) to explain the consequences of currency depreciation. Since then, the concept has been increasingly and frequently discussed, and interest in analyzing the impact of fluctuations in exchange rates on a country's trade prices and its significance for policymaking has grown. Exchange rate pass-through, according to Campa and Goldberg (2002), gauges how much of exchange rate variability is passed on traded items. According to Mumtaz et al. (2006: 4) ERPT is the percentage deviation in import prices in the domestic currency due to a one-percent shift in exchange rate between the nations participate in the process. Additionally, Beirne and Bijsterbosch (2009) further explain ERPT as it demonstrates the magnitude of changes in the exchange rate reflected in local currency prices for traded items. The study also clarifies that a complete ERPT is defined as an import price reaction to exchange rates that is exactly one-to-one, unlike below one-to-one reactions which is incomplete pass-through.

In simpler terminologies, exchange rate pass through refers to the magnitude by which exchange rate movement alter relative commodity prices. It demonstrates the consequences of exchange rate fluctuation on, consumer price, export and import prices (trade price) and volume. Our focus in this study is to illustrate the consequence of exchange rate change on domestic prices. Once the foreign exchange rate shifts, an exporter has a following three possibilities. It may opt to fully incorporate the exchange rate change into the price of its destination currency (total pass-through), retain the change to keep the price of its destination currency fixed (zero pass-through), or a mixture of the two strategies (partial pass-through). For instance, in cases where domestic demand is highly elastic, foreign firms are compelled to internalize exchange rate variations in their profit margins, instead of passing them completely over local markets (Knetter 1989, 1993 & Dornbusch, 1987).

2.1.1. Purchasing Power Parity (PPP)

The fundamental cause for the shift in exchange rate according to purchasing power parity is the difference in inflation rate among trading nation. This means that the price level of a specified basket of products in the two-trading nation should be equalized by the exchange rate between them. Once the domestic price level of a country rises (i.e., the nation possesses inflation), its currency must fall in order to be restored to PPP. This argument and the whole theoretical explanation of ERPT are based on the law of one price (LOP). The law of one price is the equalization theory for the value of identical traded items globally when price level among nations participated stated in the equivalent currency. In simpler illustrations, the law of one price ensures a one-to-one link between the domestic and foreign prices of identical items.

Furthermore, law of one price guarantee the buyers to have the same purchasing power in a global market where maximization and costless transportation, distribution and resale and absence of any legal restriction must prevail first as a precondition for the law of one price to hold. Relative purchasing power parity is the extension of absolute purchasing power parity, which signifies to rates of fluctuations in price levels, which is inflation rate price level among the foreign and the home country is equal to rate of appreciation of a currency. According to Krugman and Obstfeld (2003) the perfectly competitive market has no markup over price and total pass-through is justified by the purchasing power parity argument.

Each and every argument for incomplete pass-through should start with an explanation why the law of one price fails, i.e., a barrier to arbitrage, which can be divided into the following two groups: (1) transportation costs, tariffs, and various other trade barriers that interfere between the terminal within the nation of export and the port in the importing nation, along with (2) distribution and retail costs that intervene across the terminal in the country of import and the customer at the store counter. Krugman and Dornbusch (1987) suggested another incentive for diversion from law of one price called PTM (pricing-to-market). PTM is simply the way firms adjust prices for different market in order to capitalize on the international price differences. According to Krugman (1987) Pricing to market exists when the variation import prices failed to be proportional to the changes in exchange rate. Knetter (1993) suggested adjustment costs as a main reason for the presence of pricing to market behavior. PTM is a deviate from purchasing power parity theory mainly due to Price discrimination and Temporary shift in profits. Feenstra

and Kendall (1997) further indicate empirical proves for a huge role of pricing-to-market plays for the deviation from law of one price and for the presence of incomplete pass-through. Furthermore, Menon (1995), signifies the ability of exporters to adjust their pricing due variations in exchange rate as a means to maintain current competitiveness in the destination market, which is obviously impractical in a perfect competitive environment because it requires export prices to be set beyond the marginal production cost in the very beginning. Additionally, Herzberg et al. (2003) demonstrate that there will be incomplete pass-through if the importing nation is significant enough to have an impact on the global pricing.

According to Knetter (1992) the degree of ERPT is determined by the simultaneous reaction of firm's production costs in local currency and the mark-up of pricing above marginal cost. The proportion of imported inputs in the total inputs used in the manufacturing process determines how sensitive the exporting firm's production costs are to changes in exchange rates. The increase in the exporter's expenses following a devaluation or depreciation of the exporter's currency will be positively ascribed to the higher cost of purchasing imported input. The exporting company won't be able to lower its foreign currency export prices owing to an increase in total costs if the proportion of inputs priced in foreign currency in total inputs is higher.

The theoretical explanations of incomplete pass-through have emphasized the role of market and product differentiation. Under conditions of imperfect competition, pricing will no longer be at marginal cost, and firms would be in a position to charge a mark-up on costs to earn above normal profits even in the long run. The degree of substitutability between the domestic and imported good as determined by the degree of product differentiation and the extent of market integration or separation can be prominent factors in determining the price-setting power of firms. Dornbusch (1987) suggested that degree of pass-through is directly related to the degree of substitution between the foreign and domestically produced goods.

Another explanation for the incomplete of pass through arises from the factor which distort the flow of trade between nations. Those distortions include tariffs and quantitative restrictions. Import taxes known as tariffs are widely acknowledged as a significant obstacle to free trade. A product's supply price is increased by the tariff amount for every quantity once a tariff is imposed on it. The amount of transmission might not be impacted by this alone. For instance, a tax placed on a product sold would fully be passed through to selling prices in a competitive

market. Tariffs most likely only have an impact on the pass-through relationship in markets with poor competition. In these circumstances, overseas suppliers will probably exploit their market hegemony to convert the rising tariff levels into monopoly profits instead of passing it on to customers' prices.

The World Trade Organization (WTO) has identified a number of non-tariff trade obstacles, such as import licensing, pre-shipment inspections, rules of origin, customs delayers, and other instruments that obstruct or restrict trade. Quantitative constraints, unlike tariffs have no effect on the pass-through linkages regardless of market structure. In a market exhibiting perfect competition the effects of a tariff or quota being placed or removed on output and prices will be equivalent.

Non-tariff trade restrictions and the operations of multinational companies (MNCs) are additional causes for the incomplete pass-through (Bhagwati,1988). MNCs are able to safeguard themselves from fluctuating currency rates in numerous ways. The use of internal or intra-corporate exchange rates is one of the most obvious and typical strategies. Additionally, MNC's decision of the contract's exchange denomination, according to Menon (1995), is another form of protection. By invoicing in the import destination currency and possessing oversight over the date of the payment, MNC make its payment to subsidiary mainly when favorable exchange rate exists.

2.1.2. Transmission Channels

The movement in exchange rate can be transmitted in to prices through two broad channels, immediately (direct channel) and subsequently (indirect channels). According to Hyde and Shah (2004) following a variation in exchange rate, changes in the price of imported intermediate goods and final products can immediately affect local prices. Decreased import expenditure for finished goods and inputs are expected to follow an appreciation of the domestic currency. In the same notion, the price of imports will increase when the value of the home currency declines. This happens to be more likely to be introduced to consumer's price. Currency devaluation/ depreciation also causes an increase in foreign inputs in the production of exportable item which may catalyze the rise of marginal costs which in turn lead to higher prices of exportable commodities.

The indirect channel of ERPT is often referred to as the competitiveness of goods and services in international market. Following exchange rate depreciation in domestic country, the selling price of the exportable item shrinks, subsequently diminishing its relative value to overseas buyers. This in turn leads to an improvement in export performance and over all increment in aggregate demand. The market size for export and the degree of competition in the export market will determine the level of ERPT. For example, exporter prices may become more vulnerable to volatility in exchange rates if the corresponding industry is highly specialized and exporters will have less competition for their goods. Pricing-to-market will be minimal in this situation, and the resulting pass-through could be superior.

Lafleche (1997) used a clear and precise graphic layout to illustrate the transmission channels of exchange rate pass-through. The direct effects of exchange rate depreciation operate in two separate ways. First, variation in exchange rate affected consumer prices through the cost of import in finished goods, and second the deviations in exchange rate has an impact on production costs through input costs that are expressed in foreign currencies. The demand for exports and substitute goods is the indirect ways in which currency depreciation/devaluation works.

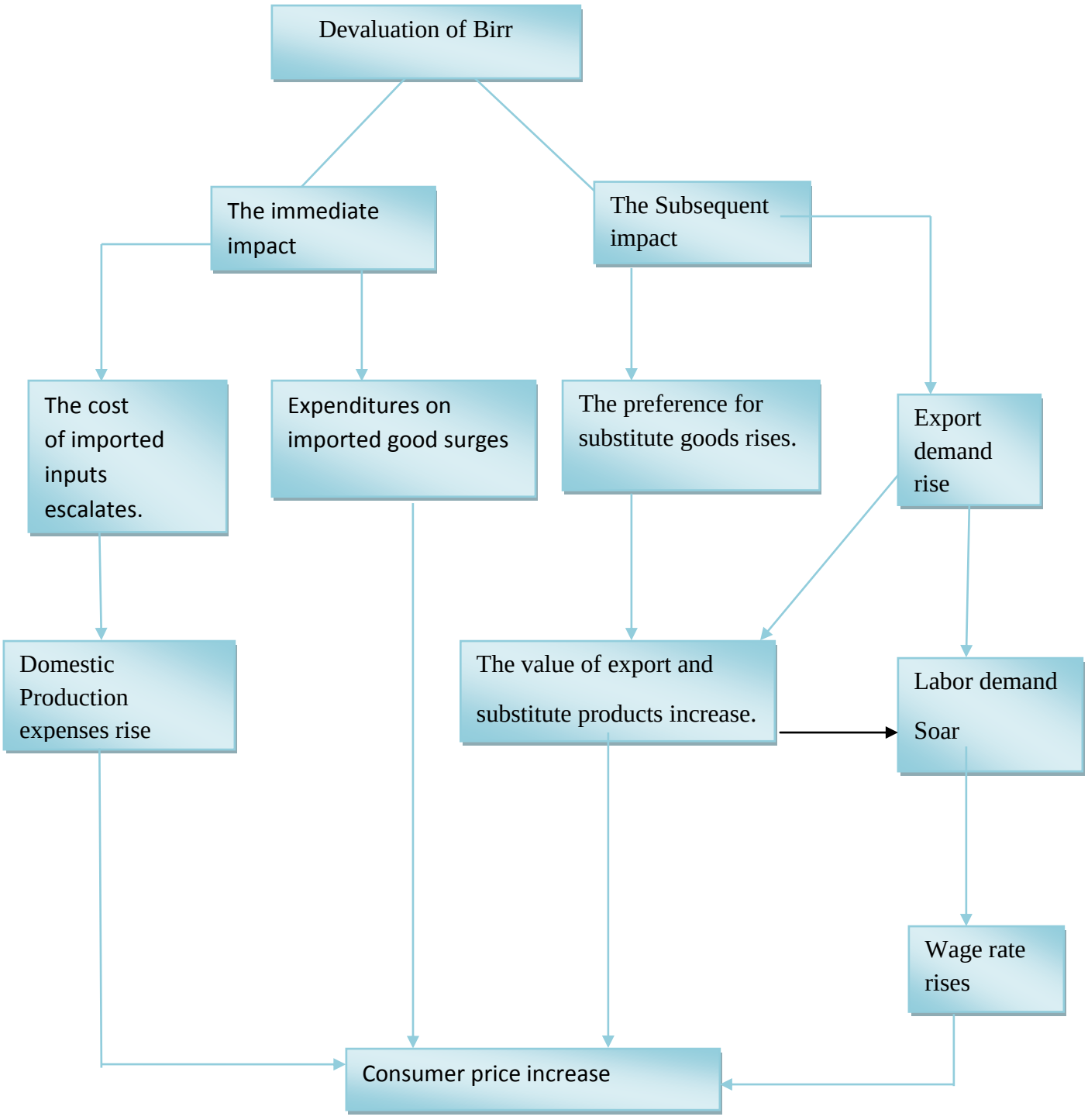


Figure 2.1; Exchange rate Pass Through Channels.

Source; Lafleche (1997) as cited in Aliyu et al. (2008) and Mohammednur (2012)

Although exchange rate transmission into price level could fail to be complete initially, it can be in the long run. Menon (1994) highlighted a range of factors that trigger partial pass-through in the short run, including menu costs, the pattern of demand reaction to price variation, the expenditures on altering supply, future exchange cover, and the currency denomination of trade contracts.

2.2. Empirical Review

Having pieced together the theory underlying exchange rate pass-through, researcher further proceed to examine how numerous writers have empirically demonstrated the postulated ERPT theory. There are multiple empirical investigations on the consequences of exchange rates on domestic prices. However, the majority of those empirical studies concentrated in developed economies such as USA, Japan, Canada, and UK, Germany or the Euro markets as a whole. Numerous empirical studies mainly focused on assessing pass-through rates for a specific nation or set of countries as well as on the industry level. A fundamental question raised concerning those literatures is the extent in which domestic prices respond to the adjustment of exchange rate. In a simple term, is ERPT complete or incomplete? Furthermore, the dilemma of whether price determination depends on local currency pricing or producer currency pricing has drawn a lot of attention in the literature of ERPT. This issue gained a considerable attention due to its profound consequences in choosing the ideal monetary policy, both on short and long run.

The frameworks of LCP and PCP [5] proposed different levels of ERPT to consumer and import prices. The elasticity of import price and consumer price with due to adjustment in the exchange rate is zero in the short-run under LCP and unity under PCP. However, enormous empirical evidences reject both LCP and PCP by suggesting the pass-through estimates of domestic prices fluctuate between zero and one. Moreover, in extended period of time, the pass-through rate estimate significantly endorses the possibility of incomplete pass-through.

[5] Local currency pricing (LCP) refers to the circumstance when exporters set their prices in the destination currency of the importing nation where as producer currency pricing (PCP) describes the case where exporters set their prices in their own currency.

Feenstra and Kendall (1997) established and evaluated two hypotheses concerning purchasing power parity (PPP) on quarterly data for the United States, Canada, Germany, Japan, and the United Kingdom from 1974: Q1 to 1994: Q4. In the course of study, a co-integrated vector auto regression approach was used. The initial prediction is that changes in the price of traded products compared to domestic alternatives will impact the purchasing power parity relationship as a result of partial ERPT. As a result of the firm hedging, another hypothesis suggests that PPP should hold forward rather than spot exchange rates, implying that the variation in interest rates might enter the purchasing power parity association for spot rates. The average weighted price of imports compared to domestic pricing was shown to be highly linked with changes in exchange rates. However, although being a substantial variable, the interest rate distinction did not explain a significant amount of the deviations from PPP.

Khosla and Teranishi (1989) studied exchange rate pass through for aggregate export of twenty-three developed countries through employing a time series data spanning from 1975 Q_1 to 1987 Q_2. The study showed a significant variation in the pass-through across countries is observed. Pass through ranges from a high of 9.6 percent for Sweden to almost zero for Norway. Surprisingly, the larger developed economies such as the US and Japan documented relatively higher pass through (8.7 and 9.2 percent, respectively). Whereas the less developed economies such as the Philippines and Indonesia record relatively lower rates of pass-through (2.7 and 1.7 percent respectively). The writers generally documented incomplete and asymmetric pass through.

Campa with Goldberg (2005) presented cross-country ERPT evidence for twenty-three OECD nations using quarterly data from 1975 to 2003. Findings from this research demonstrate partial exchange rate pass-through for oil exporting countries, notably in the industrial sector. In the short term, prices for imports in the nation's currency reflect 46 percent of the exchange rate movement and around 65 percent in the long run. The authors further found a robust link between the volatility of exchange rates and pass-through. The macroeconomic components studied, such as home country prices for imports, the amount of money in circulation, effective exchange rate, and rates of inflation, have minimal effects on ERPT. In short run, the study findings suggest that OECD nations have incomplete pass-through.

El Bejaoui (2015) used the Generalized Method of Moments to study exchange rate pass-through for most industrialized nations. The research further employed quarterly panel data collected in between 1999 and 2013 to investigate the transmission of exchange rate fluctuations into imported and exported prices at aggregate and disaggregate levels of four advanced nations such as Japan, the United States, France and Germany. The study's findings reveal that exchange rates have a substantial impact on both import and customer spending in both the short and long run for the majority of the industries studied. Furthermore, the findings show that the pass-through is minimal in the short run and unbalanced among industries. The author also argued that the ERPT is larger in the long run than in the short run.

Kreinin (1977) provides additional Multi-country ERPT investigation for developed-country import and export pricing. Information gathered in between 1970 to 1972 was used in the study. The consumer price index (CPI) is used as a proxy for marketed commodity prices in this study, and pass-through is assessed as the gap between the estimated and real price changes following an exchange rate adjustment. According to the study's findings, ERPT is often minimal and varies adversely with nation size. After 10 percent depreciation, specific country estimations for import pass-through are 100 percent for Italy, 90 percent for Canada and Belgium, 80 percent for Japan, 60 percent for Germany and 50 percent for the United States.

