

EXCHANGE RATE PASS-THROUGH TO DOMESTIC PRICES IN KENYA

SUSAN

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Thesis submitted in partial fulfilment of the requirements for the degree of

MASTER OF COMMERCE (FINANCIAL MARKETS)

Department of Economics and Economic History

Rhodes University, Grahamstown

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February 2011

DECLARATION

Except for references specifically indicated in the text, and such help as has been acknowledged, this thesis is wholly my own work and has not been submitted to any other University, Technikon or College for degree purpose.

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ABSTRACT

In 1993, Kenya liberalised its trade policy and allowed the Kenyan Shillings to freely float. This openness has left Kenya's domestic prices vulnerable to the effects of exchange rate fluctuations. One of the objectives of the Central Bank of Kenya is to maintain inflation levels at sustainable levels. Thus it has become necessary to determine the influence that exchange rate changes have on domestic prices given that one of the major determinants of inflation is exchange rate movements. For this reason, this thesis examines the magnitude and speed of exchange rate pass-through (ERPT) to domestic prices in Kenya. In addition, it takes into account the direction and size of changes in the exchange rates to determine whether the exchange rate fluctuations are symmetric or asymmetric. The thesis uses quarterly data ranging from 1993:Q1 – 2008:Q4 as it takes into account the period when the process of liberalization occurred. The empirical estimation was done in two stages. The first stage was estimated using the Johansen (1991) and (1995) cointegration techniques and a vector error correction model (VECM). The second stage entailed estimating the impulse response and variance decomposition functions as well as conducting block exogeneity Wald tests. In determining the asymmetric aspect of the analysis, the study followed Pollard and Coughlin (2004) and Webber (2000) frameworks in analysing asymmetry with respect to appreciation and depreciation and large and small changes in the exchange rate to import prices. The results obtained showed that ERPT to Kenya is incomplete but relatively low at about 36 percent in the long run. In terms of asymmetry, the results showed that ERPT is found to be higher in periods of appreciation than depreciation. This is in support of market share and binding quantity constraints theory. In relation to size changes, the results show that size changes have no significant impact on ERPT in Kenya.

ACKNOWLEDGEMENTS

First and foremost I would like to thank my Lord and personal saviour Jesus Christ for without him all this would not have been possible. I really can do everything through Him who gives me strength.

Secondly I would like to express my sincerely love and gratitude to my family, particularly parents who provided support financially, emotionally and spiritually. Thank you for investing in my future and spurring me on to achieve greatness in my life. To my brothers and sister, thank you for believing in me.

Thirdly, all this would not have been possible if was not for the guidance and support of my supervisor Prof. Meshach Aziakpono. Thank you for the many sacrifices that were made in terms of your time, patience and effort in helping me complete this thesis.

Lastly I express my deepest gratitude to my Church, River of Life, my friends and colleagues. All of you made these two years one of the most incredible years of my life. Thank you for all the encouragement and support in completing this thesis. I will hold dear all the laughs, advice and memories shared.

However, I alone remain responsible for all the errors, omissions and interpretation of the findings of this study.

I can do all things through Christ who strengthens me.....Phil 4:13

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CHAPTER 1:

INTRODUCTION

1.1 Context of the Research

High inflation levels in many developing countries have been a cause of concern to their central banks. This has led to the adoption of monetary policy frameworks such as inflation targeting to help lower inflation to more sustainable levels. The determinants of inflation are important factors to consider when looking at the different monetary policy frameworks to adopt. One of the major determinants of inflation is exchange rate movements and the degree of sensitivity of domestic prices to these movements. Formally, this is known as exchange rate pass-through (ERPT). Akofio-Sowah (2009: 296) defines it as the percentage change in the local currency import prices resulting from a one percent change in the exchange rate between the importing and the exporting country. When import prices respond fully to exchange rate movements, that is, at a hundred percent level, pass through is said to be complete. However if there is a less than hundred percent response of prices, it means that pass through is incomplete.

A number of authors (e.g. Devereux and Yetman, 2008; Choudhri and Hakura, 2006; Mwase, 2006) discovered that there is a positive relationship between exchange rate movements and the level of inflation in a country. This finding has great influence in the determination of monetary policy because it implies that fluctuations in the exchange rate could have a major impact on inflation especially when the country has a floating exchange rate policy and an open trade policy (Campa and Goldberg 2005: 3). Kenya, which is yet to adopt an inflation targeting regime, is battling with its double digit inflation rate. In addition, Kenya exchange rate policy has undergone various regime shifts over the years.

Ndung'u (2000:2) explains that the shifts were driven by economic events especially the balance of payment crisis in the 70's. In the 1960's and the early 1970's, a fixed exchange rate was maintained. This was changed in 1974 when the Kenyan Shilling was pegged to the

US dollar and after a number of discrete devaluations the peg was changed from the US dollar to the special drawing right (SDR). In general the rate depreciated by 14 percent and depreciated even further in the year 1981 and 1982. The exchange rate regime was changed to a crawling peg in real terms at the end of 1982. This regime prevailed until 1990.

In 1990 a dual exchange rate system was then adopted that lasted until October 1993, when due to further devaluations the official exchange rate was matched with the interbank rate and the shilling was allowed to float. This was preceded with the abolition of all controls in imports and foreign exchange transactions. The Liberalization stimulated foreign demand and brought about an increase in foreign exchange proceeds from exports (Ndung'u, 2000:2). Though the liberalization has brought about positive effects on Kenyan trade, it has left the country vulnerable to the effects of exchange rate variability on import, producer and consumer prices.

The theoretical literature on ERPT suggests reasons why changes in exchange rate could affect import, producer and consumer prices. According to Khundrakpam (2007:5) these include trade distortions, volatility of exchange rate, and the share of imports in the consumption basket and the composition of the imports in the domestic economy. These factors affect the magnitude and speed at which exchange rate movements are passed through to domestic prices.

A number of studies (Karoro et al, 2009; Khundrakpam, 2007; Pollard and Coughlin, 2004; Webber, 2000; Knetter, 1994) have not only focused on the degree of pass through i.e. whether complete or partial but also to the response of prices to the direction and size of exchange rate changes. This is referred to as asymmetric or nonlinear price adjustment (Pollard and Coughlin, 2004:2). As noted by Pollard and Coughlin (2004:3) there is a tendency for prices to rise faster when the exchange rate depreciates than they fall when it appreciates. On average the immediate effect on prices of an increase in input costs is at least twice as large as the effect of a decline in input costs. In the context of ERPT, there are various circumstances that could generate asymmetry. Aspects such as, binding quantity constraints, market share objective, production switching, and menu costs are taken into consideration (Khundrakpam 2007:3).

Binding quantity constraints is concerned with the limitation of foreign firms to increase sales in the importing country due to capacity constraints that they face in their distribution network (Knetter, 1994:2). This could also occur when trade restrictions are imposed. Khundrakpam (2007: 3) explains that asymmetric pass-through in the binding quantity constraint model is higher when the importing country's currency is depreciating than when it is appreciating.

A different asymmetric response occurs when the exporting firms have based their strategy on building a market share in their export markets. Pollard and Coughlin (2004:2) explain that an appreciation of the currency of the importing country might cause a higher pass-through than depreciation. This also occurs in the case of a production switching model where foreign firms can choose to purchase their inputs for production from overseas or domestically depending on the price. Thus when the importing country's currency appreciates, firms purchase their inputs domestically (Webber, 2000:2).

Besides, asymmetry with respect to the direction of changes i.e. whether appreciating or depreciating, asymmetry can also occur with respect to size – whether a change is large or small. The presence of menu costs and the type of price invoicing explains asymmetry with respect to the size of change in the exchange rate (Karoro et al, 2009:2). Menu costs are seen as costs that firms incur on their products especially when prices change in an economy. Khundrakpam (2007:3) explains that it will only be worthwhile for a firm to change its invoice price if the exchange rate change is above a certain threshold. This implies that firms allow their mark up to take up the effect of small fluctuations in the exchange rate by keeping its export prices constant. Pollard and Coughlin (2004:2) note however that with large changes in the exchange rate firms will adjust their policy and pass-through some of the change into their export prices.