Ozyurt (2016) investigated the magnitude and speed of the exchange rate pass through (ERPT) into extra-euro area import prices for the euro area aggregate. Through utilizing quarterly data in the years between 1996 and 2015 for bilateral exchange rate between Euro and USD and nominal effective exchange rate among Euro and 38 trading partners, the result generally indicates incomplete pass through while the highest degree of ERPT is observed in Italy and the lowest is documented in Germany. This indicates the sluggish adjustment in nominal price. The author further revealed an evidence for diminishing trend of ERPT over the period the study covered. The period of higher reduction in ERPT further associated with the growing contribution of emerging economies in global market, particularly China. Moreover, Butkiewicz and Ozdogan (2014) further analyzed the monetary transmission mechanism in Turkey using a VAR model and founds the declining trend in the pass-through rate soon after the floating in exchange rate

AI-Abri and Goodwin (2009) analyzed ERPT on quarterly data between 1975 and 2002 to look at five sectors in sixteen OECD nations. The study applies the threshold-based vector co-integration regression approach for analyzing import prices at both the industry and aggregate levels. The result of the study reveals that, after identified threshold impacts, the degree of pass-through enhances significantly from the 50 percent average described in research. Industries such as manufacturing have the lowest pass-through, while energy, food and raw materials provide the most. Moreover, there was a differential in pass-through where Italy invested the least.

Kenny and McGettigan (1998) used the Johansen approach with aggregate data covering 1963: Q1 to 1995: Q3 to investigate the pass-through relationship between the exchange rate and Irish prices of imports. The estimation approach includes variables such as domestic competitive prices, import unit values, foreign labor cost and a nominal import-weighted currency exchange rate. Two co-integrating connections are investigated in this study: one between import prices and both the exchange rate and foreign costs, and the second between domestic rivalry prices, the exchange rate, and foreign prices. The study discovered that incomplete pass-through occurs in the short run whereas complete pass-through occurs in the long term.

Mumtaz et al. (2005) employed a quarterly data spanning from 1984 to 2004 for estimating the transmission of exchange rates into UK import prices across 57 industries. Their findings indicated the prevalence of imperfect ERPT to varied degrees across most businesses. Aggregating bias owing to product heterogeneity was insignificant in their investigation. They discovered a considerable reduction in ERPT with time, particularly after 1995. The researchers came to the conclusion that it was attributable to the UK's steady macroeconomic climate rather than adjustments to import items.

Empirical suggestion for incomplete pass-through is well established in multiple research projects on most developed economies, the difference observed in those literatures is the limit of the study. Many of them focus only on import prices, while others consider either only consumer price, or both import and consumer prices. The reduction in the pass-through observed through the literatures could be attributed to several of factors. For instance, Krugman and Dornbusch (1987) justify the decline as the result of firm’s operation in an industry with poor competition. Parallel to Krugman and Dornbusch (1987), Campa & Goldberg (2002) hypothesize that the observed drops in the ERPT can be explained by a change in the composition of the typical

import basket toward commodities prices with less responsive to changes in exchange rates. Despite the abundant evidence concerning the presence of incomplete pass through in the literatures, there are some studies that show the proportional change of traded price to change in exchange rate can prevail, but only in the long run. For instances, look at Tange (1997) and Faruqee (2004).

The overwhelming majority in empirical literature concentrates on more developed economies. However, recently there are growing ERPT literatures on developing country based either on cross-country comparisons or on individual country bases. Comparatively speaking to other developing nations, there are fewer studies that exclusively focus on African nations. However, in recent years, there has been a growing interest in studying ERPT in African nations. An important finding in the recent literatures is that, exchange rate pass-through is higher in many developing countries. This in turn shows that ERPT can also be complete in small open economies.

Frankel, et al (2005) analyzed ERPT into import price for narrowly defined eight brand products in 76 developing countries using annually collected Panel data ranging from 1990-2001. Traditionally, emerging economies had a greater and quicker rate of exchange rate pass through than high-income nations, but in recent years, both the degree of short-run pass through and the rate of adjustment have undergone a sharp decline. The author aimed to investigate the reported diminishes in pass through and to give a possible explanation. The founding of the study shows that per capita income, tariffs, distance between trading nations, wages, country size, extended inflation and long-term exchange rate variability are significant contributors of pass-through. Transportation expenses, distribution cost and tariffs are presented as additional important barrier to plays a significant role in diminishing the degree of ERPT

For numerous emerging market nations such as India, Korea, Malaysia, the Philippines, and Thailand from Asia; Brazil, Chile, Mexico, and Peru from Latin America; the Czech Republic, Hungary, Poland, and Turkey from central and eastern Europe (Mihaljek and Klau, 2008) examine exchange rate pass through and the reasons behind for the variability in the scale of ERPT using data ranges from the first quarter of 1994 to the second quarter of 2006. The result of their study suggested that, except for the Czech Republic, ERPT have declined in all since 2001. For instance, in Brazil and Mexico, ERPT was nearly complete in the period between

late1980's to 2000. Nevertheless, in the period between 1994 and mid-2006, the pass-through coefficient declined to 10 percent in Brazil and 30 percent in Mexico along with Hungary, Philippines, Poland and Turkey appear to have further witnessed a significant reduction in the ERPT. Moreover, the exchange rate pass-through was already relatively low in countries like Chile, Korea, Malaysia, Peru and South Africa before 2001 but it was later shown to have dropped highly afterwards.

Razafimahefa (2012) investigated the effect of exchange rate into domestic price and its determinant for all sub-Sahara African countries by employing both panel vector auto regression and panel vector error-correction for individual countries. He founds that the pass through is incomplete and asymmetric (large in case of depreciations than appreciation), with the average elasticity is estimated is about 40 percent. The size of pass through is estimated to have diminished by 50 percent since the mid-1990s. According to the author this reduction corresponded with improved macroeconomic performance and a stable political climate, which boosted confidence for business environment and intensified competitiveness.

Using sample data covering the period from 1980 Q1 to 2005 Q4, Kararo et al. (2008) investigated the size and speed of ERPT to import prices of South Africa and whether ERPT is symmetric or asymmetric. The Vector Error Correction Model (VEC) was used in the investigation. The variables utilized for the estimation are the import price index, nominal effective exchange rate, and exporters production cost. The results presented in the paper demonstrate that South Africa's ERPT is both comparatively high and partial. The authors additionally claimed that ERPT is greater during the era of exchange depreciation.

Sule et al (2021) also examined the direction and significance of imported intermediate inputs on manufactured export in Nigeria using a quarterly data from 2000 Q_1 to 2018 Q_4. Vector error correction model was employed in the study to ascertain the relationship among the variables. Imported intermediate inputs, trade openness, exchange rate spread (Naira/USD), total factor productivity (TFP), consumer price index and Africa infrastructure development index for Nigeria are variables included in the study. The result of the study discussed that, exchange rate spread has a significant and positive impact on export performance, in which 12 percent of variation in manufacturing export are due to variability in exchange rate spread. Furthermore, the

authors claimed that 5 percent change in manufacturing export is due to shock on imported intermediate inputs.

Ragoobur and Chicooree (2013) conducted a study on ERPT in Mauritius by examining the effects of exchange rate on domestic price, production price and import price using structural vector auto regressive models (SVAR). They used quarterly data spanning from Q1 of 1999 to Q4 of 2010. The finding of the study reveals that exchange rate pass-through to consumer price is higher but not complete, followed by producer prices and ERPT to import prices is the lower but plays a key role in the determination of pass-through. The shock in exchange rate will lead to fall in import prices. For instance, initially the effect of exchange rate volatility on import price is 64 and 19 percent in the period of three quarter and 29 percent at the end of 12 quarters. Furthermore, the authors suggested that external shocks are a key factor in affecting Mauritian economy and prices are also further exposed to external shocks.

To discuss ERPT in Tanzania, Mwase (2006) used a quarterly data in the period 1990 Q1 and 2005 Q1. The author used a structural vector autoregressive (SVAR) technique in the estimation and reveals that ERPT has declined despite the depreciation of the currency (Tanzanian shilling). After dividing the sample into a period prior to 1995 and after 1995, He founds that in the first sample period (before 1995) pass-through elasticity was 8.7 percent and it has declined in the second sample period by 2.3 percent. In the overall sample period pass-through elasticity was found to be 2.8 percent.

In order to identify exchange rate pass through in Nigeria, Aliyu *et al*. (2009) utilized Vector Error Correction approach (VEC) to a quarterly data ranging from the first quarter of 1986 to the last quarter of 2007. They found 10.5 and 14.7 percent passthrough elasticity for consumer and import price respectively. The result further suggested that ERPT in Nigeria was decreasing throughout the pricing chains, which partially falsify the orthodox perception in the economic literature that ERPT is significantly higher in less developed economies than otherwise. This study is further validated by the work of Frimpong and Adam (2010), the article employed vector auto regression for the data series covering from Q1 of 1990 to Q_4 of 2009 in Ghana. The study indicates that, pass through elasticity in the first quarter was 0.025 percent, which is increased to 0.09 after the 8^{th} quarter and then decreased to 0.07 percent after one year. Frimpong and Adam

(2010) further shows ERPT to domestic price level is incomplete and declining overtime in Ghana.

In Ghana, Maka (2013) investigated the nature of ERPT to inflation by employing structural vector auto regression model on monthly data from the first month of 1990 to November 2011. The study found that the pass through is complete for non-food prices and partial in otherwise. Furthermore, the transmission rate is significant and positive with currency depreciation than otherwise. Similar study has been also studied in South Africa by Jooste and Jhaveri (2014) Malawi by Jombo et.al (2014) and Nigeria by Bada et. Al (2016)[6]

Fanduma et al. (2023) examined the asymmetric exchange rate pass through (ERPT) to consumer price for kwacha[7] fluctuation by adapting quarterly data from years 1985 to 2017 in Zambia. To this end the researcher used structural vector autoregressive model (SVAR). The finding of their thesis revealed that consumer prices proved to be more responsive during a period of currency depreciation than appreciation, while partial and asymmetric pass-through to domestic inflation were documented. In a similar manner the impulse response function displays more persistence in domestic prices with kwacha depreciation than otherwise. The empirical pass-through effect of changes in exchange rate on consumer prices in Nigeria further investigated by (Adyemi and Samuel, 2013). In order to meet the objective of the thesis, the researchers employed variance decomposition and structural vector autoregressive analysis. The study's findings demonstrate that shift in exchange rate, as opposed to actual money supply is more crucial in understanding Nigeria's increasing price level. The author additionally identified a long-term positive link between inflation, money supply and exchange rate.

Observing the investigations carried out in Ethiopia, relatively few articles have focused on the exchange rates pass-through yet. Helen (2012) used the Structural Vector Autoregressive (SVAR) model to estimate ERPT in import and consumer prices. She examined time series data collected on a quarterly basis in the fiscal years between 1991/92 and 2010/11. The variables

[6]Jooste & Jhaveri (2014) investigated a time varying ERPT and they discovered that the extent of pass through is high in the period of exchange rate volatility and declining pass through under moderately low inflationary pressure. Jombo et.al (2014) by employing augmented Philips curve and vector auto regression approaches they found 0.2 pass through elasticity, which puts exchange rate as a potential source of inflation.
Bada et. al (2016) utilized Johnson approach for cointegration and VECM to 1995Q1- 2015Q1 and they found 0.24 and 0.30 pass through elasticity for baseline and alternative models, which is greater for import price compared to CPI.

[7]The currency of Zambia.

employed in the estimate approach include nominal currency exchange rate, liquidity, indices of consumer prices, World commodity price index, import price and output gap (difference between actual and expected GDP). The results indicate that the currency exchange rate pass-through in import prices is moderate and persistent. In particular, birr appreciation is passed into the import price by 0.49 percent after a quarter's time, 0.18 percent after two quarters, 0.29 percent after two years, and around 0.26 percent of the exchange rate fluctuation is carried through import prices after 12 quarters. Helen (2012), typically demonstrates an incomplete and gradually falling exchange rate pass-through as the estimation horizon increases.

Mohammednur (2012) adapted impulse response function and variance decomposition within the framework of a Vector auto regression model to estimate ERPT on the domestic price level along other macroeconomic variables on the data spanning from July 2002 to June 2011. The researcher also incorporates consumer price, nominal effective exchange rate, import price, producer price index, money supply and oil price index. The findings of his research demonstrates that, after the first month, percentage shock in nominal effective exchange rate leads to 47 percent increase in import price and reaches 70 percent after 11 months and start to decline after wards. The response of CPI on the other hand is 66 percent in the initial month and substantially increased to reach 100 percent after two quarters. The author further shows that money supply and the oil price index are important in understanding the fluctuation in both consumer and import prices. More than 43 percent and 53 percent and of variation in consumer price and import price comes from their own innovations respectively, the researcher highlights oligopoly nature with low competition in the import sector as a main factor.

National Bank of Ethiopia depreciated Birr by 15 percent in nominal values against the US Dollar in 2017 and by 7.5 percent in 2018/19 and the overall balance of payments shows a higher deficit of 941.6 million USD in the 2018/19 fiscal year. Even though it is inconclusive weather those changes in exchange rate is reflected in to the export prices, change in international values for the major export items are documented. For instance, decline in coffee price by 3.2 percent, live animals by 1.7 percent, meat & meat products by 1.8 percent, 4.3 percent for pulses, gold by 3.9 percent and 2.8 percent in flower (NBE, 2018/19). In contrast to underlying theories that postulates devaluation leads to decline in export prices, rise in international prices in chat, fruits and vegetables and electricity exports are documented.

Despite recent policy measures taken in the Ethiopian economy to keep inflation rate a single digit, inflation rate stays double digit and high. For instance, according to CSA, in 2021 consumer price index (CPI) was 492.4 which increased by 26.84 percent from the previous year. Similarly, inflation rate increased by 3.015 percent in 2018 and reached 13.8 percent in 2018 and further increased 6.48 percent in 2021 and reached 26.8 percent from the base year inflation rate of 20.4 percent. Even though a slight decline of 0.9 percent is observed, this galloping inflation rate reached 33.6 percent in February of 2022 where food inflation contributed more than 54 percent of it. Devaluation have considered as one potential factor for high domestic price and low export performance through rising the price of imports and indirectly by raising import bill of the public sector, which is a big spender in Ethiopian economy.

2.3. Summary of Theoretical and Empirical Framework

The above theoretical literature suggests the difficulty to conclude the determinant of ERPT. For instance, some scholar identifies market structure with the nature of competition and pricing strategies in it as a basic factor in determining the extent of ERPT while other highlights inflation environment, trade restriction, transportation expenses and distribution cost as a basic cause for the variation in the degree of ERPT. The empirical literatures on the other hand show incomplete and diminishing ERPT over time both for developed and developing economies. Furthermore, the studies conducted in the area shows monetary policy have significant impact on domestic prices but not on the degree of ERPT, highlighting the ambiguous significance of devaluation especially for a developing country. More specifically, most of the studies conducted in Ethiopia exhibited partial and very low ERPT in consumer price compared to import price which further indicate the insignificance of monetary policy transmissions mechanism in affecting inflation environment. Studies conducted on ERPT in Africa are generally very small and even scarcer than other developing countries, but more or less informative, even though many of those studies provide conflicting results. Hence, this study tries to identify the impact of exchange rate on domestic prices along other macro-economic variables. In doing so, the paper is expected to add to the existing literatures of Ethiopia and developing country's as whole.

CHAPTER THREE

3.1. Theoretical and Methodological Frameworks

3.2. Theoretical Framework

The conceptual framework of ERPT rests primarily on the notion of Purchasing Power Parity (PPP) which states that, exchange rate among two trading nations should be equivalent to the price level of the two nations for a fixed basket of goods and services. Akofio-Sowah (2009) illustrated it mathematically as follows;

$$\mathrm{P} = ep* \qquad \ldots 1$$

Where p and $p*$ stands for domestic and foreign currency price level respectively and $e$represents exchange rate defined as the ratio of domestic currency to foreign currency. By taking the natural log of equation 1

$$\ln\mathrm{P} = \partial + \beta \ln p* + \gamma \ln e + \varepsilon \qquad \ldots 2$$

In the above equation assume PPP holds, ∂=0, β=1 and γ=1. Then there will be a complete response of destination currency of prices of traded goods to the fluctuation in exchange rate. However, in the overwhelming majority of circumstances, one to one response does not hold.

ERPT tends to be hypothesized as the proportional change in import prices arises from a one percent movement in the exchange rate among trading nations. Aggregate price indices are often used to measure ERPT (Goldberg and Knetter 1997).

Simply ERPT is given by:

$$\alpha_t = \frac{\Delta \mathrm{p_t} / \mathrm{p_t}}{\Delta(ep*) / ep} \qquad \ldots 3$$

Equation 3 is interpreted as the degree of change in nominal exchange rate reflected to domestic prices; Where α_t represent estimated exchange rate pass through coefficient for country i, $\mathrm{p_t}$ is

domestic price level of country i at a given time of t and it can be export price, import price or consumer price, e represents nominal exchange rate of country i with respect to US dollar while $p*$ denotes foreign price level.

3.2.1. Types of data and sources

The researcher merely utilized secondary data for this investigation. These data are time series covering a sample of 69 observations in between 2005Q1 and 2022Q1. In addition to availability and consistency of data, the unusual economic reality[8] reported by NBE (2005/06) is the main reason for this thesis to start the proceeding estimation process from 2005/06 fiscal period.

3.3. Methodological Framework

In general, two kinds of analytical instruments will be used in this study to analyze data acquired from various sources. Descriptive data analysis tools like charts, graphs and tables and are going to be utilized to explain the link among variables. Furthermore, the dynamic nature of domestic prices which is resulted from its different own determinants and feedback effect of exchange rate are key reasons for choosing a vector error correction model (VECM) in vector auto regressive (VAR) framework for empirical analysis. Granger causality, variance decomposition and impulse response function is further utilized to capture both the short run and long run dynamic impact of exchange rate movement in to domestic price of Ethiopia.

[8] The narrowing deficit in the overall balance of payments in the subsequent periods suddenly reached 326 million USD in 2005/06 compared to 101.4 million USD in the preceding year, which clearly attributed to the highly hiked import bill. In the other hand the overall price deflation has observed in the period prior to 2005/06 owning to implementation of economic reform and stabilization programs (1992-2005). However, despite the relatively good weather conditions and better harvest in 2005/06, sudden surge in the overall price level in particular, 40 percent rise in non-food CPI is documented. Accordingly, inflation rate reached 12.3 percent at the end of the fiscal year. This can be attributed to the absence of peace in the country aftermath of post 2005 election consequences.

3.3.1. Model Specification

The vector autoregressive model with a set of k=5 endogenous variables is used to illustrate the underlying objective of the thesis. This is:

$y = [\text{Ln}\, NEER, \text{Ln}\, Ms, \text{Ln}\, Cpi, \text{Ln}\, Imp, LnWcpi]$. ……..4

Where;

$LnNEER$: Stands for log nominal effective exchange rate

Ln Ms : Stands for log money supply

$LnCpi$: Stands for log consumer price

$LnImp$: Stands for log import price

LnWcpi: stands for world commodity price index

Definition and measurement of variables

Quarterly data on Nominal effective exchange rate, import price index, Money supply; Consumer price index and World commodity price index have been collected from National bank of Ethiopia (NBE), Central Statistical Agency (CSA) and World Bank (WB) respectively in which variables explanations presented as follows:

Nominal effective exchange rate (*NEER*) : The nominal effective exchange rate is the average weighted rate that has been adjusted because one country's currency is exchanged for a basket of several foreign currencies. It is the quantity of local money required to buy foreign currencies. Nominal effective exchange rate Index (NEER) is utilized instead of bilateral exchange rate against the USD for numerous motives: first, bilateral exchange rate in Ethiopia is fixed which fails to account for enough fluctuation to determine the impact on key variables. Another justification for employing NEER is that almost every nation in the world engages in multilateral transactions rather than bilateral ones, therefore it is critical to investigate how changes in the country's currency motivate the exchange rates and price levels of trading partners. The final rationale for using NEER is that it can better represent variations in the costs of trade. Nominal effective exchange rate is directly related to domestic prices than real effective exchange rate. This is because REER is nominal effective exchange rate after adjustment in inflation rate of

home and trading country's economy. However, inflation rate among trading nation plays a key role in the pricing strategies and on degree of ERPT (prevailing domestic inflation is a key reason for the failure of law of one price and for existence of partial pass through). Therefore, the study employed nominal effective exchange rate than REER

Consumer price index (CPI): The consumer price index (CPI) is a calculated average of the prices of a basket of goods and services. It's often measured by taking price revisions for each separate item and averaging them based on their relative weight on the consumer basket. The quarterly data collected from central statistical agency (CSA)

Money supply (*Ms*) :The model incorporates broad money supply to portray the reaction of monetary policy to a shock in exchange rate along with other variables. The data collected from National Bank of Ethiopia (NBE).

World commodity price index (Wcpi): In this study, world commodity price index employed as a proxy for international supply shock rather than oil price index. Even though in small economy like Ethiopia oil import contributes the highest share on the basket of import, the price of oil is highly supervised and subsidized by government for its consumption which further complicate to know the pure effect of oil price alone. Therefore, since the recent global economic activities that shows moderate growth with hyperinflation assumed to have a significant supply shock effect in Ethiopian economy it is logical to capture the impact through world commodity price index, which is collected from the World Bank (WB).

Numerous research projects have demonstrated that real transaction price series should be used to measure ERPT into import. This price series however, is unavailable in Ethiopia. For this reason, the study adopted unit value indices of import price ***(Imp)***, as is conventional in the literatures. That's the import value to volume ratio. The data collected from National bank of Ethiopia (NBE).

3.4. Vector Autoregressive Model

The vector auto regression (VAR) model is effective, adaptable and simple multivariate time series investigation tools. This dynamic multivariate autoregressive model is an extension of the univariate model. The VAR model has proven particularly efficient in understanding the dynamic nature of financial and economic time series. Forecasting from VAR models is

further versatile given that it could possibly be conditional on the anticipated future courses of specified variables in the model.

Furthermore, the vector auto regression model is a useful tool for structural inference and policy assessment. A few presumptions with respect to the causal structure of the data are imposed in structural analysis and the causal implications of unanticipated innovations to defined factors on the variables in the model are given. Typically, impulse response functions (Irf) and variance decompositions analysis (VD) are utilized to summarize these causal effects. In fact, the dynamic nature of domestic prices, which is resulted from its different determinants and feedback effect of domestic prices and exchange rate are significant motives to use a VAR model to conduct empirical analysis. The VAR approach is also useful for this study to analyze the parameter stability in the time serious analysis and employing co-integrated modeling fosters the avoidance of erroneous regression problems.

Furthermore, vector error correction models (VECM) effectively discriminate between long and short-term effects, thus serving as an appropriate tool for policy analysis. In other words, VAR provides a significant framework for examining both short and long-term relationships by utilizing an equilibrium error correction approach and dynamic variable simulation using Impulse response analysis (Badawi, 2005).

Based on Johansen (1988, 1991) this study considers a k-dimensional vector time series y_t involving up to k lags and model is an unrestricted VAR model.

$y_t = \beta_1 y_{t-1} + \ldots\ldots + \beta_k y_{t-k} + \mu t$ ……5

μt represent a stochastic white noise error term.

Equation 5 can be rewritten as follows

$$lnCpi_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i}\, lnCpi_{t-1} + \sum_{i=1}^{k} \beta_{2i} \ln NEER_{t-1} + \sum_{i=1}^{k} \beta_{3i}\, lnImp_{t-1} + \sum_{i=1}^{k} \beta_{4i}\, lnMs_{t-1} + \sum_{i=1}^{k} \beta_{5i}\, lnWcpi_{t-1} + \mu_t \ldots\ldots\ldots 6$$

$$lnImp_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} lnCpi_{t-1} + \sum_{i=1}^{k} \alpha_{2i} \ln NEER_{t-1} + \sum_{i=1}^{k} \alpha_{3i}\, lnImp_{t-1} + \sum_{i=1}^{k} \alpha_{4i}\, lnMs_{t-1} + \sum_{i=1}^{k} \alpha_{5i}\, lnWcpi_{t-1} + \varepsilon_t \ldots\ldots 7$$

$$lnNEER_t = \theta_0 + \sum_{i=1}^{k} \theta_{1i}\, lnCpi_{t-1} + \sum_{i=1}^{k} \theta_{2i} \ln NEER_{t-1} + \sum_{i=1}^{k} \theta_{3i}\, lnImp_{t-1} + \sum_{i=1}^{k} \theta_{4i}\, lnMs_{t-1} + \sum_{i=1}^{k} \theta_{5i}\, lnWcpi_{t-1} + \tau_t \ldots\ldots 8$$

$$lnMs_t = \varphi_0 + \sum_{i=1}^{k} \varphi_{1i}\, lnCpi_{t-1} + \sum_{i=1}^{k} \varphi_{2i} \ln NEER_{t-1} + \sum_{i=1}^{k} \varphi_{3i}\, lnImp_{t-1} + \sum_{i=1}^{k} \varphi_{4i}\, lnMs_{t-1} + \sum_{i=1}^{k} \varphi_{5i}\, lnWcpi_{t-1} + \text{ב}_t \ldots\ldots 9$$

$$lnWcpi_t = \gamma_0 + \sum_{i=1}^{k} \gamma_{1i} lnCpi_{t-1} + \sum_{i=1}^{k} \gamma_{2i} \ln NEER_{t-1} + \sum_{i=1}^{k} \gamma_{3i} lnImp_{t-1} + \sum_{i=1}^{k} \gamma_{4i} lnMs_{t-1} + \sum_{i=1}^{k} \gamma_{5i} lnWcpi_{t-1} + \text{א}_t \ldots\ldots\ldots 10$$

Where $\beta_0\ \alpha_0$, φ_0 andγ_0 are the parameters to be estimated and k stands for individual lag length which is to be selected based on information criteria. While $\mu_t,\ \varepsilon_t, ב_t, \tau_t and\ א_t$ are a white noise residual term.

Unit Root Test

The conventional classical estimating methods used in practical econometric work are built upon the assumption of the stationarity of the variables. According to Gujarati (2004) if a stochastic series' mean and variance are constant across time and each period's covariance value is solely dependent on the lag between the two separate periods, it is said to be stationary rather than the actual time at which the covariance is calculated. The inverse holds if a time series refers to those that are not stationary in the manner stated above. By simpler terminology a non-stationary time series possess a fluctuating mean, variance or both over time.

Therefore, it's critical to conduct the unit root test in econometric research. For at least two key reasons as stated by Gujarati (2008), it is necessary to do the unit root test for a particular data set in econometric research. This is because, if we have two or more non-stationary time series, regression analysis with such time series may result in inaccurate or nonsense regression. In econometric analysis, a stationary time series is desirable than otherwise because it enables the investigation of a variable's behavior across time.

Thus, researcher applied a test based on a Dickey and Fuller (1979, 1981) to figure out whether the series under consideration has the suspected problem of non-stationarity. The ADF test is merely a modified Dickey-Fuller test that is employed when the error term is not white noise. Gujarati (2004), demonstrates that the test may be calculated in at least three distinct ways, as illustrated by Dickey and Fuller

ModeI : $y_t = \beta_1 y_{t-1} + \ldots + \beta_k y_{t-k} + \mu t$ …… (11) Random walk without drift.

Model II : $y_t = \varphi_0 + \beta_1 y_{t-1} + \ldots + \beta_k y_{t-k} + \mu t$ …… (12) Random walk with drift

Model III : $\varphi_0 + \theta t + \beta_1 y_{t-1} + \ldots + \beta_k y_{t-k} + \mu t$ …… (13) Random walk with drift and trend.

Thus, the following hypothesis shall be tested:

Ho: The variables possess with a unit root problem; therefore, the time series is non-stationary.

H1: The variables don't possess a unit root; therefore, the time series is stationary.

Decision rule: If the t statistics value is more than ADF critical value, we reject the null hypothesis and accept H1; otherwise, we reject Ho and accept H1.

Lag Length Selection Criteria

According to Lütkepohl (1991) choosing the ideal lag length is important due to; a too few lags will lead to model misspecification and it will result in loss of power if it is too large. In order to choose the appropriate lag length, it is important to check the residuals of vector auto regression model and suitable lag selection after conducting one lag after other and the best is based on the one that lacks model specification problems in the residuals. The Akaike Information Criterion (AIC), Hannan-Quinn (HQ), LR test statistic, Final prediction error (FPE) and Schwarz Information Criterion (SIC) were all employed to establish the optimum lag length in the model.

Test for co-integration.

After selecting appropriate lag length, we proceed into constructing the unrestricted cointegration test which is a long run equation of the series. The analysis put through by doing Johansen cointegration test with k-1 lag and the numbers of co-integrating vectors depends on the maximal Eigenvalue and the trace test. This enables one to create an extended links between dependent and independent variables (Alemayehu et al. 2009). In reality, many non-stationary economic series move together over time. Implying that, variables under discussion may deviate from long run equilibrium, with a force operating on the series that lead them to converge on long-run value.

Granger Causality Test

Granger causality is a statistical hypothesis test adapted to check the direction of causation between endogenous variables in the model. In other words, the objective of the Granger causality test is to examine if one time series could potentially be used to forecast another in the model. Vector error correction approach (VEC) will be applied if endogenous variables included in the model are co-integrated to identify the extended relationship between the variables. However, according to Dorsman et al. (2012) analyzing causation is also essential.

3.5. Vector error correction model (VECM)

The vector error correction (VEC) approach is just a particular category of the VAR for variables that is stationary and co-integrated after the first differences. It constrains the long-run endogenous variable's behavior that converges to co-integrating relationships while offering short-run adjustment mechanisms. Since a series of short-run adjustments correct itself gradually from the deviation from long-term equilibrium. In other simpler words as stated by (Verbeek, 2008) if variables possess an extended interaction, error correction terms can be designed to demonstrate a long-term connection among them. The VECM model further proves to be effective in finding short-term dynamics throughout the variables by constraining the nature of variables overtime. To this end, the VECM model is optimal to undertake the investigation in this research work. We can write vector autoregression in equation 5 above can be rewritten with their corresponding first difference and lags in error correction terms. Thus, a k-1dimensional vector error correction (VEC) model is given as follows:

$$\Delta yt = \sum_{i}^{k-1} \theta \Delta yt - 1 + \pi Etc_{t-k} + vt \quad \text{.....14}$$

Equation 14 further elaborated as follows

$$\Delta lnCpi_t = \beta_0 + \sum_{i=1}^{k-1} \beta_{1i} \Delta lnCpi_{t-1} \sum_{i=1}^{k-1} \beta_{2i} \Delta \ln NEER_{t-1} + \sum_{i=1}^{k-1} \beta_{3i} \Delta lnImp_{t-1} + \sum_{i=1}^{k-1} \beta_{4i} \Delta lnMs_{t-1} + \sum_{i=1}^{k-1} \beta_{5i} \Delta lnWcpi_{t-1} + \pi Etc_{t-1} + vt \quad \text{...15}$$

$$\Delta lnImp_t = \alpha_0 + \sum_{i=1}^{k-1} \alpha_{1i} \Delta lnCpi_{t-1} + \sum_{i=1}^{k-1} \alpha_{2i} \Delta \ln NEER_{t-1} + \sum_{i=1}^{k-1} \alpha_{3i} \Delta lnImp_{t-1} + \sum_{i=1}^{k-1} \alpha_{4i} \Delta lnMs_{t-1} + \sum_{i=1}^{k-1} \alpha_{5i} \Delta lnWcpi_{t-1} + \pi Etc_{t-1} + vt \quad \text{.....16}$$

$$\Delta lnNEER_t = +\theta_0 \sum_{i=1}^{k-1} \theta_{1i} \Delta lnCpi_{t-1} + \sum_{i=1}^{k-1} \theta_{2i} \Delta \ln NEER_{t-1} + \sum_{i=1}^{k-1} \theta_{3i} \Delta lnImp_{t-1} + \sum_{i=1}^{k-1} \theta_{4i} \Delta lnMs_{t-1} + \sum_{i=1}^{k-1} \theta_{5i} \Delta lnWcpi_{t-1} + \pi Etc_{t-1} + vt \quad \text{.....17}$$

$$\Delta lnMs_t = \varphi_0 + \sum_{i=1}^{k-1} \varphi_{1i} \Delta lnCpi_{t-1} + \sum_{i=1}^{k-1} \varphi_{2i} \Delta \ln NEER_{t-1} + \sum_{i=1}^{k-1} \varphi_{3i} \Delta lnImp_{t-1} + \sum_{i=1}^{k-1} \varphi_{4i} \Delta lnMs_{t-1} + \sum_{i=1}^{k-1} \varphi_{5i} \Delta lnWcpi_{t-1} + \pi Etc_{t-1} + vt \quad \text{.....18}$$

$$\Delta lnWcpi_t = \gamma_0 + \sum_{i=1}^{k-1} \gamma_{1i} \Delta lnCpi_{t-1} + \sum_{i=1}^{k-1} \gamma_{2i} \Delta \ln NEER_{t-1} + \sum_{i=1}^{k-1} \gamma_{3i} \Delta lnImp_{t-1} + \sum_{i=1}^{k-1} \gamma_{4i} \Delta lnMs_{t-1} + \sum_{i=1}^{k-1} \gamma_{5i} \Delta lnWcpi_{t-1} + \pi Etc_{t-1} + vt \quad \text{.....19}$$

Where yt is the set of I (1) variables and θ stands for a parameter to be estimated. If the variability in exchange rate possess ∑ θ<1, incomplete ERPT exist. Whereas Δ represent change syntax and π is a speed of adjustment, which illustrates the prior period's deviation adjusted in the current period (Brooks. 2014). vt niid (0, σ^2); residual which is white noise and stochastic error term. Finally, Etc_{t-1} indicates the lagged error correction element which represents a divergence from the future co-integrating interactions among the variables included in the estimation process.