The growing empirical research in the area of exchange rate pass-through and asymmetry has focused much on industrialized nations such as USA, Japan and other countries in the European region. (Al-Arbi and Goodwin, 2009; An, 2006; Marazzi and Sheets, 2006; Mumtaz et al, 2006; Campa and Goldberg, 2005; Marazzi et al 2005; Taylor, 2000). The

findings of these studies show that for the most part, pass-through is incomplete. An (2006) for example, carried out an empirical study using a vector auto regression method for eight major industrial countries namely Canada, Italy, UK, Finland, Sweden and Spain for the period 1976 to 2005. ERPT was found to be incomplete though complete pass-through was occasionally observed.

Other studies have focused on a vast array of countries to explore the degree of exchange rate pass-through and whether the inflationary environment matters (e.g. Akofio-Sowah, 2009; Devereux and Yetman, 2008; Ca'Zorzi et al, 2007; Choudhri and Hakura, 2006; Karim, 2005; Korhonen and Watchel, 2005). Studies such as one done by Choudhri and Hakura (2006) focused on the link between exchange rate pass-through and inflationary environment of 71 countries from 1971 to 2000. They found that though there has been a decline in the inflationary levels it was more predominant in developed countries and they exhibited low levels of pass through.

Although there is a vast array of literature around the world on ERPT there are still a limited number of papers that have exclusively focused on African countries, apart from those that have included certain African countries to analyze pass-through in the developing world (e.g. Bussiere and Peltonen, 2008; Devereux and Yetman, 2008; Juniour, 2007; Choudhri and Hakura, 2006; Barhoumi, 2006; Frankel et.al, 2005 and Korhonen and Wachtel, 2005). Some of the papers that have exclusively looked at an African country are for example Parsley (2010) and Karoro et al (2009) for South Africa, Mwase (2006) for Tanzania, Ogun (2000) for Nigeria and Atta et al (1999) for Botswana.

In East Africa, Mwase (2006) looked at exchange rate pass-through in Tanzania using structural vector auto regression for a period dating from 1990 to 2005. The paper found incomplete and decreasing exchange rate pass-through to inflation in Tanzania. In South Africa, Karoro et al (2009) did an empirical study that not only focused on exchange rate pass-through but also the presence of asymmetry in the country. The study used the Johansen maximum likelihood approach with data ranging from 1980 to 2005 and found that though the ERPT was incomplete, it was relatively high. They also found some evidence of

asymmetry in the direction of change in exchange rates with pass-through being greater when the currency depreciates than when it appreciates.

To date very few papers (e.g. Kiptui et al 2005) have focused on exchange rate pass-through in Kenya. However some studies (Devereux and Yetman, 2008; Choudhri and Hakura, 2006) have included Kenya among other countries that analysed exchange rate pass-through in developing countries. Both papers indicated that pass-through in Kenya is incomplete. Choudhri and Hakura (2006) in a time series study from 1979 to 2000 classified Kenya among the countries with a moderate inflation environment with the level of pass-through being 35 percent in four quarters. Devereux and Yetman (2008) also found pass-through in Kenya to be incomplete in the long run at a level of 53 percent.

Kiptui et al (2005) focused exclusively on Kenya and used the Johansen co-integration method to investigate the two stages within the direct transmission of exchange rate changes to domestic prices. Their results revealed that in the long-run, ERPT to import prices was 71 percent indicating incomplete pass-through. The short-run ERPT also reported incomplete pass-through with depreciations in the exchange rate positively affecting import prices. However, the study did not focus specifically on the asymmetric pass-through of exchange rates in Kenya.

Given the conflicting results of the level of pass-through in Kenya and given that not much empirical work has been done on Kenya, this thesis investigates exchange rate pass-through to domestic prices in terms of speed and magnitude of price changes. It also focuses on pass-through asymmetry in terms of direction and size of exchange rate changes to domestic prices in Kenya.

1.2 Goals of the Research

The aim of this study is to determine the degree of exchange rate pass-through to import, producer and consumer prices in Kenya. Specifically, the study will focus on the following key areas:

- To estimate the magnitude and speed of exchange rate pass-through to import prices in Kenya

- To determine whether ERPT is asymmetric with respect to the direction and size of change to import prices in Kenya
- To determine the channel of transmission of the effect of a change among the domestic prices – import, producer and consumer prices,
- Make policy recommendations

1.3 Methodology

For the empirical analysis of this study, the paper will estimate the size and speed of ERPT as well as analyse pass-through asymmetry in Kenya using quarterly data spanning 15 years (60 observations) from 1993:Q1 to 2008:Q4. The sources of data are from International Financial Statistics IFS and The World Bank African development indicators. The start date was chosen to be consistent with the period that the Kenyan Shilling was allowed to freely float and the end date was purely due to date availability for all the variables. The analysis into the speed and magnitude of ERPT was carried out in two stages. The first stage looked at the changes in the exchange rate that are transmitted to the prices of imported goods. The second stage looked at the pass-through of changes in the exchange rate to import prices, producer and consumer prices.

The first stage of the analysis which is based on the law of one price was used to determine the prices of imports by using the Johansen (1991) and (1995) cointegration approach and a vector error correction model (VECM) in order to estimate the long and short-run pass-through relationships. The cointegration method tests for long-run cointegrating relationships between the variables. After establishing the existence of the long-run relationships the VECM was estimated to test the short-run dynamics in the relationships between the variables.

The second stage was determined by analysing impulse response and variance decomposition functions, as well as block exogeneity Wald tests. The analysis proceeded further using the Pollard and Coughlin (2004) framework to estimate pass-through asymmetry with respect to appreciations and depreciations and also with respect to large and small changes in the exchange rate to import prices.

1.4 Organisation of the study

The study is organised in the follow sequence: Chapter Two reviews the empirical and theoretical literature on ERPT and pass-through asymmetry of exchange rate changes to prices. The chapter reviews the theory of ERPT and summarises the findings of various authors on the subject matter. This is done from the perspective of studies done on developed countries, developing countries and lastly for Kenya.

Chapter Three discusses the History of Kenya from a macroeconomic perspective and looks at the various exchange rate regimes that prevailed in Kenya in the past and what policies are in place presently. Specifically, the chapter looks at evolution of the various exchange rate regimes from 1970 to 1992 when the Kenyan Shilling was allowed to float freely. The chapter also looks at the structure and composition of Kenya's trade and the implications that this has on the rate at which changes in the exchange rate affect Kenya's domestic prices.

Chapter Four discusses the methodology and data used in this study. This chapter outlines in detail the econometric method and empirical framework that is adopted for this study. Chapter Five reports the findings and Chapter Six summarises the study and discusses the policy recommendations and areas for further research in this area.

CHAPTER 2:

THEORETICAL AND EMPIRICAL REVIEW OF EXCHANGE RATE PASS-THROUGH TO DOMESTIC PRICES

2.1 Introduction

This chapter reviews the theoretical and empirical literature on ERPT. Theoretically, it begins with the fundamental principles of ERPT by looking at its definition, channels of ERPT, either direct or indirect and the various determinants of ERPT. The principles of pass-through asymmetry are also discussed with respect to the aspects that generate asymmetry such as menu costs and binding quantity constraints. Empirically, the literature on ERPT is reviewed in three areas: ERPT in developed countries, ERPT in developing countries and in Kenya. The chapter concludes by reviewing the literature on the pass-through asymmetry of exchange rate changes to import prices.

2.2 Theoretical Literature

2.2.1 Defining exchange rate pass through

Over the past three decades there has been an increased interest to analyse the effects that exchange rate movements have on the domestic prices of a country and the implications that this will have on the policy making decisions that the central bank needs to make. This stems from the fact that high inflation levels of many developing countries have been a cause of concern to their central banks coupled with the fact that one of the major determinants of inflation is exchange rate movements and the degree of sensitivity that domestic prices have to these movements. This is particularly enhanced when a country has a floating exchange rate policy and an open trade policy (Campa and Goldberg 2005: 3)

Exchange rate pass-through (ERPT) as defined by Mumtaz et al (2006: 4) is the percentage change in local currency import prices following a one percentage change in the exchange rate between importing and exporting countries. According to Barhoumi (2005:3), ERPT can statistically be represented as the elasticity of import prices to a change in exchange rates. This relationship can be tested based on the following equation:

$$\Delta p_t = \gamma \Delta e_t + \varepsilon_t \quad (2.1)$$

Where p_t and e_t are the natural logarithm of import price and the nominal exchange rate and ε_t is an error term and γ is the exchange rate coefficient. The extent of the ERPT coefficient is based on the value of γ . According to Akofio-Sowah (2009:296) a one to one response of import prices to exchange rate variations is known as complete ERPT and by implication the value of $\gamma = 1$ whereas a less than a one to one response ($\gamma < 1$) is known as partial or incomplete ERPT.