The F-test in the VAR framework fails to indicate whether changes in the actual value of a specific variable have any consequences in other variables or how much time it would take for

the variable's effect to eventually work through the system. This information will be acquired by investigation of impulse responses (IRF) and variance decompositions (VDC). Impulse response traces the responding ability of the dependent variables in the VAR shocks to each variable from each equation independently; a unit shock is applied to error. Furthermore, the impulse response function (IRF) records a variable's directional reactions to one standard deviation shock of another variable. This enables the researcher to monitor the extent, direction, and persistence of import and consumer price variations in response to shifts in nominal exchange rates.

Variance decomposition, on the other hand provides a percentage of movements in explanatory variables caused by their own shocks as well as disturbances to the remaining variables in the model. It evaluates the extent to which a given variable's step forward forecast error variation is explained by adjustments to each independent variable. Hence, we can assess the relative impact of change in domestic prices due to any shifts in nominal exchange rates using the variance decomposition.

Generally, the VAR methodology has been widely used to examine the ERPT since it allows to measure simultaneous relationships between variables. Within the frame of VAR model, VECM expresses ERPT as the reaction of domestic price (consumer and import prices) to the movement in nominal exchange rate. The scale of the responsiveness in domestic prices to exchange rate shifts can be measured either by immediate consequences of exchange rate behaviors on import/consumer prices (short-term pass-through) or by the combined impact of such changes (long-term pass-through).

Post Estimation Test

Prior to the analysis and interpretation section, a critical post-estimation test presented below, would be performed to ensure the authenticity of the data utilized.

Normality Test

In order to ascertain whether the sample data has been selected from a normally distributed population a normality test utilized. Which means it’s a test designed to assess the normality of the residuals in the model. In the process of testing for the normality, the study used the Jarque-Bera (JB) test. Decision rule: The residuals are not normally distributed if the probability values of Jarque-Bera statistics are less than 5% of the critical values, and vice versa.

Auto Correlation Test

Auto correlation is statistical representation which shows the extent of resemblance among a given time series variables and a lagged copy of itself in a given period. To test for the presence of such correlation the study utilized Breusch-Godfrey serial correlation LM test.

Ho, indicates that the residuals exhibit no serial correlation.

H1: The residuals show a serial association. If the measured probability result of the Breusch-Godfrey serial correlation LM test are less than 5% critical values, we accept the alternative hypothesis, indicating that serial correlation exists, and vice versa.

Heteroscedasticity Test

One of the assumptions made regarding residuals in the ordinary least regression is that the error terms don't possess a homogenous variance; if not the problem known as, heteroscedasticity arises. Therefore, the study applied Breusch-pagan Godfrey test to examine whether the error term in the model is homoscedastic or not. Ho: constant variance. H1: the residual is not homoscedastic. Accordingly, if the likelihood value is less than 5% critical values, then we accept the H1, meaning that the residuals have a heteroscedastic variance and vice versa.

Stability Test

A stability test is conducted to know how well the model accurately reflects the way the time series transformed throughout the entire sample in study periods. Accordingly, if all roots have a modulus lower than unity or reside within the unit circle, the vector autoregressive is said to be stable.

CHAPTER FOUR

4. EMPIRICAL RESULTS AND DISCUSSION

INTRODUCTION

The previously reviewed sections evaluated literature that offers an understanding of the topic while assisting in identifying discrepancies in knowledge in the research area. In in line with the examined literature, the research problem, goals, hypotheses, and research methodology utilized in this study were also addressed. This section put forward the result of trends and the link between variations in exchange rate and domestic price in Ethiopia from the period 2005 to 2022. It is organized into the following sequences; the first section discusses the behaviors (trends) of the variables over time. Section 2 offers the findings of econometric analysis such as Error correction method, impulse response function and variance decomposition analysis.

4.1. Trend analysis of variables

4.1.1. Trend of Export Value in Ethiopia

Despite significant substantial incentives in export sectors, Ethiopian export performance remains more fragile (World Bank, 2017). The entire amount of export merchandise is less than four billion dollars, which can only cover 20 percent of the overall import expenses (NBE, 2021). In comparison to other Sub-Saharan African nations including neighboring nations, the percentage contribution of the total export of goods and services to GDP is remarkably poor this further shows the diminishing pattern of the proportion of exports to GDP. World Bank (2019) suggests 7.3 percent of GDP in 2017 and 7.9 percent in 2019.

According to NBE (2018/19) total export value declined by 6 percent compared to previous period due to decline in value of export in almost every sector of export mainly, coffee price declined by 3.2 percent, live animals by 1.7 percent, meat & meat products by 1.8 percent, 4.3 percent for pulses, gold by 3.9 percent and 2.8 percent in flower. The price of export marginally increased in 2019 than previous year by 2.10%. Total export earnings in 2021 further increased slightly by 0.4 percent over the last year owning to increase of coffee, flower, meat and meat products and textile and textile products export by 34.4 percent,35.2 percent,8.9 percent and 7.2 percent respectively. The major destinations for Ethiopian export are Europe, Asia and Africa,

which contributes 38.1 percent, 37.6 percent and 12 percent of Ethiopian export earning respectively.

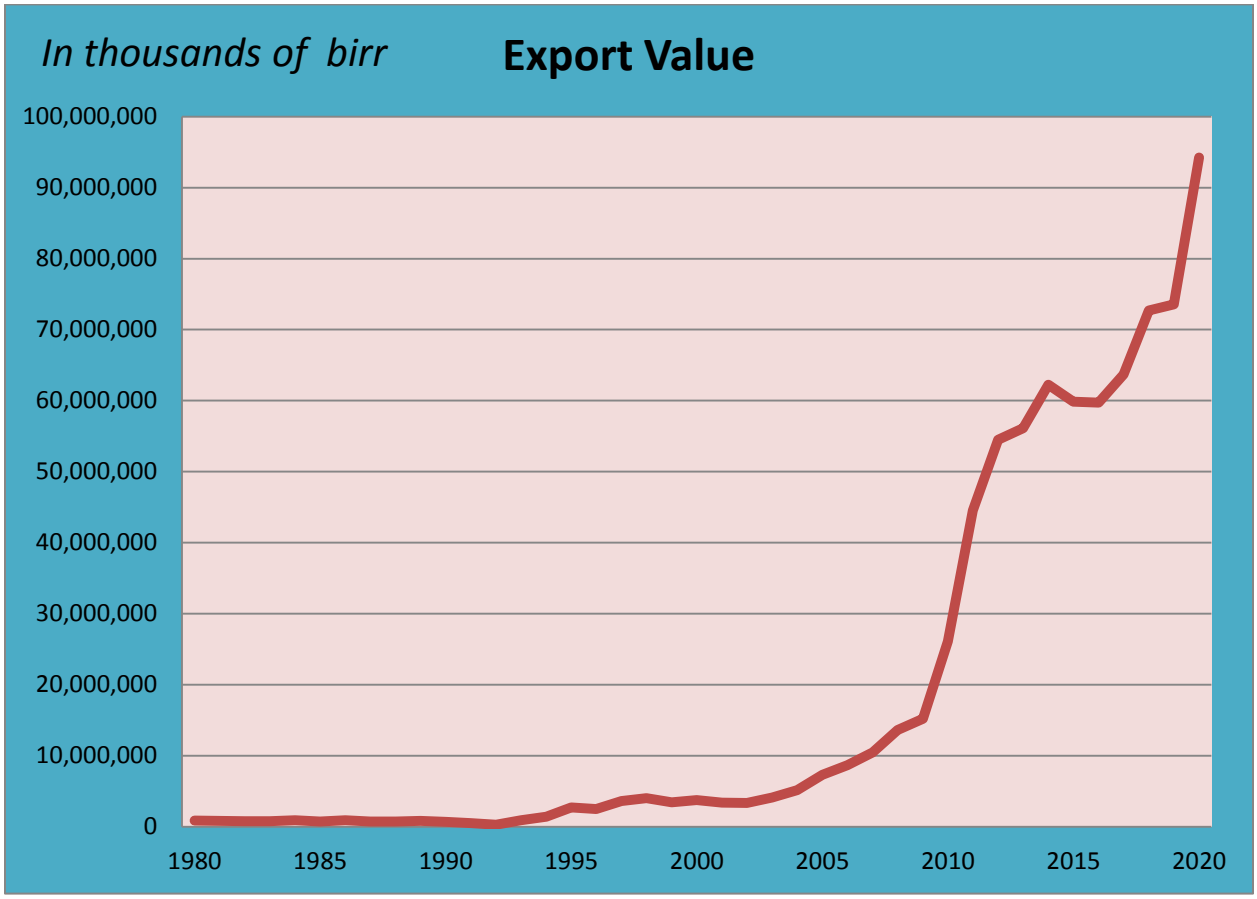


Figure 4.1 Trend in Export bill.

Figure 4.1 esteem the position of export value throughout time, which remained fairly stable prior to 2005. The export value index as a measure of Export price reaches the minimum value in 1992 which is 300.6 million ETB and started to move upward in 1993. The above rise in the value of export occurred following the period of largest devaluation in the history of the nation which is undertaken in 1992 and it is about 142 percent. After 2003, the value of export shows persistent upward movement, the degree of increment is higher after 2009 that can be associated with 23.7 percent devaluation in Ethiopian birr in the same period.

4.1.2. Trend of Import price in Ethiopia

The vast majority of Ethiopia's commodity imports come from Asia (62.3%), subsequently followed by Europe (21.4%), then the United States (10%), along with other African nations (6.2%), where as China alone makes up 26% of total imports. According to UN Comtrade (2020) the value of merchandise imports of Ethiopia totaled 14.9 billion USD in 2018 compared to 2017 which was equal to 15.7 billion USD. The value of merchandise imports decreased by 773 million USD .Overall goods and service imported to Ethiopia also decreased by 4.9 percent compared to 2017.

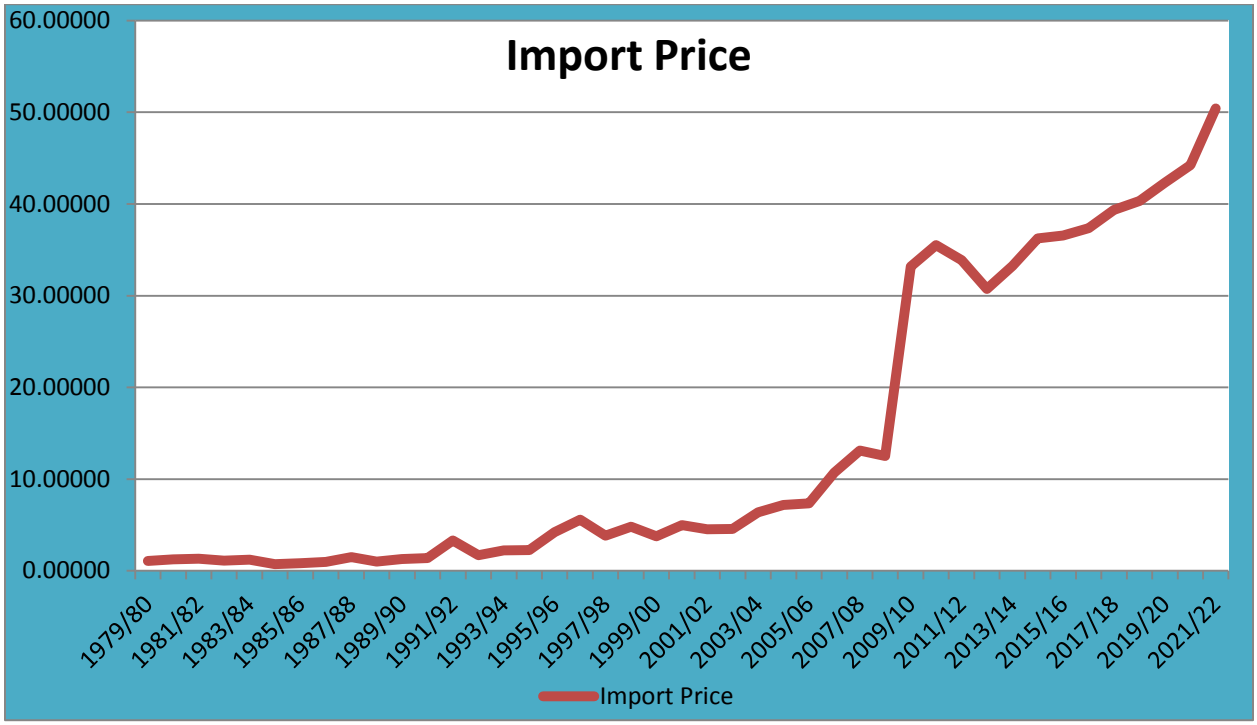


Figure 4.2 Trend of Import Price index.

From figure 4.2 it's obvious that 1984 the trend of import price reaches it is minimum of 0.71 million ETB and generally stable until 1992 and started to move upward slowly until the beginning of the millennium. The consistence upward movement in the Import price first occurred in 2002. The increase in import price becomes sharper in 2010, which can be associated with 16.7 percent devaluation in Ethiopian birr in the same period. The highest increment rate in other hand is registered in 2021/22 in which import price shows a 27.8 percent increment compared to base year. According to NBE (2018/19) overall import value reached 15.1 billion USD and declined by 0.9 percent compared to last year same period primarily due to decreased

import bill of capital, miscellaneous and consumer goods. Payments for semi-finished goods, raw materials and fuel however, tended to annual increase. Furthermore, the report of (NBE, 2021/22) shows that Total import bill reached 5 billion USD in the fourth quarter, which is 27.8 percent increment. The increment in import bill generally associated with an increase in fuel payment, which is surged by 97 percent, 89.3 percent payment increase of semi-finished product and the increase in the bill of fertilizer increased significantly by 229 percent. Moreover, 2.8 percent and 3.4 percent decline in non-durable and durable the bill payment respectively contributed 2.9 percent decline in overall consumer goods declined by

4.1.3. Trend of Consumer Price Index in Ethiopia

As we can infer from Figure 4.3 below consumer prices in Ethiopia is fluctuating by an increasing rate with un even pace. For instance, consumer prices rose by 36.5 percent in 2008 compared to the previous year. The growth rate of consumer price continues with higher rate of 34 percent over the previous year in 2011/12. Consumer price further escalates by more than 100 percent in the year between 2005/06 and 2009/10.

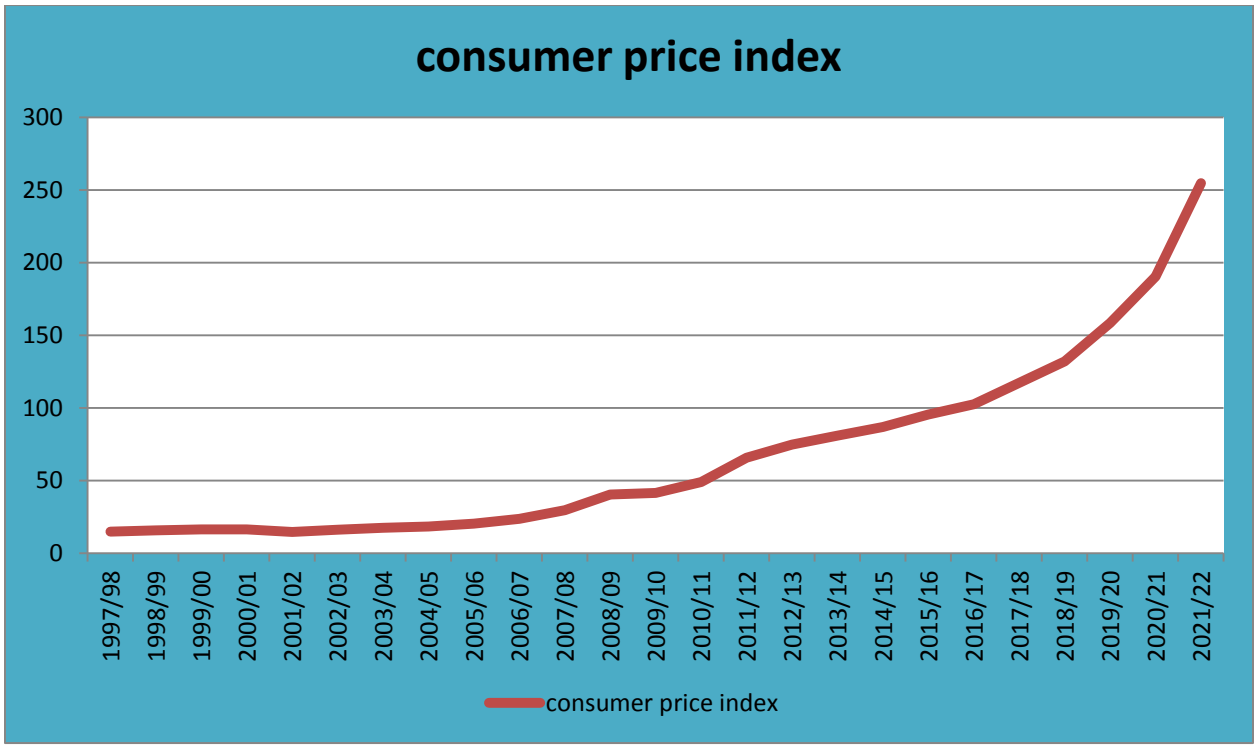


Figure 4.3 Trend of Consumer Price Index.