The main theoretical basis for the existence of exchange rate pass-through as stated by Eckstein and Soffer (2008: 335) is the law of one price (LOOP) and purchasing power parity (PPP). An exchange rate change which is not followed by a local currency change in the price of goods would be regarded as divergence from the LOOP. Demand and supply mechanisms are expected to bring about the necessary change in local prices in order to bring foreign and domestic prices back to the same level. According to this assumption, exchange rate pass-through should be complete or close to 100% in the very long run if the economy is sufficiently open. However, most empirical studies (e.g. Al-Arbi and Goodwin, 2009; Bussiere and Peltonen, 2008; Devereux and Yetman, 2008; Junior, 2007; An, 2006; Barhoumi, 2006; Choudhri and Hakura, 2006; Marazzi and Sheets, 2006; Mumtaz et al, 2006; Campa and Goldberg, 2005; Frankel et.al, 2005; Marazzi et al, 2005 and Taylor, 2000) have found ERPT to be incomplete for most countries.

There are various reasons why ERPT has been found to be incomplete for most countries and declining in developing nations. In the next section the channels through which exchange rate movements can affect domestic prices and the various determinants of ERPT are discussed.

2.2.2 Channels and determinants of Exchange rate pass-through

There are two broad channels that exchange rate movements can affect domestic prices, these are direct and indirect channels. According to Hyde and Shah (2004:3), exchange rate movements can affect domestic prices directly through changes in the price of imported finished goods and imported inputs i.e. raw materials and capital goods. When the currency

of the domestic country appreciates, it will result in lower import prices of finished goods and inputs. Likewise, when the currency of the domestic currency depreciates it will result in higher import prices which are more likely to be passed on to consumer prices. Currency depreciation also causes an increase in imported inputs which may result in producers increasing their marginal costs thus leading to higher prices of domestically produced goods.

The indirect channel of ERPT as explained by Hübner and Schröder (2002:2) refers to the competitiveness of goods on the international market. Generally, when the exchange rate of the domestic country depreciates, the prices of the domestic products decrease making them relatively cheaper to foreign buyers. This will induce an increase in the volume of exports and an increase in aggregate demand. This will result in an increase of domestic prices. However, as stated by Hyder and Shah (2004:3), the speed and magnitude of how these exchange rate movements affect domestic prices are determined by a number of factors.

Generally exchange rate movements affect domestic prices in three major areas, import prices, consumer prices and producer prices. According to Akofio-Sowah (2009:303) these effects are dependent on factors such as market structure, export partner's production costs, pricing behaviour of firms, as well as factors such as inflation persistence on prices, size of the economy, exchange rate volatility, size of public debt, share of imports and the composition of imports in a country and the degree of trade openness in a country.

Among the factors that determine the extent of ERPT is the size of the export market and the degree of competition the exporter faces in that market. According to Knetter (1994:2), if the export market for the product is large, then exporting firms are often willing to absorb a proportion of the exchange rate change so as not to lose market share. This is particularly so if the industry is highly competitive. However this is usually done when firms view the shocks as transitory. On the other hand, if the industry is highly differentiated and exporters do not face much competition for their products, then exporter prices may be somewhat less responsive to exchange rate changes. In this case, pricing-to-market will be lower and the corresponding pass-through will be higher.

The pricing behaviour of firms is also another factor that influences exchange rate changes onto prices. According to Al-Abri and Goodwin (2009 :144), when exporting firms have a higher market share in an industry they are more likely to set their prices in their own currency, thus causing pass-through to be higher (i.e. closer to one). This is known as producer-currency pricing (PCP). However, when the imports are denominated in the currency of the imported country, pass through is expected to be less (i.e. close to zero). This is known as local currency pricing (LCP).

In exploring other determinants of ERPT, Taylor (2000) put forward the hypothesis that the responsiveness of prices to exchange rate fluctuations depends positively on inflation. The theoretical basis for this is the fact that there is a positive correlation between the level and persistence of inflation, coupled with a link between inflation persistence and pass-through. In other words, the more persistent inflation is, the less exchange rate movements are seen to be transitory and thus firms might respond via price-adjustments. Various studies across the board (e.g. Devereux and Yetman, 2008; Choudhri and Hakura, 2006; Mwase, 2006; Campa and Goldberg, 2005) appear overall supportive of the Taylor hypothesis. This hypothesis is reflected to a greater degree in developing economies than in developed economies. This is due to the fact that developing economies have higher rates of inflation, with some countries battling with double digit rates.

Another important determinant of ERPT is the degree of trade openness of a country. According to Ca'zozzi et al (2007: 7), the more a country is open the more movements in exchange rates are transmitted via import prices into CPI changes. In other words the larger the volume of imports and exports the greater the degree of ERPT through the direct and indirect channels of EPRT. Contrastingly, the presence of tariffs and quantitative restrictions act as a barrier to arbitrage of goods between countries which leads to lower levels of pass-through.

An Important aspect that could also have an influence in the degree to which exchange rate movements are passed on to domestic prices are the share of imports in the consumption basket of a country. According to Khundrakpam (2007:5), the larger the share of imports in the consumption basket the greater the proportion of imported inputs in production and the

greater the impact of the exchange rate on producer prices which will eventually be passed onto consumer prices.

Alongside the aspect of the share of imports in the consumption basket is the issue of the composition of the imports in the consumption basket. This is due to the fact that degree of pass-through according to Khundrapam (2007:5) differs depending on the category of imports being considered. For example, pass-through to manufactured products is found to be less as compared to energy and raw materials.

Another important determinant of ERPT is exchange rate volatility. According to Akofio-Sowah (2009: 303), the effect of exchange rate volatility on pass-through is dependent on whether the effects are expected to be transitory or permanent. If transitory firms would rather adjust their profit margins rather than change prices, thus pass-through is minimised. However if the effects are viewed as permanent then prices would be changed resulting in exchange rate movements affecting prices to a greater degree.

All these factors discussed above reflect the importance of EPRT study, particularly in countries such as Kenya, which have a floating exchange rate policy, open trade policy coupled with the fact that it is battling with double digit inflation rates, all of which will affect to some degree the magnitude and speed to which exchange rate movements are passed through to domestic prices.

The floating exchange rate policy indicates that the Kenyan Shilling is volatile. As discussed above, this would imply that depending on whether the effect is permanent or transitory, this would have an impact on domestic prices. Likewise, the open trade policy implies that many of Kenya's trade barriers have been removed which results in a greater volume of imports and exports into and out of the country which could result in an increase of EPRT to domestic prices in Kenya. These factors however will be discussed in greater detail in chapter three which explores the overview of the country in regard to the determinants discussed above. This will bring greater insight to the importance of the study of ERPT in Kenya.

In this section we have discussed the factors that affect the magnitude and speed at which exchange rate movements are passed through to domestic prices, and have assumed that prices react in the same way to big and small changes. In the next section, pass-through will be discussed when prices do not react in the same way to big and small changes. In other words there is a nonlinear price adjustment.

2.2.3 Exchange rate pass-Through Asymmetry

Asymmetric pass-through deals with the response of prices to the direction and size of exchange rate. It is also known as nonlinear price adjustment. According to Przystupa and Wróbel (2009:5) linear responses mean that prices react in the same way to big and small changes in the exchange rate and many papers (e.g. Akofio –Sowah, 2009; Barhoumi 2006; Coricelli et al 2006; Korhonen and Watchel, 2006) rather assumed linearity than tested it. If there is the presence of pass-through asymmetry in a country, the pass-through would depend upon the period of appreciation and depreciation and the size of exchange rate change during the varying sub periods (Khundrakpam 2007:5).