4.2. Trend of Consumer Price Index

Furthermore, in the five years period after 16.7 percent devaluation in 2010, which is in between 2010/11 and 2015/16, consumer price more or less increases fairly from one fiscal year to the other but the average increment between the periods, that is in five years, consumer price increased by 77.2 percent. Moreover consumer price further increased by 14.1 percent and 19.9 percent in 2017 and 2018 respectively. This might be associated to the 15 percent devaluation in 2017. Inflation rate hiked by 3.15 percent in 2018 compared to devaluation period of October 2017. CPI further increased by 33 percent in 2021 compared to base year and even surged dramatically by 117.1 percent in five years after devaluation of 2017(in the period between 2021/22 and 2017/18).

4.2.1. Exchange Rate policies and The Behavior of Birr

Ethiopian legal tender currency, which initially called Ethiopian dollar, was first issued and the official transaction of this currency visa-a-visa US dollar was created on July 23, 1945. The gold content of the currency was 0.357690 gram that was constant until the collapse of Bretton wood system. The gold content was parallel to an official rate of 2.48 ETB/USD. The name changed in to Ethiopian birr in 1976 but the exchange rate of birr against US dollar was remained fixed. Therefore, the Ethiopian currency has been pegged to 2.07 ETB/USD until the huge devaluation in 1992.Even though, dynamic variation in the world major currencies is documented, this pegged official exchange rate was unaltered for almost twenty years, which resulted in the overvaluation of ETB in terms major trading countries currency including USD. The devaluation of October 1992 marked the beginning of managed floating exchange rate, which aims to regulate the overvaluation of the exchange rate through gradual depreciation of ETB every year. The higher depreciation rate was expected to generate the higher increase in export rate, determines the value of imports and better economic growth. In comparison to the previous exchange rate system, the deviation between the official and unofficial rates has been minimized.

National bank of Ethiopia further devalues ETB by 16.7 percent and 15 percent in 2010 and 2017 respectively. The real exchange rate in other hand shows appreciating trend since 2010/11 until it depreciate in 2017/18 fiscal years by 5.9 percent while nominal effective exchange rate deprecating by 10.9 percent on annual basis from 2011/12 until 2017/18 fiscal period.

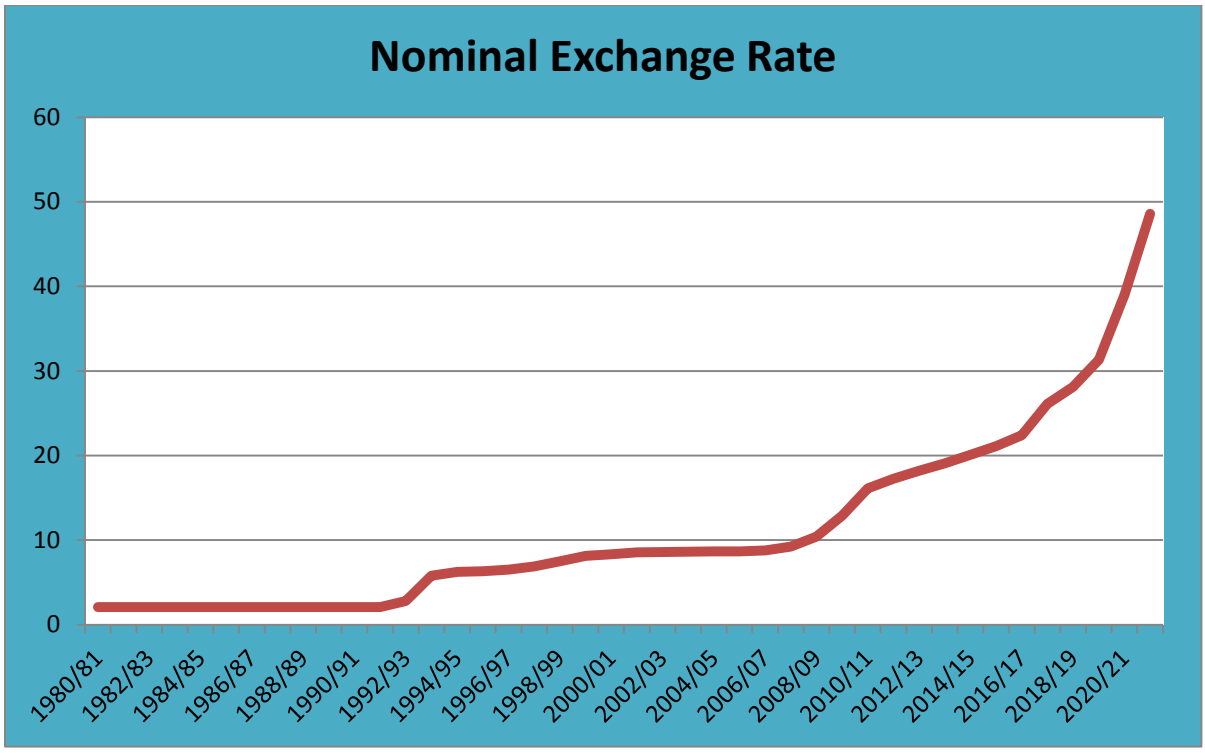


Figure 4.4 Trend of Nominal exchange rate

Figure 4.3 above demonstrates the stagnant nominal exchange rate until 1992 devaluation period. The trend in nominal exchange rate depicted in the above table shows a short-term persistent rise in the period between 1992/93 and 2007/08. Nominal exchange rate in Ethiopia indicates a considerable upward shifts since 2009/10 periods and 48.56 in 2021/22 period. According to National bank of Ethiopia ETB depreciated by 36.5 percent in real terms and 3 percent in nominal terms in 2021/22 fiscal period compared to base year. Faster depreciation of Ethiopian birr against USD relative to other trading partners currency is also observed in the same fiscal year and continues until the first quarter 2022/23. The important issue is not a movement in the exchange rate at least in this thesis, rather the impact of the change in exchange rate on domestic price and an overall economy. An upward movement in the in nominal exchange rate (devaluation) might be desirable or not which is also true for downward movement in the exchange rate that needs well investigation.

4.2.2. Descriptive Analysis

For the purpose of evaluating the impact of exchange rate fluctuations on domestic prices along other macro-economic variables, this section further strives to address the detailed statistical properties consisting of mean, median, average, standard deviation, maximal and minimal values of investigated variables is discussed in the following table.

Table 4.1 Summary and Descriptive Statistics

	LnCpi	LnImp	LnMs	LnWcpi	LnNEER
Mean	4.284292	3.120875	12.27108	4.884838	3.941853
Median	4.389700	3.292781	12.32646	4.842302	3.764935
Maximum	5.737944	4.231308	14.40306	5.352652	4.514907
Minimum	2.997824	1.538781	10.45264	4.486018	3.543854
Std. Dev.	0.753169	0.530810	1.153202	0.201071	0.308410
Observations	69	69	69	69	69

As it can easily be observed in the above table, this study employed 69 quarterly data observations, which range from 2005 Q_1 to 2022 Q_1. The dependent variable in this study is price consumer price index and imports price. As it obviously seen, from the above descriptive analysis; the average result of consumer price index is 4.39 percent and the average result of import price is 3.29 percent, along with maximum of 5.74 percent and a minimum of 2.99 percent for consumer price index and maximum of 4.23 percent and minimum of 1.53 percent for import price. This indicates that, in the period study covers, the value of consumer price index ranges from 2.997824 to 5.737944 with total average of 4.389700 percent. Furthermore, each observation in the study deviates from average value of consumer price index and import price by 0.753169 percent and -0.530810 percent respectively.

4.3. Econometric Analysis

Stationarity is an important concept in estimating time series analysis. In order for series to be stationary: the variances and auto-covariance of a stochastic process must be finite and time independent. According to Green (2002) and Gujarati (2012) undertaking time series analysis with non-stationary data will produce “spurious” regression. To eliminate "nonsense" regression results, all variables in vector auto-regression models must remain stationary. Accordingly, Augmented Dickey-Fuller (ADF) test is carried out to determine if the series is stationary or not and the results are presented in the following table. Table 4.2 Augmented Dickey-Fuller unit root test

Table 4.2 Augmented Dickey-Fuller test for a unit root

Variables	ADF test						
	At level			**At first difference**			
	Test Statistic	**Critical** value	**P-value**	**Test statistic**	**Critical** value	**P-value**	
LnNEER	-1.907442	-2.905519	0.3271	-5.425444	2.905519**	0.0000	I(1)
LnImp	-2.242732	-2.904848	0.1935	-11.58050	-2.90519**	0.0000	I(1)
LnCpi	-0.137937	-2.904848	0.9404	-5.171792	2.909206**	0.0000	I(1)
LnWcpi	-2.574090	-2.905519	0.1034	-5.224096	2.905519**	0.0000	I(1)
LnMs	1.811032	-2.906210	0.9997	-12.27129	2.906210**	0.0000	I(1)

Sources: Author's computation using Eviews software. **represent significance at the 5% level of statistical probability.

As we observe from table 4.5, all variable's absolute test statistics are lower than critical values, which leads us to reject the null hypothesis, which insists on the stationarity of the variables at a level. The presence of unit root in the variables makes the estimation process and result spurious. Therefore original data must be transformed in to its first difference to test whether unit root exist or not. Accordingly, the calculated statistics of all variables in the system are above the critical values at the first difference. As a result, all variables are stationary resulting in order one co-integration.

Optimal Lag Length Selection

The maximum lag lengths are required to be chosen prior to estimating the VAR. This is because insufficient lags in the model result in premature rejection of the null hypotheses, whereas excessive lags in the model diminish the statistical validity of the test results (Verbeek, 2004). This appears to imply choosing an optimal lag length, which minimizes the problem posed by model selection criteria, is an essential initial assignment. Accordingly, Model selection criteria such as, Akaike information criteria, Final Prediction Error test, Hannan-Quinn information criteria, Likelihood Ratio and Schwarz information criteria are all applicable methods to establish the ideal lag length for the VAR model. As figured out by Lütkepohl (1991), the Akaike information criteria asymptotically overrate the sequence of events with positive probability.

Table 4.3 VAR Lag Selection Criteria

Lag	*LogL*	L_R	F_{PE}	A_{IC}	S_C	H_Q
0	-21.91621		1.66^{-17}	0.882499	1.055521	**0.950308**
1	307.8338	594.6311	$7.64e^{-11}$	-9.109304	**-8.071169***	**-8.702449**
2	335.0086	44.54897	$7.23e^{-11}$	-9.180611	-7.277364	**-8.434711**
3	396.8237	**91.20260***	$2.26e^{-11}$	-10.38766	-7.619304	-9.302718*
4	423.2836	34.70142	2.34^{-11}	-10.43553	-6.802055	**-9.011535**
5	454.7210	36.07574	**$2.19e^{-11}$****	-10.64659	-6.148006	**-8.883552**
6	481.8320	26.66654	$2.57e^{-12}$	--10.71580	-5.352106	**-8.613719**
7	511.6482	24.43954	$3.14e^{-12}$	-10.87371	-4.644903	**-8.432583**
8	541.9532	19.87212	$4.56e^{-12}$	**-11.04765***	-3.953725	**-8.267471**

Sources: Author's computation using Eviews software.

****indicates the lag selected by Final Prediction Error test at 5% level of significance**

L_R: Likelihood Ratio

F_{PE}: Final prediction error

A_{IC}: Akaike information criterion

H_Q: Hannan-Quinn information criterion

S_C: Schwarz information criterion

The Schwarz information criteria, as shown in Table 4.6, selected lag length one, whereas the Hannan-Quinn information criteria and LR test statistic choose lag three. Final prediction error criteria (FPE) choose optimal lag length five. Finally, Akaike information criterion chooses lag length eight. In order to discriminate one model from the other, it is advisable to look at the following lag exclusion test.

Table 4.4 Lag Exclusion Test

Number of lags	1	3	5	8
Joint χ^2 test statistics(P values)	176.8660	51.18379	39.11149	23.71427
	[0.000000]	[0.001519]	[0.035903]	[0.535929]

Multiple literatures recommended the lag length that supported by many selection criteria as an optimal lag, though every lag length poses their own strength and weakness. Lag exclusion test therefore, enhances to identify appropriate lag length. Accordingly, the results depicted in table 4.7 propose that, it is difficult to discriminate one model from other because all lags length are significant. Therefore, subjective decision is taken to ease the ambiguity. Following final prediction error criteria, optimal lag length five is selected in this study due to; a fewer and excessive lag length reduce the accuracy of the estimation and estimating VECM with lag length five generates residual free from serial auto correlation, autocorrelation and heteroscedasticity but failed in normality problem[9].

Co-integration Test

Following the outcomes of unit root test and optimal lags selected to be to be embedded in the model, the next step becomes examining the potential co-integrating relationship between variables. Some sets of series are co integrated if a linear combination of those variables has an inferior order of integration. Co-integration of two or more variables in the system suggests the presence of stable, linear and long run links in the models. In other words, the system has a tendency to get around disequilibrium position and fluctuate around zero mean. The

[9]According to Gujirati (2003) as further cited by Helen (2012) since the primary objective of normality test is for inference (weather the sample data drawn from normally distributed population). The deficiency of the model to suit with normality assumption doesn't distort the estimator's un-biasedness and consistency property

most prominent methods of co-integration test in the literatures are Johanson (1988) and Engle and Granger (1987) But for this study, Johanson co-integration technique is employed. According to Binh (2013) Johanson co-integration method is mostly recommended in multivariate analysis due to its ability to invalidates the issue arises in selecting a dependent variable and problems occurred when residuals moves from one step to the next. The optimal lag length selected above employed to test Johanson co-integration test. Furthermore, the result of the co-integration test further driven by the determination to include or remove a trend, which is based on the behavior of the series estimated in the VAR model. This research paper selected a model with intercept and no trend that is most recommended in the co-integrating equation. Here under the findings of both trace statistics; the maximum eigen/likelihood ratio test and trace test are presented.

Table 4.5: Unrestricted Co-integration Rank

Trace test				Maximum Eigen value		
Hypothesized No.of CE(s)	Eigen value	Trace Statistic	5% Critical value	Eigen value	Trace Statistic	5% Critical value
None*	0.511079	95.08466	69.81889	0.511079	45.07987	33.87687
At most 1	0.302479	50.00478	47.85613	0.302479	22.69401	**27.58434***
At most 2	0.270452	27.31077	**29.79707***	0.270452	19.86576	21.13162
At most 3	0.0106446	7.445011	15.49471	0.0106446	7.090577	14.26460
At most 4	0.005610	0.354435	3.841466	0.005610	0.354435	3.841466

Trace statistics in table 4.7 depicts evidence of 2 co-integrating relationship between variables at the 5% significance level. The co-integration equations imply that two linear combinations exist between in the model, which drives the series to an extended relationship. However, the maximum Eigen value test statistic shows only one co-integrating equation. According to Banerjeeetal (1993) as cited by Hussain (2008) and Negasi (2014), maximum Eigen value is more powerful relative to trace statistics. Therefore, following the result of eigen value test statistic, the study adopted one co-integrating equation among for the upcoming illustration.

Despite short run deviation from equilibrium, the co-integration equation shows the presence of one linear combination, which in turn indicates the long run link with in the system.

Diagnostic Test

So far we have seen that our variables are stationary and co-integrated of order one. The subsequent phase involves the assessment the residuals for normality, stability, heteroscedasticity, and serial correlation using the Jarque-Bera test, the inverse roots characteristics polynomial of AR. Breusch-Pagan test and Lagrange-multiplier test respectively before proceeding to the discussion of VECM. The outcome demonstrates that the model has no evidence of autocorrelation, in which we failed to reject the null hypothesis. The presence of the all unit roots within the main circle further indicates the stability of the model. The model also doesn't show any heteroscedasticity problem. Finally, our model encountered with normality problem but it does not hinder us to go further. Having pieced together our post-estimation in which we enunciated our result as good further initiate as to investigate VECM models, impulse response function(IRF) and Variance decomposition analysis (VD) in the upcoming sections.

The Long run Model

The previously reported finding demonstrates that LnNEER, LnCpi, LnImp, LnMs, and LnWcpi are co-integrated in the long-term. This leads the researcher towards employing the co-integrating vector to develop the vector error correction (VEC) model. Through normalizing LnCpi, the suggested error correction term (Ect) which is a long-run relationship between variable is presented below.

Table 4.6: Long run Estimate of VECM

Co-integrating eq:	**CointEq1**
LnCpi	**1**
LnImp	**-0.504309*** (0.16629) [-3.03269]
LnNEER	-0.2442342 (0.19379) [-1.47957]
LnMs	**-0.552747*** (0.05285) [-10.4578]
LnWcpi	-0.176826 (0.17855) [-0.99037]
Cons	5.895785

$Ect_1 = 5.89 + LnCpi - 0.50\text{LnImp} - 0.24LnNeer - 0.55\text{LnMs} - 0.17LnWcpi$ ……..... (20)

Since error term assumed zero in the long run, the above equation can be rewritten as:

$lncpi = 0.50\text{Lnimp} + 0.24\text{Lnneer} + 0.55\text{Lnms} + 0.17Lnwcpi$ ……..……(21)

(-3.03269) (-1.47975) (-10.4578) (-0.0990.3)

The long run result presented in equation 21 shows that, import price and money supply have considerable and positive impact on consumer price. Meaning that, in the ceteris paribus condition, 1 percent increases in import price and money supply increase consumer price by 0.50 percent and 0.55 percent respectively. Nominal effective exchange rate (NEER) and world commodity price index (Wcpi) in other hand has a positive impact on consumer price. Meaning that, in the ceteris paribus condition, 1% increase in nominal effective exchange rate (devaluation) and world commodity price index generates 0.24 percent and 0.17 percent increment in consumer price respectively. However, the nominal effective exchange rate (NEER) and world commodity price index (Wcpi) has a statistically insignificant long-run impact on consumer prices.