As noted by Pollard and Coughlin (2004:2) there is a tendency for prices to rise faster than they fall and on average the immediate effect on prices of an increase in input costs is at least twice as large as the effect of a decline in input costs. In the context of exchange rate pass-through there are various circumstances that could generate asymmetry. These include, binding quantity constraints, market share objective, production switching, and menu costs (Khundrakpam 2007:4).

Binding quantity constraints is concerned with the limitation of foreign firms to increase sales in the importing country due to capacity constraints that they face in their distribution network (Khundrakpam, 2007:3). In the case where there is an appreciation of the importing country's currency, firms are unable to expand their sales through the lowering of import prices due to capacity constraints. Firms instead raise their mark-ups to keep import prices in the importing country's currency fixed thus they keep their sales volume at the same level while raising the profit margin. On the other hand capacity constraints do not affect the raising of import prices in the case of depreciation of the importing country's currency (Khundrakpam, 2007:4). This implies that pass-through is higher for depreciation than

appreciation. Knetter, (1994:56) notes that binding capacity constraints could also occur when trade restrictions are imposed.

A different asymmetric response occurs when the exporting firms have based their strategy on building a market share in their export markets. Pollard and Coughlin (2004:2) explain that an appreciation of the currency of the importing country might cause a higher pass-through than depreciation. This occurs because during currency depreciation exporting firms may offset the potential increase in price by reducing their mark-up. With an appreciation they maintain their mark-ups and allow their import price to fall. In the case of production switching foreign firms can choose to purchase its inputs for production from overseas or domestically depending on the price. Webber (2000:3) notes that this is done especially when the importing country's currency appreciates, thus causes the firms to purchase their inputs domestically. This implies that the extent of pass-through will depend on the elasticity of the mark-up. In the case of depreciation, no pass-through occurs because foreign firms use inputs from the country with the depreciating currency.

The previous factors have focused on asymmetry with respect to the direction of change i.e. whether appreciating or depreciating. The presence of menu costs and the type of price invoicing explains asymmetry with respect to the size of change in the exchange rate (Karoro et.al, 2009:381). Khundrakpam (2007:4) explains that it will only be worthwhile for a firm to change its invoice price if the exchange rate change is above a certain threshold. This implies that firms allow their mark up to take up the effect of small fluctuations in the exchange rate by keeping its export prices constant. Pollard and Coughlin (2004) note, however, that with large changes in the exchange rate firms will adjust their policy and pass-through some of the change into their export prices.

2.3 Empirical Literature

The theory on ERPT has been tested empirically by various authors to verify the validity of the theoretical propositions that have been put forth. The studies have focused on investigating the degree of ERPT to import, producer and consumer prices. Other studies have gone further to look at the response of prices to the direction and size of exchange rate changes i.e. asymmetric or nonlinear price adjustment. Generally, authors have used various

methodologies with times series or panel data to analyse ERPT on a macro scale for a particular country or region. Alternatively authors on a micro scale have focused on a specific sector¹ or product² in the economy in order to emphasize the role of the exporting firms' price setting behaviours.

A large body of empirical literature has focused on developed nations (e.g. Yoshida, 2010; Al-Arbi and Goodwin, 2009; Campa and Minguez, 2006; Coeicelli et.al, 2006; An, 2006; Campa and Goldberg, 2005; Choudhri et.al, 2005; Pollard and Coughlin, 2004 and Feenstra and Kendall, 1997) other studies have focused on developing nations (e.g. Frimpong, 2010; Akofio-Sowah, 2009; Karoro et al, 2009; Ca'zorzi et al, 2007; Barhoumi, 2006; Mwase, 2006 and Bhundia, 2002) though the latter has a less body in comparison to developed nations, particularly studies focusing on Africa.

Existing empirical evidence on ERPT has generally indicated that there has been a downward decline in the degree of pass through over time. According to Al-Abri and Goodwin (2007: 143), most studies that have focused on developed countries have found that the degree of ERPT to aggregate import prices to be 50% or less, despite the growing trend of trade and economic integration, however this is less so in the case for developing nations.

The following section reviews empirical studies for various countries in three categories: developed countries, developing and emerging countries, putting a specific emphasis on African countries and then finally reviewing studies done in Kenya. The section will also look at empirical evidence on ERPT asymmetry. A summary table has been included at the end of the chapter which highlights data, methodology and findings of some of the literature reviewed in this section.

¹ Kadiyali (1997) used a structural econometric framework to study interacting effects of market structures and pricing strategies in the US photographic industry.

² Gross and Schmitt (2000) did an empirical investigation of ERPT to test Oligopolistic rivalry among source producers in the case of imported automobiles in Switzerland.

2.3.1 Literature from developed countries

In looking at the degree of ERPT, one of the empirical studies done on developed nations is the paper by Feenstra and Kendall (1997). They developed and tested two hypotheses about purchasing power parity (PPP) using quarterly data from 1974:Q1 to 1994: Q4 for US, Canada, Germany, Japan and the UK. The first hypothesis is based on the premise that changes in the price of traded goods relative to domestic substitutes will affect the PPP relation due to partial ERPT. The second hypothesis explains that PPP should hold forward rather than spot exchange rates due to the hedging done by firms, which implies that the interest rate differential should enter the PPP relation for spot rates. A cointegrated vector auto regression model was used and the results show that both hypotheses were supported however the latter less so. The weighted average of imports relative to domestic prices was found to be significantly correlated with exchange rate movements to a degree of about a third or more of the observed deviations from PPP. However the interest rate differential though a significant variable, did not explain a considerable portion of the deviations from PPP.

Campa and Goldberg (2005), provide cross-country, time series and industry specific evidence of ERPT to import prices for 23 OECD countries with quarterly data ranging from 1975-2003. The Variables include: local country import prices, money supply, effective exchange rate indices and inflation rate. In the findings the study showed on a cross-country average, import prices in local currencies reflect 46% of exchange rate fluctuations in the short run, and nearly 65% over the long run. By contrast, exchange rate pass-through into U.S. import prices is approximately 23% in the short run and 42% over the long run. In general they found incomplete pass-through for OECD countries and that the composition of imports to be more significant in explaining the behaviour of pass-through than inflation and exchange rate volatility.

Choudhri et al (2005) focused on six non US G7 countries, namely: Canada, France, Germany, Italy, Japan and the UK with an aim at examining a variety of new open economy macroeconomic models to explaining ERPT in a wide range of prices. The study spanned from 1979 to 2003 using quarterly data and was based on the methodology of local currency pricing (LCP) and producer currency pricing (PCP) models and comparing the responses of

each model using an impulse response analysis in a Vector autoregressive model framework. The results revealed that ERPT to consumer prices and wages are low in the short run and that pass-through to export and import prices are larger but incomplete in the short run. The models based on LCP are able to predict responses of domestic prices and wages well and an LCP model with distribution costs provides better overall fit for VAR data. In general however, both LCP and PCP models had problems in matching the responses of import and export prices.

Coricelli, et al (2006) focused on four new EU member countries Czech Republic, Hungary, Poland and Slovenia. The purpose of their study was to assess the effect of the Euro and effectively exchange rate pass-through to domestic inflation given their exchange rate regimes of floating and managed floating exchange rate regimes. The study spanned from 1993-2002 using monthly data and analyzed using a cointegrated vector auto-regression model. The empirical results indicate high pass-through coefficients especially for Slovenia and Hungary. Smaller impacts were found for Poland (80%) and the lowest was for the Czech Republic with 46%. The differences in results were attributed to the different degrees of monetary policy accommodations and it was concluded that different exchange rate regimes have a fundamental impact on domestic inflation through differences in ERPT.

Mumtaz, et al (2005) estimate the exchange rate pass-through into UK import prices, where these prices are measured for 57 Industries. Quarterly data from 1984: Q1 to 2004: Q1 was used. They found that ERPT is incomplete and varies in most industries. Aggregation bias due to heterogeneity of products was negligible in their study. They found a significant decline of ERPT over time especially from 1995 onwards. The authors explain that this is due to the stable macroeconomic environment in UK rather than changes in import bundles.

An (2006), provided cross-country and time series evidence for 8 industrial countries on the extent of ERPT at different stages of distribution- import, producer and consumer prices. The study is based on a vector auto regressive (VAR) model for a period ranging from 1976:Q1 to 2005:Q3. The results found incomplete ERPT in many horizons, though complete pass-through was occasionally observed such as import price for Canada on three horizons. The study found that greater degrees of ERPT are associated with economies that are smaller in

size with higher import shares, more persistent and less volatile exchange rates, more volatile monetary shocks, high inflation rate and less volatile GDP.

Marazzi and Sheets (2007) recently did a study where they provide a detailed analysis of ERPT to U.S. import prices across different categories with various bilateral trade partners. It spanned over three decades from 1972: Q4 to 2004: Q4. The results indicate a significant and sustained decline in ERPT from above 0.5 through the 1970's and 1980's to approximately 0.2 in the last decade. This decline was attributed to a number of factors. The first was one that is supported by Campa and Goldberg (2004) that the decline is due to the shift in the composition of imports that are less sensitive to exchange rate movements. Secondly, the authors explain that over the past years foreign exporters have set their prices consistent with either pricing to market or LCP, keeping a close eye on the U.S. domestic prices. And lastly the decline has been attributed to larger increases in China's market share and reduced the share of material-intensive goods in the U.S. imports.

Shambaugh (2008) followed a different approach to the conventional analysis of the correlation of exchange rate and prices. He rather identifies fundamental shocks to the economy and tests their effects on exchange rates, consumer prices and import prices. Using quarterly data from 1973:Q1 to 1999:Q4 for 16 countries an open model economy was used and restrictions set on the long run behaviour of variables to identify the shocks and thus test the variance decomposition of the variables and the impulse response to the shocks. The results obtained revealed that pass-through varies by shock. For example, supply shocks results in lower prices and appreciation of exchange rates. The measure of the import price pass-through ratio does not vary substantially across shocks, however, the supply, demand and nominal shocks all change import prices and exchange rates in the same direction with pass-through ratios (change of prices divided by changes of exchange rates) of roughly one. Consumer price pass-through is almost complete in response to some shocks but low in response to others.

The previous studies have focused on a macroeconomic scale level. However other studies have focused on a micro scale by focusing on specific industries within the countries or across a number of countries. Such is the study done by Al-Abri and Goodwin (2009) who

did a study on 5 industries in 16 OECD countries using quarterly data from 1975:Q1 to 2002:Q2. The study focuses on ERPT to import prices at both aggregate and sectoral levels using a threshold vector cointegration regression method that takes into account nonlinear adjustments by observing the relative size and sign of changes in the nominal exchange rate that affect the long run equilibrium relationship of import prices and nominal exchange rates. The results obtained reveal that the degree of pass-through improves dramatically from the 50% average documented in literature. Within the industries, energy, food and raw materials contribute to high levels of pass-through while the manufacturing sector has the lowest. There are also significant cross country difference in terms of ERPT to import prices with UK, USA and Italy having the lowest levels of pass-through.

Finally, Yoshida (2010), focuses on a more disaggregate level by investigating ERPT of Japanese exports at port-level to see whether ERPT is homogenous across local regions within an exporting country. The empirical analysis was based on panel data regression framework using monthly data ranging from January 1988 to December 2005. The results reveal that export prices are set differently among Japanese local ports and that price responsiveness differs across local ports even when the sample products are from one particular industry. From the authors point of view this seems to reflect that firms choose different regions for their differentiated products and quality models.

2.3.2 Emerging and developing countries (outside Africa and within Africa)

The empirical literature originally focused on the major developed economies but more recent work has examined developing economies, including the transition economies. Recently, there is a growing ERPT literature applied to emerging market economies at an aggregate level, including cross-country comparisons, as in Barhoumi (2006), Choudhri, Faruquee, and Hakura (2005), Choudhri and Hakura (2006), Ca' Zorzi et al. (2007) and Ghosh and Rajan (2007). An important finding of this recent literature is that ERPT can also be incomplete in developing countries, although generally it is higher on the import side and lower on the export side, compared to developed countries. Furthermore there has been an observed decline in pass through in developing countries which began to be observed in the early nineties.

Frankel, et al (2005) examined ERPT into import prices of eight selected narrowly defined brand commodities in 76 developing countries, with an aim to examine the reported decline in pass-through in developing countries and possible explanation. Panel annual data from 1990-2001 was used. They reported a downward trend in ERPT as in developed markets as well as decline in pass-through, which was much more rapid for developing countries than high-income countries. They found that per capita income, bilateral distance, tariffs, country size, wages, long-term exchange rate variability and long-term inflation are important determinants of pass-through. They also noted that smaller countries, countries with a higher presence of foreign firms and less developed countries generally tend to have higher pass-through of exchange rates on to prices

Barhoumi (2006) did a study on 24 developing countries with the aim of contributing to the empirical analysis of ERPT to import prices in developing countries and to explain the differential impact that a change in exchange rates has on import prices in the long run. The study used annual data ranging from 1980 to 2003. The focus was on three macroeconomic determinants namely nominal effective exchange rate volatility proxied by exchange rate regimes, country's openness proxied by tariff barriers and inflation proxied by inflation regimes. These were the basis for the groupings that the 24 countries were placed in. The results obtained were that countries with fixed exchange rate regimes experience a higher long run pass-through than floating exchange rate regimes. Lower tariff barrier countries experience higher long run ERPT than higher tariff barrier countries which according to Barhoumi(2006: 940) indicate that tariff barriers can explain the cross country difference of long run ERPT into import prices. It was also found that countries characterized by high inflation regimes experience a higher long run ERPT than lower inflation regimes. This finding supports Taylor (2000) view that ERPT is lower in low inflation environments.

Chaudhri and Hakura (2006) also tested the hypothesis suggested by Taylor (2000) for 71 countries both industrial and developing from 1979 to 2000. This is because the inflationary environment in developing countries varies more than in industrial countries. They found a strong positive association between pass-through and the average inflation rate across countries. The inflation rate was found to dominate other macroeconomic variables in explaining cross-country differences in pass-through.

Devereux and Yetman (2008) did a similar study and developed a theoretical model of ERPT, which can explain the finding of very low pass-through for developed economies and higher pass-through for developing ones. The aim was to determine whether ERPT can be attributed to sticky prices or more structural features of international trade. Thus an open economy model was constructed linking slow ERPT to a slow rate of price adjustment in imported goods. The model was found to at least partly attribute slow ERPT to slow adjustment of nominal prices. The authors compared their model predictions to real world data of 144 countries and estimate country specific ERPT coefficients and second stage regression on the estimates. The results showed strong evidence that there is a non-linear relationship between inflation and ERPT such that greater volatility in inflation and exchange rate increases ERPT. Thus countries with higher levels of inflation exhibited higher levels of pass-through. This explains to a degree why low pass-through is observed for developed countries with low inflationary levels as opposed to developing countries with higher inflationary levels. In general the results are in support of the hypothesis that sticky prices are an important factor in determining ERPT at an aggregate level.

Studies done specifically on African countries are rather scanty but there has been an increased interest to analyse ERPT in African countries in recent years (e.g. Frimpong, (2010); Parsley, (2010); Akofio- Sowah, (2009), Karoro et al, (2009); Mwase, (2005); Bhundia, (2002); Ogun, (2000)). Ogun (2000) did an empirical study on ERPT and export prices in a small semi-open economy in Nigeria. How export prices react to exchange rate changes. He used quarterly data spanning from 1986 to 1995 using ordinary least squares (OLS) method. The results obtained indicated that only 93% of the exchange rate changes are reflected in the price of manufactured exports. The author attributed this to the fact that 75% of the data was generated due to lack of availability of data. His analysis suggested the existence of market segmentation in the manufactured export sector of the country. The author explains that the manufactured export firms price discriminate between the domestic and export markets, thus as a result the exchange rate changes may not usually be reflected fully in the domestic price of manufactured export goods of the country.