Therefore, even if there is change in consumer price it's not NEER and Wcpi rather it is from money supply and import price. This may arise from; the effect of exchange rate throughout pricing and distribution chain dies out. Meaning that variability in exchange transmitted into pass to import prices first, then producer prices, and finally to consumer prices. Moreover, according to Helen (2012) the structure of local market and distribution expenses, tariff barriers that intervene between the port of destination market and the buyers at the store counter are reflected in consumer price. That is producer mark up their marginal cost on imported commodity.

The short run Dynamics

The Vector error correction model further describes the short-term link that exists among money supply, consumer price index, nominal effective exchange rate, import price and the world commodity price index. The error correction term, which demonstrates the pace of equilibrium readjustment, ought to possess a negative sign, at least for co-integrating equations, in our case consumer price index.

Table 4.7: Adjustment coefficients of VECM

Error correction	**D(LnCpi)**	**D(LnImp)**	**D(LnNEER)**	**D(LnMs)**	**D(LnWcpi)**
Co-integrated Eq1	-0.427136	0.563649	0.009456	-0.034689	0.114743
t-stat	[-4.10703]	[1.96386]	[0.08247]	[-0.81198]	[0.85811]

From table 4.7 above, it's possible to infer that the error correction term acquired with an accurate sign. This shows the tendency to converge towards equilibrium level. That is the speed the model adjusts to equilibrium position once it deviates due to shocks. That is, the coefficients of LnImp, LnNEER and LnWcpi are insignificant with unexpected sign. The coefficient of money supply in other hand is insignificant with the correct sign. Finally, the error correction term of target variable LnCpi is statistically significant and further exhibits the projected sign. This result shows that if the shock struck throughout the model the change in consumer price have a substantial moving authority to bring the model in to equilibrium level by the adjustment speed of 42.7 percent each quarter.

Granger Causality Test

This statistical testis designed for evaluating the cause-and-effect relationship. This causality assessment is applied to assess the capacity of a time series to foresee the future values by considering prior values of another time series. That is, in the granger causality test, we aren't desperately looking for the presence of a real cause-and-effect relationship; rather, we are curious to find out if a particular variable occurs before another in the time series. The result of Granger causality test presented in appendix 4, therefore shows that import price, money supply and world commodity price granger cause consumer price but not vice versa. The result of Granger Causality test further indicates the extending causes through the nominal effective exchange rate towards the money supply but not vice versa.

Impulse Response Function

The impulse response function explores the directional reaction of one variable in the system to a shock from another variable in the system. This means IRF helps us to understand the scope, direction, and resilience of domestic prices due to shifts in nominal effective exchange rate. To identify those responses, the Cholesky decomposition approach is implemented. Cholesky decomposition technique implies that any adjustment has an immediate effect on the variables that come later but does not have an instantaneous effect on the variables that appear before it. Accordingly, subsequent shocks in the model are less likely to alter world commodity prices contemporaneously, whereas its shocks tend to affect all variables in the model. This attributed to a price taking nature of Ethiopian economy in a global market. Nominal effective exchange rate ordered second followed by money supply assuming monetary policy may respond to exchange rate movement. Finally, domestic prices ordered based on pricing and distributions chain.

Hence the study apply Cholesky Ordering of

LnWcpi → LnNEER → LnMs → LnImp → LnCpi

Twelve quarters or three years are taken to show the reaction of consumer price and import price to the shock in nominal effective exchange rate.

Table 4.8: Effects on Consumer price and Import price to one standard deviation of exchange rate

	After Q_2	After Q_4	After Q_6	After Q_8	After 12Q
Consumer price index	0.0139	0.0243	0.0258	0.0308	0.0031
Import price	0.0373	0.0496	0.0335	-0.0911	-0.011

As we can see in table 4.8 and figure 4.5 below, consumer price and import price responds slowly and positively to the innovation of Nominal effective exchange rate until the second year for import price. For instance the shock in NEER transmitted by 1.39 percent and 3.7 percent on consumer price and import price respectively for one standard deviation which is at increasing trend and reaches 2.4 percent and 4.96 percent after one year. Furthermore, the shock in exchange rate transmission in to import and consumer price reaches its pick in the second year, which is 3.0 percent and 9.1 percent respectively and instantly diminishing as the estimation horizon increases. This indicates that ERPT in Ethiopia is low and temporary. But the suggested pass-through rate of consumer price is higher compared to the result reports by Helen (2012) and Negasi (2014). This disparity in estimated result could be occurred either from difference in sample size used or the huge difference observed between official and black market exchange rate[10].

The estimated result generally shows lower ERPT on domestic price and higher for import price compared to consumer price. This may be due to; Economic literatures suggest that the size of pass- through is highly determined by the degree of trade openness and level of integration with international market. According to Soto and selaive (2003), the less open the nation's economy is to foreign trade, the lower is the ERPT to domestic prices, purchasing power parity no longer holds and exchange rate fluctuation due to monetary policy change depends on degree of openness.

Traditional international trade theory argues that, substantial cost arises due to shipping of goods over the long distance between exporting and importing countries is the main reason for less

[10] IMF staff paper (1984), after initial shock to domestic price due to exchange rate depreciation, the response of domestic price and cost structure depends on black market exchange rate and on the size of the its transaction relative to official rate.

sensitivity of consumer price for the change in exchange rate. However, Engel and Roger (1996) forward an evidence that geographical distance is not the main factor for the weaker responsiveness of consumer price due to change in exchange rate[11]. This argument further validated by Camp and Goldberg (2006) and (Valderrama 2004)[12]. The other explanation for lower ERPT to consumer price than import price arises from non-tradability nature of some products in global transaction and the price of those commodities are entirely determined domestically and further included in to consumer price.

The other important reason that explain the rationale behind lower ERPT to consumer price than import price is the shock in exchange rate initially passed in to price of import and eventually strike consumer price following adjustment in producer price. That is ERPT to consumer price is indirect and its impact dies out along pricing chain. The prevailing market structure is an additional explanation for low sensitivity of consumer price to change in exchange.

[11] The price of different cities in one country move more closely together than nearby cities in different countries, which generally suggested national borders plays important role than physical distance.

[12] The factors that intervene in between the destination's market port and the buyers at the store counter are highly related to the low sensitivity of consumer price to the exchange rate change.

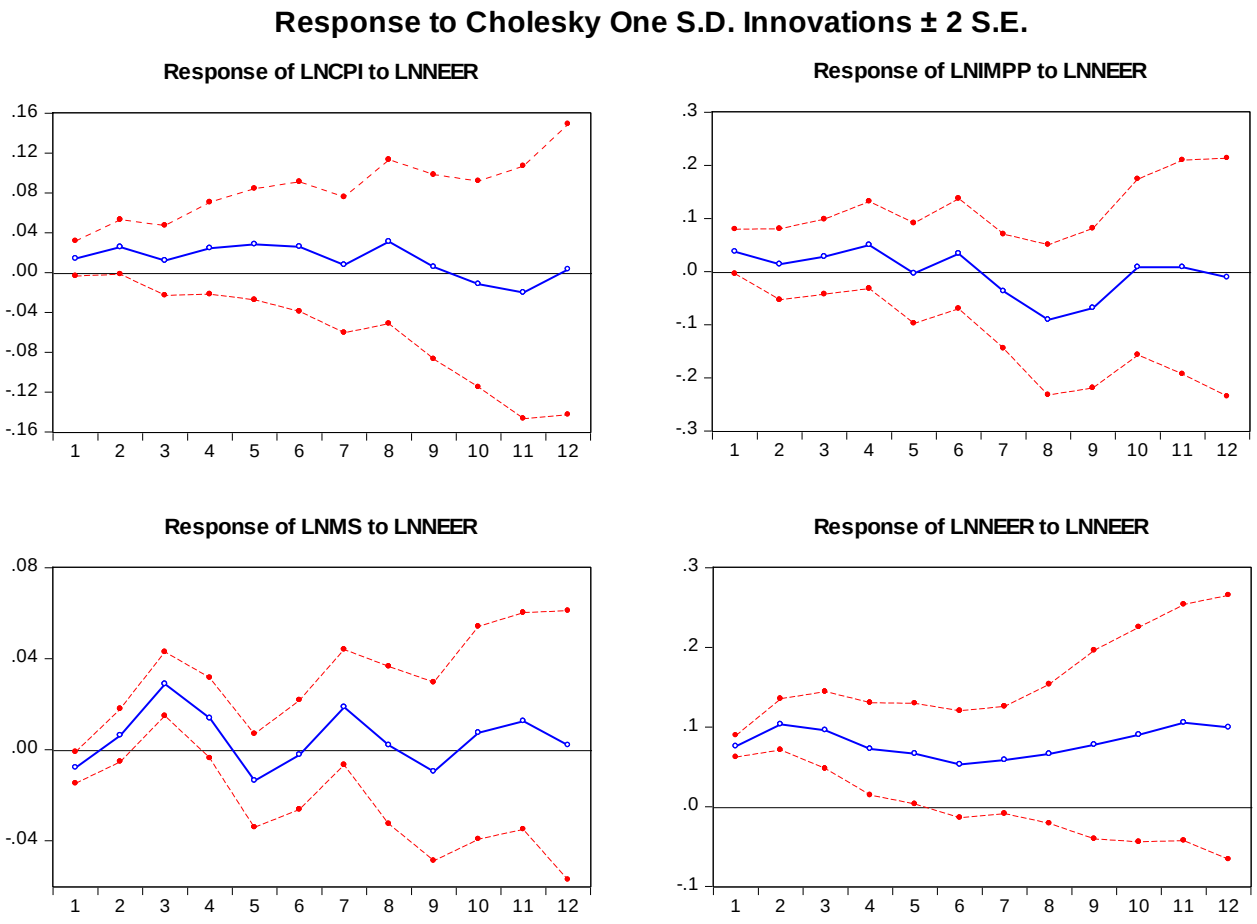


Figure 4.5; below illustrates the direction of change in trade prices due to a shock in NEER.

For instance, in perfectly competitive market structure, where domestic and foreign goods are a perfect substitute, domestic importer is more responsive to the change in exchange rate. Hence, full effect of shock in exchange rate passes into consumer price. In imperfect market, the response of the importer is low as of consumer price. Dornbusch, R. (1987) further validate the above theory by suggesting, the size of transmission is highly and directly affected by the extent of substitution between local and foreign product. Distribution cost [13] and inflation environment[14]are additional arguments for lower ERPT of consumer price.

[13] Distribution expenses such as cost of shipping, handling, packing, storage, marketing and service that intervene between production and basket of customer.

[14] As postulated by Taylor (2000) a prevailing lower inflationary environment is associated with the lower ERPT. The low historical inflation rate in Ethiopia except recently explains the lower ERPT to domestic price.

Variance Decomposition

The variance decomposition signifies the forecast error variability decomposed for individual variable, which illustrates the degree of variation in those variables owing to their own innovations and the innovation arising from other variables. The variance decomposition (VD) reveals the corresponding information of import and consumer price shocks with respect to shocks in the nominal effective exchange rate. Since the major goal of our study is to examine the level of ERPT to domestic prices, the discussion afterward concentrates on examining variance decomposition separately for consumer and import prices over a period of 16 quarters (4 years).

Table 4.9: Variance decompositions of import and consumer price.

	Period	LnWcpi	LnNEER	LnMs	LnImp	LnCpi
Variance decomposition of Import Price	Q_1	23.92959	3.739901	2.287340	70.04317	0.000000
	Q_4	35.32317	5.232006	10.18960	45.76860	2.810054
	Q_8	30.75812	13.43983	13.79824	37.69114	4.312671
	Q_{12}	29.61868	15.90768	13.50300	34.98669	5.983943
	Q_{16}	28.22584	18.28503	12.86337	33.39304	7.232727
Variance decomposition of consumer price	Q_1	0.064967	3.902459	2.176345	13.91041	79.94582
	Q_4	24.28947	6.775076	6.326236	26.33846	36.27076
	Q_8	29.26880	7.852907	14.51955	27.46555	20.89320
	Q12	27.90775	8.446869	17.16852	25.99768	20.47918
	Q16	26.77949	9.648570	16.75832	26.14667	20.66694

The variance decomposition analysis for import price suggests that in the first quarter, innovation or shocks to import price of 70.04 percent comes from its own which instantly decline to 33.39 percent after the fourth year. Exchange rate shock in other hand contributes around 3.74 percent variation to the import price, while the consumer price index and the money supply contributed zero and 2.28 percent respectively. After two years the share of exchange rate innovation increases in to 13.4 percent, while the involvement of consumer price and money supply reaches 4.32 percent and 13.8 percent respectively. Furthermore, world commodity price index contributes 23.92 percent innovation in import price in the initial quarter, which makes it the

second candidate variable about variation in import price after import price own shock and the diminishing contribution reaches 29.6 percent after the third year.

The above table of variance decomposition further shows, in the very short run the highest contribution to the variation in consumer price arises from its own shock. That is 79.94 percent in the first quarter and 20.67 percent in the extended periods (16 quarter). Innovation in NEER further contributes 3.9 percent variation in consumer price in the initial quarter and 8.44 percent after three years. The highest contribution of import price which is 27.5 percent and 17.1 percent from money supply is documented in the second and third year respectively. World commodity price index (Wcpi) in other hand contributes 0.06 in quarter one and 29.26 percent and 26.77 percent after the second and 16 quarter respectively. The contribution of Wcpi shows the existence of significant imported inflation.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

International economic theories strongly suggested the accelerating impact of Exchange rate shock in determining international trade. Accordingly, countries adapted Currency devaluation as a tool for boosting economic growth. The goal of this thesis was to inquire into the pattern of ERPT into domestic prices and to understand more about the effectiveness of devaluation in the Ethiopian economy for a sample period ranging from 2005 to 2022 with 69 observations. To that end, a theoretical and empirical literature has discussed and the study further used secondary data from NBE, World Bank and central statistical for the target variables. The study investigated the consequences of shift in exchange rate by employing the vector error correction (VEC) model, where the long run coefficient is estimated by the exchange rate coefficient in the normalized co-integrated vector for consumer price and independent impulse response function and variance decomposition is further conducted for both consumer price and import price.

By inducting the effect of nominal effective exchange into domestic price, both on import and consumer side as a center of investigation, the estimated statistical outcome demonstrates that all variables are stationary. Following the stationarity of all variables after first difference and the presence of the co-integrating connection, which validates the long-run relationship between the target variables, further induced us to run the vector error correction models with five lags adapted. The long-term links that is estimated by VECM indicates that import price and money supply have significant and positive impact on consumer price while the coefficients of exchange rate shock and world commodity prices are positive but insignificant. That is exchange rate and world commodity price indexes are not the determinants of consumer price in the long run.

The VECM's short-term dynamics also demonstrate that the corresponding coefficient of error correction term of LnCpi is negative (desirable) and statistically significant. Meaning that, any time disturbance occurred in the whole system, the movement in consumer price will have a considerable moving power to bring model back into equilibrium position. The granger casualty test further shows that import price, money supply and world commodity price are the variables

that causes consumer price while nominal effective exchange rate granger causes money supply but no other way around.

The impulse response function (IRF) and variance decomposition (VD) with respective estimation horizon taken in the study suggested that the ERPT in Ethiopia is incomplete, low and higher for import price compared to consumer price. The world commodity price index in other hand contributes 28.2 percent and 26.7 percent variation in import price and consumer price respectively, which considered as an evidence for the presence of imported inflation in Ethiopia.

5.2. Policy Implication

The lower and partial ERPT to the price import in the short-term indicates the important implication about exchange rate channel of monetary policy is less effective to improve the country's external balance. Accordingly, devaluation as initiatives to improve export and trade balance as whole circumscribed by the incomplete response of import price to the movement in exchange rate. The less response of import to the variability in nominal effective exchange rate in turn rebuts the policy aimed at encouraging people to switch their spending from foreign goods to domestic goods. Meaning that devaluation of birr raises price of import and reduce the demand for imported goods. The change in import price however is incomplete and low; therefore, the motive of the customer to change spending from foreign goods to local product will be diminished. Therefore, the policy experts must take in to account the nature of response of import price to the movement in exchange rate before devaluing the currency.

In the long-run import price has a significant impact on consumer price and more than half of Import price variation arises from import price itself. This might be due to importer markup price over their marginal cost to reap higher profit margin. This in turn may arise from oligopoly nature of the import sector with less competitiveness. Therefore, the government must put regulatory actions on import sector to minimize price escalation in Ethiopian economy. A lower exchange rate shock transmission in to consumer prices further shows that a deliberate shock to exchange rate might not be viable option to affect inflation environment in Ethiopia. Rather policy makers must halt the imported inflation from global market through import substitution and export promotion. The low ERPT to domestic price can further boost the policy maker's freedom to choose independent monetary policies.