Bhundia (2002) carried out an empirical investigation on ERPT in South Africa which focused on CPIX inflation using monthly data from 2000-2001 under a structural autoregressive model. This period was chosen as it was when monetary policy had the most impact on inflation. The findings obtained indicated that average pass-through is low however for nominal shocks it appears to be much higher. On average, eight quarters after a 1% shock to the NEER, will result in a 0.12 % increase to the CPIX, giving rise to a pass-through elasticity of 12%. It is also noted that exchange rate shocks result in a steady increase over time in the level of CPIX.

Mwase (2006) studied the effects of exchange rate changes on consumer prices in Tanzania using structural VAR models with quarterly data spanning from 1990: Q1 to 2005: Q1. The analysis was done using both the entire period and by dividing the sample into the periods before and after 1995: Q3. This was done to analyse how pass-through evolved in the 1990's. The first sample captured the period characterised by passive monetary policy with high and volatile inflation while the second captured the period characterised by depreciation and declining and stable inflation. The results for the full period indicate a significantly low level of pass-through with a 10% exchange rate appreciation resulting in a 0.05 decrease in inflation. The sub-sample results indicated a significant decrease in the short run ERPT to inflation in the second sample. The first period impulse response results indicated that a 10% depreciation during the period 1990: Q1 to 1995:Q3 results in a 0.17% increase in inflation with pass-through effects rising to 0.89% in 12 periods. In contrast the period after 1995:Q3 showed that a 10% depreciation is associated with a 0.03% decrease in inflation with pass-through effects rising to 0.23% in 12 periods.

Akofio-Sowah (2009) conducted a study on 27 developing countries, 15 in Sub-Saharan African and 12 in Latin American to determine whether there was a link between ERPT and the monetary regime: pegged, currency board and dollarization of a country. The period covered was between 1980 and 2005. He found ERPT to be incomplete and significantly influenced by the inflationary environment. The regimes that succeeded in reducing inflation tended to have lower degrees of ERPT. This was seen in the COMESA countries in Africa that had high levels of Inflation resulting in higher degrees of ERPT as compared with other countries which the author attributed to the monetary regime adopted. Latin America also

showed a positive relationship between ERPT and the inflation environment. The effect of size and trade openness on ERPT were not significant for both Sub-Saharan Africa and Latin America while the effect of exchange rate volatility is shown to be positive and significant in Sub-Saharan Africa and significantly negative in Latin America. The author explains that this is because exchange rate movements are perceived to be permanent in Sub-Saharan Africa and transitory in Latin America.

Frimpong (2010) did a study on ERPT in Ghana by examining the effects of exchange rate changes on consumer prices using VAR models. He used monthly data spanning from 1990:M1 to 2009:M2. The finding showed that ERPT to inflation in Ghana is incomplete with a 1% depreciation resulting in a 0.025 increase in inflation a quarter after the impact. It increases and stays at 0.07% after 12 quarters of the impact. This shows that pass-through to inflation is persistent with the implication that exchange rate movements have a small but prolonged impact on inflation. In the long run however the pass-through coefficient is not significant indicating low or absence of ERPT in the long run.

Recently Parsley (2010) did a panel study on ERPT in South Africa but at the most disaggregate level possible. Two distinct panels of disaggregate data were chosen. The first was based on annual prices of 158 individual goods and services at consumer level from 1990 – 2000. The second was quarterly average import unit values for 26 – 8 digit import categories from 10 of South Africa's top trading partners from 1998 Q1 – 2009 : Q2 . The author states that this was done to mitigate some of the measurement problems and simultaneous biases present in studies at aggregate levels. The results obtained indicate a low pass-through to consumer prices between 15-25% in two years following an exchange rate change. Import price pass-through is much higher averaging about 60% for 8 of the 10 trading partner countries.

2.3.3 Kenya

In looking at the studies done on Kenya, to date very few papers have looked at exchange rate pass-through. The most prominent one is one done by Kiptui et al (2005) that investigated the two stages within the direct transmission of ERPT to domestic prices in Kenya using the Johansen cointegration method and impulse response and variance decomposition functions

in stages one and two. The study spanned from 1972 to 2003 and the variables used in the study include: import price index (IMP), nominal effective exchange rate (NEER), export price index (EXP), consumer price index (CPI) and the domestic competing product proxied by manufacturing value index (MVI).

The results of the study indicate that pass-through in Kenya during the period 1972–2002 is incomplete with long run ERPT to import prices being 71 percent. An exchange rate shock leads to a sharp increase in CPI inflation; however, this dies out after four years. Exchange rate shocks account for 46 percent of the variation in inflation in the first year, peaking at 57 percent in the third year. Furthermore the study shows that in the short run ERPT is incomplete at 69 percent with exchange rate depreciations positively affecting import prices. This result is supported by variance decomposition estimates, which indicate that exchange rate shocks explain 76 percent of the variation of import prices during the first period.

Some studies (e.g. Chaudhri and Hakuru, 2006 and Devereux and Yetman, 2008) have included Kenya among other countries that analysed exchange rate pass-through in developing countries. Both studies indicated that pass-through in Kenya is incomplete. Chaudhri and Hakura (2006) in a time series study from 1979 to 2000 classified Kenya among the countries with a moderate inflation environment with the level of pass-through being 35% in four quarters. Devereux and Yetman (2008) also found pass-through in Kenya to be incomplete in the long run. These studies however did not focus on the asymmetric pass-through of exchange rates in Kenya.

Given the conflicting results of the level of pass-through in Kenya and further that not much empirical work has been done on Kenya, this paper will aim to investigate exchange rate pass-through to import prices as well as pass-through asymmetry of exchange rate changes to import prices in Kenya

2.3.4. Empirical Evidence on ERPT Asymmetry

The empirical literature that considered the possibility of either non-linear or asymmetric responses is to date relatively scarce, although some papers (e.g. Karoro et al, 2009;

Khundapram, 2007; Pollard and Coughlin, 2004; Knetter, 1994,) actually indicate that this constitutes an important extension to look for.

Knetter (1994) examined the asymmetric adjustment of export prices in terms of trade between Japan and Germany at a 7-digit industry level of aggregation. The estimation was based on the premise that asymmetric adjustment with respect to currency fluctuations occurs in two scenarios; when a firm faces capacity constraints in the distribution network and cases where a firm has market share objectives in the face of trade restrictions. The study tested the asymmetric hypothesis within a panel data framework with a sample period of 1933- 1987 for Japan exports and 1975- 1987 for German exports. The framework was modified to allow for asymmetric responses to appreciation and depreciation through interactive dummies. The main findings of the study were that most of the data was not strong enough to reject a symmetric response to appreciation and depreciation however there was evidence that supported the market share model such that prices are adjusted to offset the effects of appreciation of the exporters currency more than they are adjusted to offset the effects of depreciations. This was especially evident with the automobile industry categories that supported the market share model with a marginal significant level just below 0.15 for Germany.

Pollard and Coughlin (2004) analyse exchange rate pass-through to U.S. import prices for 30 industries in the manufacturing sectors and test whether the direction and the size of exchange rate changes affect pass-through. They tested such effects using interactive dummy variables which capture not only appreciation and depreciation changes but also size effects, large and small. Quarterly data was used with a sample period from 1978:Q1 to 2000: Q4. The results indicated that pass-through is asymmetric with respect to appreciations and depreciations, although the direction of the asymmetry varies by industry. Most firms respond asymmetrically as well to large and small changes in the exchange rate with pass-through being positively related to the size of change with the results suggesting menu costs as a possible explanation to the differential effect of large verses small changes in the exchange rate. Overall, they study concludes that the size effect is more important than the direction effect.

In looking at developing countries, Khundrakpam (2007) did a study on economic reforms and ERPT to domestic prices in India during the post-economic reforms initiated after a major devaluation in 1991. The study took into account both symmetric and asymmetric changes in the exchange rate using a cointegrated framework with monthly data ranging from 1991 : 8 to 2005: 3. The results showed no significant decline in pass-through with a pass-through coefficient of 0.063 in the Short run and 0.09 in the long run. The asymmetric results revealed that the pass-through coefficient is higher for appreciation than depreciation with 0.141 and 0.037 respectively in the short run and 0.20 and 0.053 in the long run. The author attributed that higher pass-through coefficient to the fact that goods were domestically produced irrespective of quality. Size changes revealed that pass-through was higher for small changes than for large changes and this was attributed to the presence of menu costs.

Lastly Karoro et al (2009) examined the magnitude and speed of change of ERPT to import prices in South Africa and also explored the asymmetric responses under direction and size changes. Monthly data ranging from 1980:M1 to 2005:M12 was used under a Johansen cointegrated method. The variables used included import price index, nominal effective exchange rate and exporters production cost (EPC) proxied by the export price index of foreign producers of South Africa's imports. It was calculated using three different weighting methods thus three different options of EPC were used. The results revealed that pass-through is incomplete but high. The long-run coefficients showed that 10% depreciation in the rand is estimated to increase import prices by 8.1, 8.2 and 7.5 % depending on the option of EPC used. In the short run a 10% depreciation in the rand will increase import prices by 0.46, 0.46 and 0.5 respectively. The asymmetric pass-through results showed that pass-through to import prices are greater for depreciation at 72% than for appreciation at 64%. Furthermore asymmetry under size changes in the long run revealed more or less the same magnitude with small changes at 81.7% and large changes at 81.4%. This suggests that pass-through is more or less the same irrespective of the size effect.

2.4 Summary

In the previous sections key fundamental issues in ERPT both theoretical and empirical have been discussed. The discussions began by defining ERPT and theoretically basing it on the theory of the law of one price. Under the law of one price pass-through would be expected to

be complete but as observed in most empirical studies pass-through has been shown to be incomplete. According to Al-Abri and Goodwin (2007: 143) most studies that have focused on developed countries have found that the degree of ERPT to aggregate import prices to be 50% or less, despite the growing trend of trade and economic integration, however this is less so in the case for developing nations. As seen in the previous section pass-through estimates for developing countries have been as high as 93% as in the case of Nigeria as noted by Ogun (2000) and 89% for Tanzania as observed by Mwase (2006).

Many reasons were attributed to why ERPT is incomplete and the significance of the coefficients obtained. Studies such as Chaudhri and Hakura (2006) and Devereux and Yetman (2008) attributed pass-through levels to the inflationary environment of an economy. As explained by Taylor (2000) the responsiveness of exchange rate fluctuations depends positively on inflation. Contrastingly Marazzi and Sheets (2007) and Campa and Goldberg (2005) attributed their findings more to the composition of imports rather than Inflation and exchange rate volatility. Other studies such as Akofio-Sowah (2009), Barhoumi (2006) and Coricelli et al (2006) found that different exchange rate regimes and different monetary policy accommodations have a fundamental impact on domestic inflation. Such that countries with fixed exchange rate regimes have higher long-run pass-through than countries with floating regimes. In a general most empirical studies in their findings have supported the theoretical premises that have been put forth.

The Literature on pass-through asymmetry though scarce revealed that the asymmetric movement in the exchange rate is a key aspect that needs to be considered. This is particularly important in Africa as very few papers (e.g. Karoro et al, 2009) have focused on asymmetric responses of exchange rate movements. The results of the countries reviewed showed that asymmetric responses differ from country to country. In South Africa, Karoro et al (2009) found that pass-through to import prices is greater for depreciation than for appreciation while in India, Khundrakpam (2007) reported that pass-through is higher for appreciation than for depreciation. Size changes if significant were attributed to menu costs.

In conclusion, given the theoretical and empirical evidence reviewed, it is essential to do a study on ERPT to Kenya, especially given the fact that literature on Africa is still generally

small and even scarcer when it comes to pass-through asymmetry. Most of the studies done on Kenya have been multi-country studies, thus this thesis aims to add to the existing literature on developing countries, particularly in Africa. It also aims to add onto the literature on the asymmetric pass-through of exchange rate changes to import prices in Kenya. Table 2.1 below provides a brief summary of variables, data, methodology and findings of some of the reviewed literature.

TABLE: 2.1 SUMMARIES OF FINDINGS

Study	Country cover	Year cover	Estimation method(s)	Variables	Summary of Findings
Feenstra and Kendall (1997)	US, Canada, Germany, Japan and UK	1974:Q1 - 1994: Q4.	Cointegrated vector auto regression model.	Average quarterly spot rate of foreign currency per US dollar; wholesale price index; average traded goods price (weighted average of import and export price indices); interest rate differential.	Imports found to be significantly correlated with exchange rate movements to a degree of a third or more of the observed deviation from PPP.
Kadiyali (1997)	U.S. photo film industry	1980-1990	OLS method	Prices of film; market share estimates; quarterly consumer income; annual wholesale price index.	In the short run market structure is a determinant of pass-through but in the long run market structure is also a function of exchange rate movements.
Gross and Schmitt (2000)	Switzerland (oligopoly of automobiles from Germany, France, Japan and Belgium)	1977-1994	Johansen Cointegration method	Prices of automobiles; cost of production; nominal exchange rate	Degree of pass-through is lower in the long run than in the short run. This is because, while rival producers match long run price changes, others do not thus causing the producer who faces a change in exchange rate to absorb a greater proportion of the variation in time.
Webber (2000)	8 countries across Asia Pacific	1980:Q2 - 1997:Q3	Johansen and Engle and Granger Procedures	Domestic currency price of imports; domestic currency; import unit value indices; world price variable; domestic currency price of US dollar.	6 out of 7 countries cannot reject the hypothesis of asymmetry. One estimate each exhibits absolute PPP, complete asymmetric pass-through and partial symmetry pass-through. Partial asymmetric pass-through occurs in 9 cases and two cases exhibit explosive asymmetric pass-through
Bhundia (2002)	South Africa	1975:Q1-2001:Q1	Structural vector auto regressive model	Rand price of oil; output gap; import price index; production prices index; consumer price	The inflationary impact of exchange rate depreciation has been absorbed at intermediate stages of production. However, exchange rate

Study	Country cover	Year cover	Estimation method(s)	Variables	Summary of Findings
				index; real effective exchange rate; traded weighted foreign price level.	shocks result in a gradual increase over time in the level of CPIX on average 8 quarters. After 1% shock to NEER, the level of CPIX increases by 0.12 giving a pass through elasticity of 12%. However pass through elasticity from shocks to producer price inflation is high at 72% after 8 quarters
Pollard and Coughlin (2004)	U.S Multi Industry Study	1978: Q1 - 2000:Q4	Methodological framework based on a profit maximization model, estimated using simple OLS	Industry level exchange rate index; import prices; producer price index; industry shipment data	ERPT is found to be asymmetric with respect to appreciations and depreciations, as well as large and small currency changes in many of the investigated industries. However, there is no clear direction in this asymmetry across industries. Overall, ERPT is reported to be incomplete in all the studied industries
Brissimis and Kosma (2005)	Japan and USA	1975:Q1 - 2001:Q1.	Cournot model estimated using Johansen Multivariate cointegration technique and Likelihood based cointegration tests in heterogeneous panels	Import prices; REER; producer price index; aggregate & manufacturing imports of the USA from Japan and world	Japanese firms have market power and this validates the use of an imperfect completion model. However it appears that market power is not the only element on which to base the analysis of the incomplete ERPT by Japanese firms
Campa and Goldberg (2005)	23 OECD countries	1975:Q1- 2003:Q4.	Cross country and time series log-linear regression models	Local country import prices; money supply; effective exchange rate indices; inflation rate	Partial pass-through in the short run especially with manufacturing industries. In the long run producer currency pricing is more prevalent for many types of imported goods. Countries with higher rates of exchange rate volatility have higher pass-through elasticities. Pass through changes in these countries have been