Money supply has a considerable positive impact on consumer price in the long-run. That is, the injection of a massive amount of money to the economy further worsens inflation in Ethiopia. National bank should respond by applying more contractionary monetary policies, such as raising the reserve requirement ratio or discount rate and/or the interest rate and smooth operations of open market operation to reduce the circulation of money in the market while bearing risk of sluggish economic growth.

Despite the fact the study attempts to explain the ERPT in Ethiopian domestic prices, it was hampered by a lack of data on producer prices and quarterly real gross domestic product. In future studies, including producer price and the real gross domestic product could possibly be essential to capture domestic supply shocks to overall price levels and for precisely estimating ERPT throughout the pricing chain. Furthermore, future studies should be conducted to explore the impact of exchange rates via sector-specific or industry-level analyses. Disaggregate pricing analysis could reveal more about the true nature of ERPT in Ethiopia than aggregate price analysis (if data become available). Finally, upcoming research works should consider the consequence of the black-market exchange rate (unofficial rate) on domestic pricing (if data become available).

Reference

Abalı, Elif Ege. (2004). "Exchange rate pass- through into the export and import prices of Turkey. "Master's thesis, Middle East technical university.

Al-Arbi, A and Goodwin, B. (2009). "Re-examining the exchange rate pass-through into import prices using non-linear estimation techniques: Threshold Cointegration". International Review of Economics and Finance. 18: 142-16l.

Akofio-Sowah, N. (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.

Aliyu, S.U.R., Yakub, M.U., Sanni, G.K. and Duke, O.O. (2009). "Exchange Rate Pass Through in Nigeria: Evidence from a Vector Error Correction Model", MPRA Paper, 25053.

Alterman, William (1991). "Price trends in US trade: New data, new insights." In *International economic transactions: Issues in measurement and empirical research*, pp. 109-143. University of Chicago press.

Arize, Augustine C., Thomas Osang, and Daniel J. Slottje. (2000)). "Exchange-rate volatility and foreign trade: evidence from thirteen LDC's." *Journal of Business & Economic Statistics* 18, no. 1 (2000): 10-17.

Beirne, J. And Bijsterbosch, M. (2009), "Exchange Rate Pass-through in Central and Eastern European.

Bwire& Francis L. Anguyo & Jacob Opolot, 2013. "**Exchange Rate Pass-Through to Domestic Prices in Uganda: Evidence from a Structural Vector Auto-Regression (SVAR)**," Journal of Statistical and Econometric Method Member States," European Central Bank, Working Paper Series 1120.

Betts, C. and Devereux, M. B. (2000). "Exchange Rate Dynamics in a Model of Pricing to-Market", Journal of International Economics, 50, pp. 215-244.

Bhagwati, J. N. (1988). “The pass-through puzzle: A Tale of the Missing Prince from Hamlet”, Discussion Paper, University of Columbia, (reprinted in Political Economy and International Economics edited by Douglas, A. I.)

Campa, J. M. and Goldberg L.S. (2002). “Exchange Rate Pass-Through into Import Prices: A Macro or Micro Phenomenon?” National Bureau of Economic Research Working Paper No. W8934.

Choudhri, E. And Hakura, D. (2003). “Exchange Rate Pass-Through to Domestic Prices: Does the Inflationary Environment Matter?” IMF Working Paper No.194.

Choudhri, E. U. and Hakura, D. (2001). “Exchange Rate Pass-Through to Domestic Prices: Does the Inflationary Environment Matter?” IMF Working Paper No. 01/194.

Clark Leith, J. (1991). “The exchange rate and the price level in a small open economy”. Journal of Policy Modeling 13 (2), 309-15.

Devereux, M. And Yetman, J. (2008). ”Price Adjustment and Exchange Rate Pass-through. Bank for International Settlements”, University of Hong Kong, Institute for Monetary Research.

Doki, N. Onyeje, Tersoo Shimonkabir Shitile, and Abubakar Sule. (2021). "Imported Intermediate Inputs and Manufactured Exports in Nigeria: The Role of Dual Exchange Rate Regime." *African Journal of Economic Review* 9, no. 1: 148-171.

Dornbusch, R. (1987). “Exchange Rates and Prices”, American Economic Review, 77, pp: 93-106.

Feenstra, R and Kendall, J, 1997. "Pass-through of exchange rates and purchasing power parity". Journal of international Economics. 43: 237-261

Feenstra, R. C. (1989). “Symmetric Pass-Through of Tariffs and Exchange Rates under Imperfect Competition: An Empirical Test”, Journal of International Economics, 27, pp: 25-45

Frankel, J, Parsley, D and Wei, S. 2005. “Slow pass through around the world: A new import for developing countries?” NBER Working Paper No. 11199.

Goldberg, P. K. and Knetter, M. M. (1997). “Goods Prices and Exchange Rates: What Have We Learned?” Journal of Economic Literature, 35, pp: 1243-72

Harris, Richard, and Robert Sollis. (2003). “*Applied time series modelling and forecasting*.” Wiley.

Helen, B. (2012) " Exchange rate pass-through to import and consumer prices: Evidence from Ethiopia ". Master’s thesis, Addis Ababa University.

Helpman, E. and Krugman, P. R. (1989). “Trade Policy and Market Structure”. The MIT Press, Cambridge.

Herzberg, V., Kapetanios, G. And Price, S. (2003). “Import Prices and Exchange Rate Pass-through: Theory and Evidence from the United Kingdom”, Bank of England Working Paper No. 182.

Hossain, A. (2002). “Exchange Rate Responses to Inflation in Bangladesh”, (Washington D.C., IMF Working Paper No. WP/02/XX)

Hyder, Z and Shah, S. (2004). “Exchange rate pass-through to domestic prices in Pakistan”. State Bank of Pakistan Working Paper No.5.

Jihene El Bejaoui, Hayet. (2015). "Essays on exchange rate pass-through: the role of asymmetries and trade globalization." PhD diss., Sorbonne Paris Cité.

Johansen, S. (1988) “Statistical analysis of cointegration vector”. Journal of Economics Dynamics and Control. 12: 231-254

Johansen, S. (1991). “Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models”, Econometrica, 59, no. 006, 1551-1580

Johansen, S. and K. Juselius. (1992). “Testing Structural Hypotheses in a Multivariate Cointegration Analysis of the PPP and the UIP for UK”. Journal of Econometrics, 53, 211-244.

Kalyoncu, H., Ozturk, I., Artan, S. and Kalyoncu, K. (2009). “Devaluation and trade balance in Latin American countries”. Proceedings of Rijeka Faculty of Economics: Journal of Economics and Business, 27(1), pp. 115-128.

Karoro, T.D. (2008). "An analysis of exchange rate pass-through to prices in South Africa". Master’s thesis, Rhodes University.

Khosla, A. and Teranishi, J. (1989). “Exchange rate pass-through in export prices -an comparison”. Hitotsubashi Journal of Economics 30 (1), 31-48.

Knetter, M. (1992). “Exchange Rates and Corporate Pricing Strategies”, NBER Working Paper No.4151

Kreinin, M.E. (1977). “The effect of exchange rate changes on the prices and volume of foreign trade”. IMF Staff Papers 47, 207-29.

Krugman, P. and Obstfeld, M. (2003). “International Economics: Theory and Policy”. Sixth edition, Pearson Education, Inc.

Lafleche, T. (1996). “The Impact of Exchange Rate Movements on Consumer Prices”, Bank of Canada Review, winter, 1996-1997, 21-32.

Lindert, P. H. "International economics/Peter H. Lindert, Thomas A. Pugel." (1996).

Lütkepohl, Helmut, and Don S. Poskitt (1991). "Estimating orthogonal impulse responses via vector autoregressive models." *Econometric Theory*: 487-496.

Magee, Stephen. 1973. "Currency Contracts, Pass-Through and Devaluation." Brook-ings Papers 3: 303-23.

Mallick, S and Marques, H. 2010. “Data frequency and exchange rate pass-through: evidence from India's exports”. International review of economics and finance. 19: 13-22.

Marazzi, M., Sheets, N. And Vigfusson, R. And Faust, J., Gagnon, J., Marquez, J., Martin, R., Reeve,

T. and Rogers, J. (2005). “Exchange Rate Pass-through to U.S. Import Prices: some New Evidence”, Board of Governors of the Federal Reserve System, International Finance Discussion Paper, No. 832, April 2005.

Mengistu, A. T., Montero, E., & Segura, A. (2017). “The impacts of exchange rate movements on prices and trade across sectors: Evidence from Ethiopian firms”. Centre for Economic Policy Research, 2018, 1-48.

Menon, J. (1992). “Exchange Rates and Prices of Australian Manufactured Exports”, Weltwirtschaftliches Archive, 128, pp: 695-710

Menon, J. (1993). “Exchange Rate Pass-Through Elasticities for the Monash Model: A Disaggregate
Analysis of Australian Manufactured Imports”, Centre of Policy Studies Monash University Working Paper No. Op-76

Menon, J. (1995). “Exchange Rate Pass-Through”, Journal of Economic Surveys, 9(2), pp: 197-231

Mihaljek, D. and Klau, M. (2001). “A note on the Pass-Through from exchange rate and Foreign Price Changes to Inflation in Selected Emerging Market Economies”, BIS Papers, No.8, pp.69-81

Mohammednur, B. (2012) "Exchange rate pass-through in Ethiopia". Master’s thesis, Addis Ababa University.

Moldasheva, G. (2013). "Exchange rate pass-through into import prices: Evidence from Central Asia." *International Journal of Economics and Finance Studies* 5, no. 1): 157-167.

Mumtaz, H., Oomen, Ö. and Wang, J. (2006). “Exchange rate pass-through into UK import prices‖, Bank of England working papers” 312, Bank of England.

Mwase, N. (2006). “An empirical investigation of the exchange rate pass-through to inflation in Tanzania”. IMF Working paper No. 150.

National Bank of Ethiopia. (2018/19). Annual Report, Various Issues.

Ogun, 0. (2000). “Exchange rate changes and Export Prices in a small semi-open economy. Open economies review”. 11: 127-134

Razafimahefa, I.F. (2012). “Exchange rate pass-through in sub-Saharan African economies and its determinants”, IMF Working Paper 141, June, IMF, Washington, DC

Reinhart, C. M. (1995). “Devaluation, relative prices, and international trade: evidence from developing countries”. Staff Papers, 42(2), 290-312.

Samuel, E.Kayamo. (2019).”Do exchange rates matter for Ethiopia’s export?” Master’s thesis, Master’s thesis, Wageningen University

Tandrayen-Ragoobur, V. And Chicooree, A. (2013). “Exchange rate pass-through to domestic prices: Evidence from Mauritius”, Journal of Economic Research (JER), Vol. 8 No. 1.

Taye, H. K. (1999). “The impact of devaluation on macroeconomic performance: The case of Ethiopia. Journal of Policy Modeling”, 21(4), 481-496.

Yang, J. (1997). “Exchange Rate Pass-Through into U.S. Manufacturing Industries”. Review of Economics and Statistics, 79: 95-104.

Reinhart, C. M. (1995). “Devaluation, relative prices, and international trade: evidence from developing countries”. Staff Papers, 42(2), 290-312.

Samuel, E.Kayamo. (2019)”Do exchange rates matter for Ethiopia’s export?” Master’s thesis, Master’s thesis, Wageningen University

Tandrayen-Ragoobur, V. And Chicooree, A. (2013), “Exchange rate pass-through to domestic prices: Evidence from Mauritius”, Journal of Economic Research (JER), Vol. 8 No. 1.

Taye, H. K. (1999). “The impact of devaluation on macroeconomic performance: The case of Ethiopia. Journal of Policy Modeling”, 21(4), 481-496.

Yang, J. (1997). “Exchange Rate Pass-Through into U.S. Manufacturing Industries”. Review of Economics and Statistics, 79: 95-104.

Appendix

Appendix 1: Augmented Dickey-Fuller Test of Unit Root(Stationarity test)

LnCpi at level

Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.137937	0.9404
Test critical values:	1% level	-3.530030	
	5% level	-2.904848	
	10% level	-2.589907	

*MacKinnon (1996) one-sided p-values.

LnCpi at first difference

Null Hypothesis: D(LNCPI) has a unit root

Exogenous: Constant

Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.171792	0.0001
Test critical values:	1% level	-3.540198	
	5% level	-2.909206	
	10% level	-2.592215	

*MacKinnon (1996) one-sided p-values.

LnImp at level

Null Hypothesis: LNIMPP has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-2.242732	0.1935
Test critical values:	1% level	-3.530030	
	5% level	-2.904848	
	10% level	-2.589907	

*MacKinnon (1996) one-sided p-values.

LnMs at level

Null Hypothesis: LNMS has a unit root

Exogenous: Constant

Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.811032	0.9997
Test critical values:	1% level	-3.533204	
	5% level	-2.906210	
	10% level	-2.590628	

*MacKinnon (1996) one-sided p-values.

LnMs at first difference

Null Hypothesis: D(LNMS) has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.27129	0.0000
Test critical values:	1% level	-3.533204	
	5% level	-2.906210	
	10% level	-2.590628	

*MacKinnon (1996) one-sided p-values.

LnNEER at level

Null Hypothesis: LNNEER has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.907442	0.3271
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

*MacKinnon (1996) one-sided p-values.

LnNEER at first difference

Null Hypothesis: D(LNNEER) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.425444	0.0000
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

*MacKinnon (1996) one-sided p-values.

LnWcpi at level

Null Hypothesis: LNWCPI has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.574090	0.1034

Test critical values:	1% level	-3.531592
	5% level	-2.905519
	10% level	-2.590262

*MacKinnon (1996) one-sided p-values.

LnWcpi at first difference

Null Hypothesis: D(LNWCPI) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.224096	0.0000
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

*MacKinnon (1996) one-sided p-values.

Appendix 2: VAR optimal lag length

VAR Lag Order Selection Criteria

Endogenous variables: LNCPI LNIMPP LNMS LNNEER LNWCPI

Exogenous variables: C

Date: 05/07/23 Time: 11:13

Sample: 2005Q1 2022Q1

Included observations: 61

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-21.91621	NA	1.66e-06	0.882499	1.055521	0.950308
1	307.8338	594.6311	7.64e-11	-9.109304	-8.071169*	-8.702449
2	335.0086	44.54897	7.23e-11	-9.180611	-7.277364	-8.434711
3	396.8237	91.20260*	2.26e-11	-10.38766	-7.619304	-9.302718*
4	423.2836	34.70142	2.34e-11	-10.43553	-6.802055	-9.011535
5	454.7210	36.07571	2.19e-11*	-10.64659	-6.148006	-8.883552
6	481.8320	26.66654	2.57e-11	-10.71580	-5.352106	-8.613719
7	511.6482	24.43954	3.14e-11	-10.87371	-4.644903	-8.432583
8	541.9532	19.87212	4.56e-11	-11.04765*	-3.953725	-8.267471

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Appendix 3: Cointegration test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.511079	95.08466	69.81889	0.0001
At most 1 *	0.302479	50.00478	47.85613	0.0310
At most 2	0.270452	27.31077	29.79707	0.0943
At most 3	0.106446	7.445011	15.49471	0.5265
At most 4	0.005610	0.354435	3.841466	0.5516

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.511079	45.07987	33.87687	0.0016
At most 1	0.302479	22.69401	27.58434	0.1869
At most 2	0.270452	19.86576	21.13162	0.0744
At most 3	0.106446	7.090577	14.26460	0.4785
At most 4	0.005610	0.354435	3.841466	0.5516

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Appendix 4: Granger causality test

Pairwise Granger Causality Tests
Date: 04/30/23 Time: 18:04
Sample: 0200Q1 0217Q1
Lags: 5

Null Hypothesis:	Obs	F-Statistic	Prob.
LNIMPP does not Granger Cause LNCPI	64	4.58408	0.0015
LNCPI does not Granger Cause LNIMPP		2.38482	0.0504
LNMS does not Granger Cause LNCPI	64	3.79068	0.0052
LNCPI does not Granger Cause LNMS		1.69089	0.1529
LNNEER does not Granger Cause LNCPI	64	0.42006	0.8327
LNCPI does not Granger Cause LNNEER		1.18403	0.3295
LNWCPI does not Granger Cause LNCPI	64	4.29233	0.0024
LNCPI does not Granger Cause LNWCPI		1.62642	0.1691
LNMS does not Granger Cause LNIMPP	64	2.29245	0.0585
LNIMPP does not Granger Cause LNMS		1.03589	0.4063
LNNEER does not Granger Cause LNIMPP	64	1.64506	0.1643
LNIMPP does not Granger Cause LNNEER		0.54356	0.7424
LNWCPI does not Granger Cause LNIMPP	64	0.84674	0.5229
LNIMPP does not Granger Cause LNWCPI		1.70333	0.1499
LNNEER does not Granger Cause LNMS	64	8.27749	8.E-06
LNMS does not Granger Cause LNNEER		0.87298	0.5055
LNWCPI does not Granger Cause LNMS	64	2.25459	0.0622
LNMS does not Granger Cause LNWCPI		0.61837	0.6863
LNWCPI does not Granger Cause LNNEER	64	0.93788	0.4642
LNNEER does not Granger Cause LNWCPI		0.70380	0.6231

Appendix 5: VECM model estimation

Vector Error Correction Estimates
Date: 05/07/23 Time: 11:51
Sample (adjusted): 2006Q2 2022Q1
Included observations: 64 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LNCPI(-1)	1.000000
LNIMPP(-1)	-0.504309
	(0.16629)
	[-3.03269]
LNMS(-1)	-0.552747
	(0.05285)
	[-10.4578]
LNNEER(-1)	-0.242342
	(0.16379)
	[-1.47957]
LNWCPI(-1)	-0.176826
	(0.17855)
	[-0.99037]
C	5.895785

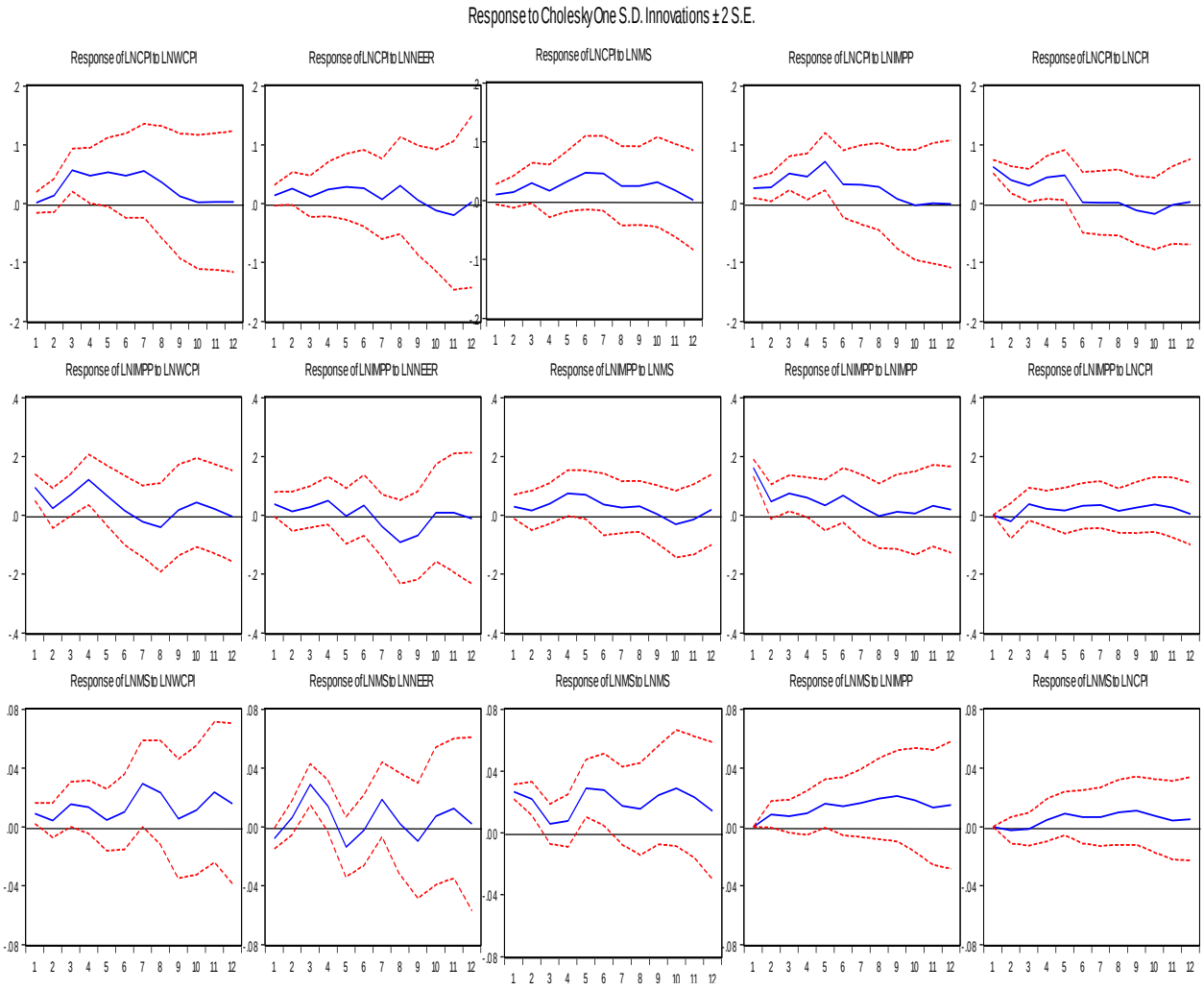
Error Correction:	D(LNCPI)	D(LNIMPP)	D(LNMS)	D(LNNEER)	D(LNWCPI)
CointEq1	-0.427136	0.563649	-0.034689	0.009456	0.114743
	(0.10400)	(0.28701)	(0.04272)	(0.11466)	(0.13372)
	[-4.10703]	[1.96386]	[-0.81198]	[0.08247]	[0.85811]

D(LNCPI(-1))	0.018908	-0.886341	0.020242	0.160883	0.339922
	(0.12238)	(0.33772)	(0.05027)	(0.13492)	(0.15734)
	[0.15451]	[-2.62446]	[0.40266]	[1.19243]	[2.16039]
D(LNCPI(-2))	0.255523	0.004037	0.051024	-0.012235	0.130269
	(0.14389)	(0.39710)	(0.05911)	(0.15864)	(0.18500)
	[1.77580]	[0.01017]	[0.86323]	[-0.07713]	[0.70414]
D(LNCPI(-3))	0.309740	-0.515868	-0.022861	0.135296	-0.071733
	(0.11713)	(0.32325)	(0.04812)	(0.12914)	(0.15060)
	[2.64434]	[-1.59587]	[-0.47513]	[1.04768]	[-0.47632]
D(LNCPI(-4))	0.306410	-0.782511	0.084271	0.157511	-0.195795
	(0.10395)	(0.28687)	(0.04270)	(0.11460)	(0.13365)
	[2.94767]	[-2.72776]	[1.97354]	[1.37439]	[-1.46498]
D(LNIMPP(-1))	-0.091047	-0.192170	0.013409	0.058922	0.072539
	(0.06231)	(0.17195)	(0.02560)	(0.06870)	(0.08011)
	[-1.46122]	[-1.11757]	[0.52390]	[0.85773]	[0.90547]
D(LNIMPP(-2))	0.070380	0.105688	-0.004397	0.026480	0.205215
	(0.06249)	(0.17246)	(0.02567)	(0.06890)	(0.08035)
	[1.12621]	[0.61282]	[-0.17128]	[0.38434]	[2.55405]
D(LNIMPP(-3))	0.000659	0.069848	0.017997	-0.034067	0.048946
	(0.05349)	(0.14762)	(0.02197)	(0.05897)	(0.06877)
	[0.01232]	[0.47318]	[0.81905]	[-0.57768]	[0.71170]
D(LNIMPP(-4))	0.072502	-0.180023	-0.009466	0.011748	0.057141
	(0.04989)	(0.13767)	(0.02049)	(0.05500)	(0.06414)
	[1.45334]	[-1.30763]	[-0.46195]	[0.21360]	[0.89089]

D(LNMS(-1))	-0.216764	-0.636551	-0.027427	-0.208117	-0.069417
	(0.36456)	(1.00608)	(0.14975)	(0.40193)	(0.46873)
	[-0.59459]	[-0.63270]	[-0.18315]	[-0.51780]	[-0.14810]
D(LNMS(-2))	-0.105638	0.533199	-0.527479	0.184612	-0.063335
	(0.31766)	(0.87663)	(0.13049)	(0.35021)	(0.40842)
	[-0.33255]	[0.60824]	[-4.04242]	[0.52714]	[-0.15507]
D(LNMS(-3))	-0.591691	1.226059	0.133201	-0.112737	0.220427
	(0.34005)	(0.93842)	(0.13968)	(0.37490)	(0.43720)
	[-1.74004]	[1.30651]	[0.95359]	[-0.30071]	[0.50417]
D(LNMS(-4))	-0.519440	0.784161	0.307380	0.455655	0.194093
	(0.33927)	(0.93627)	(0.13936)	(0.37404)	(0.43620)
	[-1.53107]	[0.83753]	[2.20560]	[1.21820]	[0.44496]
D(LNNEER(-1))	0.016557	-0.005338	0.168960	0.400212	0.149042
	(0.13831)	(0.38170)	(0.05682)	(0.15249)	(0.17783)
	[0.11970]	[-0.01399]	[2.97379]	[2.62451]	[0.83810]
D(LNNEER(-2))	-0.288027	0.507970	0.224379	-0.115584	-0.125878
	(0.16464)	(0.45436)	(0.06763)	(0.18152)	(0.21168)
	[-1.74943]	[1.11799]	[3.31770]	[-0.63677]	[-0.59465]
D(LNNEER(-3))	-0.113663	0.715127	-0.209275	0.018074	0.170274
	(0.19067)	(0.52620)	(0.07832)	(0.21021)	(0.24515)
	[-0.59612]	[1.35905]	[-2.67192]	[0.08598]	[0.69457]
D(LNNEER(-4))	-0.202685	-0.741580	-0.060768	-0.011740	-0.007829
	(0.20527)	(0.56649)	(0.08432)	(0.22631)	(0.26393)
	[-0.98738]	[-1.30907]	[-0.72067]	[-0.05187]	[-0.02966]

D(LNWCPI(-1))	-0.086904	0.211724	-0.134340	0.135242	0.406107
	(0.12871)	(0.35520)	(0.05287)	(0.14190)	(0.16549)
	[-0.67519]	[0.59607]	[-2.54089]	[0.95307]	[2.45404]
D(LNWCPI(-2))	0.250356	0.330924	0.144016	-0.354198	-0.258712
	(0.14476)	(0.39951)	(0.05947)	(0.15960)	(0.18613)
	[1.72940]	[0.82833]	[2.42182]	[-2.21926]	[-1.38998]
D(LNWCPI(-3))	-0.023749	0.785931	-0.121846	0.003599	-0.126839
	(0.15759)	(0.43490)	(0.06474)	(0.17374)	(0.20262)
	[-0.15070]	[1.80713]	[-1.88223]	[0.02071]	[-0.62600]
D(LNWCPI(-4))	-0.254285	-0.320339	0.095445	-0.059718	-0.143451
	(0.14781)	(0.40791)	(0.06072)	(0.16296)	(0.19004)
	[-1.72037]	[-0.78533]	[1.57198]	[-0.36646]	[-0.75485]
C	0.084692	0.002759	0.059104	-0.037629	-0.024936
	(0.05053)	(0.13946)	(0.02076)	(0.05571)	(0.06497)
	[1.67596]	[0.01978]	[2.84729]	[-0.67541]	[-0.38380]
R-squared	0.681361	0.516417	0.817714	0.378238	0.456562
Adj. R-squared	0.522042	0.274626	0.726571	0.067357	0.184842
Sum sq. resids	0.199186	1.516987	0.033610	0.242110	0.329270
S.E. equation	0.068866	0.190049	0.028289	0.075924	0.088542
F-statistic	4.276705	2.135797	8.971762	1.216664	1.680270
Log likelihood	93.90465	28.93695	150.8455	87.65987	77.82028
Akaike AIC	-2.247020	-0.216780	-4.026423	-2.051871	-1.744384
Schwarz SC	-1.504904	0.525336	-3.284307	-1.309755	-1.002268
Mean dependent	0.040903	0.028091	0.058775	-0.003381	0.010630
S.D. dependent	0.099612	0.223144	0.054099	0.078618	0.098069

Appendix 6: *Impulse response*



Appendix 6: V*ariance Decomposition*

Variance Decomposition of LNCPI:

Period	S.E.	LNCPI	LNMS	LNIMP	LNNEER	LNWCPI
1	0.070361	79.94582	2.176345	13.91041	3.902459	0.064967
2	0.091715	66.39092	3.855177	17.35137	10.05869	2.343837
3	0.127412	40.16088	7.447701	25.15694	6.101380	21.13311
4	0.152969	36.27076	6.326236	26.33846	6.775076	24.28947
5	0.188642	30.38484	7.206419	31.71698	6.704357	23.98741
6	0.204452	25.87554	11.44424	29.62375	7.310373	25.74609
7	0.219355	22.48188	14.37126	27.86319	6.468845	28.81482
8	0.227560	20.89320	14.51955	27.46555	7.852907	29.26880
9	0.229777	20.73772	15.43271	27.05737	7.760295	29.01191
10	0.232896	20.73516	16.85683	26.35038	7.805741	28.25189
11	0.234419	20.47761	17.17595	26.00974	8.433166	27.90352
12	0.234482	20.47918	17.16852	25.99768	8.446869	27.90775

Variance Decomposition of LNIMPP:

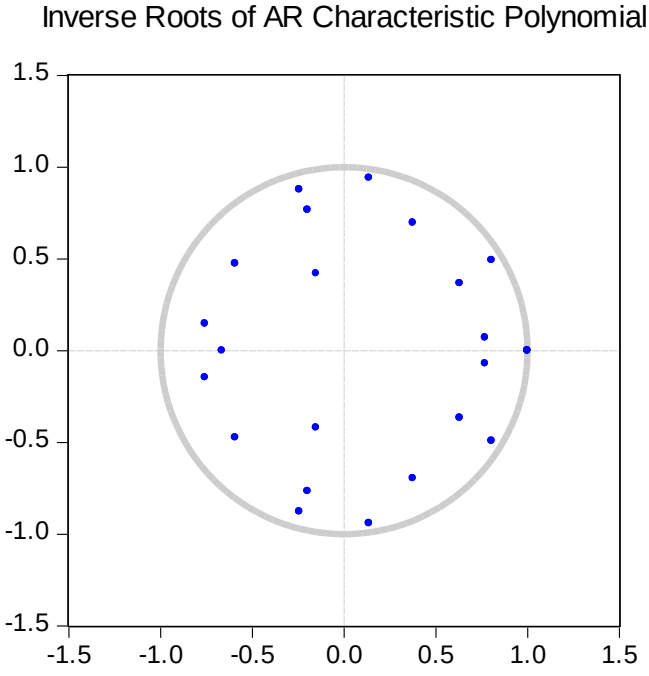
Period	S.E.	LNCPI	LNMS	LNIMP	LNNEER	LNWCPI
1	0.029282	0.000000	2.287340	70.04317	3.739901	23.92959
2	0.038468	0.972123	2.711638	69.21043	3.861478	23.24433
3	0.051316	3.327501	4.904838	61.48358	4.284700	25.99938
4	0.056353	2.810054	10.18960	45.76860	5.908578	35.32317
5	0.067450	2.746207	14.19555	41.69368	5.232006	36.13256
6	0.075351	3.507858	14.35647	42.77072	5.925968	33.43899
7	0.086669	4.548761	14.40560	41.67354	6.979552	32.39255
8	0.093581	4.312671	13.79824	37.69114	13.43983	30.75812
9	0.100186	4.667919	13.13911	35.99049	16.67404	29.52845
10	0.106966	5.581410	13.42672	34.81651	16.16949	30.00587
11	0.113466	6.009283	13.32421	34.95318	15.91568	29.79765
12	0.116511	5.983943	13.50300	34.98669	15.90768	29.61868

Variance Decomposition of LNMS:

Period	S.E.	LNCPI	LNMS	LNIMP	LNNEER	LNWCPI
1	0.193187	0.000000	83.00819	0.000000	7.228863	9.762949
2	0.202051	0.367787	80.93481	4.793191	6.893437	7.010778
3	0.234377	0.293780	46.73110	4.656799	35.48647	12.83185
4	0.285719	0.906411	40.69724	6.678529	35.49429	16.22353
5	0.304010	2.421656	46.74585	10.19518	28.84213	11.79518
6	0.317246	2.737444	51.10191	11.64247	23.20098	11.31719
7	0.324524	2.682567	42.68704	12.30349	22.16768	20.15922
8	0.341260	3.420477	39.32243	14.76260	19.05774	23.43675
9	0.349769	4.174544	40.27046	17.25822	17.54385	20.75293
10	0.355767	4.146945	42.60542	18.03336	15.87079	19.34348
11	0.359191	3.842155	41.95696	17.35348	15.33250	21.51490
12	0.360343	3.856279	41.26562	18.07860	14.56922	22.23029

Appendix 6: Diagnostic test

1. Stability test



2. Test for Residual Autocorrelation

VEC Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h
Date: 05/07/23 Time: 12:17
Sample: 2005Q1 2022Q1
Included observations: 64

Lags	LM-Stat	Prob
1	20.88267	0.6991
2	23.86904	0.5270

Probs from chi-square with 25 df.

3. Test for Residual Normality

Component	Jarque-Bera	df	Prob.
1	23.26199	2	0.0000
2	3.320625	2	0.1901
3	3.634511	2	0.1625
4	111.9397	2	0.0000
5	2.741519	2	0.2539
Joint	144.8984	10	0.0000

4. Test for Residual Heteroskedasticity

VAR Residual Heteroscedasticity Tests: No Cross Terms (only levels and squares)

Joint test:

Chi-sq	df	Prob.
604.6748	630	0.7594