Study	Country cover	Year cover	Estimation method(s)	Variables	Summary of Findings
					due to the dramatic shifts in the composition of country import bundles
Choudhri et al (2005)	Non US- G7 countries	1979:Q1 - 2001: Q3	Methodology based on LCP and PCP models and comparing responses of each model by using an impulse response analysis of a VAR model framework	Interest rate; foreign interest rate index; exchange rate; import price index; producer price index; wage rate; foreign consumer price index	ERPT to consumer prices and wages are low in the short run. Pass-through to export and import prices is larger but incomplete in the short run Models based on LCP are able to predict responses of domestic prices and wages well. An LCP model with distribution costs provides better overall fit for VAR data. Both LCP and PCP models have problems in matching the responses of import and export prices
Kiptui et al. (2005)	Kenya	1972 - 2003	VAR framework involving pair-wise granger-causality tests, cointegration, error correction modelling, impulse response functions and variance decomposition.	IMP; NEER; export price index; CPI; domestic competing product price proxied by manufacturing output.	ERPT in Kenya is incomplete supporting the presence of pricing to market effects. Exchange rate changes amount for about 70% of import price changes, as well as explaining 46% of the variation in consumer prices in the first period
Korhonen and Wachtel (2005)	CIS Countries	1999:01 – 2004:12	Vector auto regressive model with impulse response and variance decomposition	Consumer price indices; exchange rate; inflation data from US and oil prices	Exchange rate movements have a clear impact on price development. Speed of pass-through is fairly high with full effect transmitted onto domestic prices in less than 12 months. The relative share of exchange rates in explaining changes in domestic prices is much higher than the benchmark group of emerging market countries.
An Li(2006)	8 major industrial	1976:Q1 to 2005:Q3.	Vector auto regression model with sign	Oil price; output gap; short term interest rate; NEER; foreign	ERPT is incomplete for most countries. A greater pass-through coefficient is associated with an

Study	Country cover	Year cover	Estimation method(s)	Variables	Summary of Findings
	countries		restrictions	export price, import prices CPI and PPI	economy that is smaller in size with higher import shares, more persistent and less volatile exchange rates, more volatile monetary shocks, higher inflation rates and less volatile GDP
Barhoumi (2006)	24 developing countries	1980 -2003	Panel Unit root tests and tests for panel cointegration	PPI; GDP; import price; wholesale price index(CPI was used for some countries); marginal cost for production; NEER and REER	Using the Pooled mean group approach for long run ERPT, Countries with fixed exchange rate regimes experience a higher pass-through than floating exchange rate regimes (0.721 and 0.481 respectively). Lower tariff barrier countries experience higher long run ERPT than higher tariff barrier countries (0.554 and 0.259 respectively). Low inflation countries are characterised by a low long run coefficient than higher inflation regimes (0.080 and 0.217). Group mean estimators point out the same conclusion.
Campa and Mínguez (2006)	Euro Zone	1989: Q1 to 2001: Q3.	OLS method	Monthly unit value indices of imports from non-euro area countries of 13 product categories for 11 countries; monthly NEER indices expressed in units of domestic currency per unit of foreign currency; world price index, monthly input-output tables.	International goods market fairly integrated. ERPT is incomplete in the short run. Pass-through increases in the Long run as they fail to reject the null hypothesis of 100% pass-through in the long run.
Coricelli et al (2006)	4 new EU member countries	1993:01 – 2003:12	Cointegrated Vector auto-regression model	Industrial production index; NEER; domestic and foreign CPI inflation rate.	Very large pass-through from exchange rate depreciation to CPI inflation especially for Hungary and Slovenia. Higher estimates of pass-through than other NM studies.

Study	Country cover	Year cover	Estimation method(s)	Variables	Summary of Findings
Mwase (2006)	Tanzania	1990:Q1 to 2005: Q1.	Structural vector auto regression model	Consumer price index; nominal bilateral exchange rate; NEER; real GDP gap; broad money supply and reserve money.	Incomplete pass-through to inflation during the period of 1990-2005. Pass-through to inflation is persistent, implying that the exchange rate movements have a small but prolonged impact on inflation. Long run negative relationship between exchange rate depreciation and inflation.
Bouakez and Rebei (2007)	Canada	1973:Q2 to 2006:Q2	stochastic general equilibrium model and impulse response	REER; CPI; 3month T-bill and inflation rate measured as the change in Canadian CPI.	ERPT to Canadian import prices stable, while pass through to consumer prices has declined. Results show that the change in monetary policy regime is largely responsible for this decline
Ca'Zorzi et al (2007)	12 emerging markets	1975:1 to 2004:1	Vector auto regressive models	Oil price index; GDP; NEER, import price index; consumer price index; producer price index; short term interest rates	Emerging markets with only 1 digit inflation have pass-through to import and consumer prices low and not very dissimilar from the levels of developed economies. Robust evidence for positive relationship between the degree of the ERPT and inflation. Positive link between import openness and ERPT
Bhattacharya et al (2008)	USA, UK and Japan	1971:01 to 2002:12.	Vector auto regressive with exogenous variables model	Import and producer prices; export prices; trade weighted exchange rates	ERPT for industries in the USA range from 30% to 50%.USA food and machinery and transport equipment industry as well as UK tobacco and non-ferrous metal industry show evidence of a higher pass-through. Results from Japanese wood industry and UK pulp and metal ore industries show greater evidence of producer currency pricing
Ghosh and Rajan (2009)	Korea and Thailand	1980:Q1 to 2006:Q4.	Stock and Watson (1993) Dynamic method and Johansen and	NEER per USD of JPY; producer price index; consumer price index; import prices;	ERPT to import prices for Korea using NEER is 53% while for Thailand it seems to be complete ERPT to consumer prices for Korea using NEER

Study	Country cover	Year cover	Estimation method(s)	Variables	Summary of Findings
			Juselius (1990) cointegration method	NEER for each nation	is 14% and 29% for Thailand
Karoro et al (2009)	South Africa	1980:1 to 2005:12.	Johansen co-integration technique	Import price index; NEER; exporter's production cost	ERPT in South Africa is incomplete but very high. ERPT is found to be higher in periods of rand depreciation than appreciation
Mallick and Marques (2009)	India's exports	1991-2006(annual) and 1996-2001 (monthly)	Panel Cointegration approach	India's export prices in 2 digit industries	Incomplete ERPT to prices in India's export market after having controlled for the level of exchange rate volatility and domestic inflation. Results indicate that monthly data reflects more incomplete ERPT to destination market prices relative to annual data.
Shambaugh (2009)	16 countries	1973:Q1 to 1999:Q4.	Long run restrictive VAR model	Industrial production; real exchange rate indices; import prices	Consumer price pass-through is nearly complete in response to some shocks but low in response to others. Import prices and exchange rates typically respond in the same direction and pass-through seems quick
Maria-Dolores (2010)	new member states of the EU	2001:01 to 2007:06	OLS method	Import indices for eight product categories; exchange rate expressed in domestic currency/foreign currency; foreign price index(world price)	No evidence either in favour of the local currency pricing hypothesis (zero pass through) or for produce currency pricing (complete pass through) except for Slovenia and Cyprus. In terms of industry results, the lowest values for ERPT are in the manufacturing sectors Observed a ERPT decline through the pricing
Frimpong (2010)	Ghana	1990Q1: 2009Q2	Vector auto regressive (VAR) model	CPI; NEER(cedi/US\$); 3 month treasury bill rates; US CPI	Incomplete and decreasing pass through in Ghana with long run pass through coefficient is not significant, indicating low/ absence of ERPT in the long run. Low degree of ERPT effect to inflation with around 7%-100% shock in

Study	Country cover	Year cover	Estimation method(s)	Variables	Summary of Findings
					exchange rate after a long period. Pass through is low with a 10% exchange rate appreciation resulting in a 0.9% decrease in inflation at eight-quarter
Parsley (2010)	South Africa	Panel 1: 1990-2009. Panel2: 1998:Q1-2009:Q2	Panel data regression framework	160 local currency retail prices; world export price index; import unit values	Low pass-through to consumer prices 15-25% in two years following an exchange rate change. Import pass-through at 60% for 8 of the 10 exporting countries studies
Yoshida (2010)	Japan	1988:M1 - 2005:M12	Panel data regression framework	Unit prices; average monthly exchange rate; export price and marginal cost variable	Export prices are set at different levels in Japanese local ports and respond differently to exchange rate fluctuations even when importing countries and HS4 industries are controlled

CHAPTER 3:

OVERVIEW OF THE KENYAN ECONOMY

3.1 Introduction

This Chapter discusses Kenya's Macroeconomic policies and environment taking particular interest to the inflationary environment, exchange rate policies and Kenya's trade policies. It explores the evolution of Kenya's economy since its independence in 1964, with controls placed on key areas of the economy such as domestic prices, trade and exchange rates among others being liberalized in the early 1990's. Much of the focus however, will be on the period after the liberalization as this will provide background information on the state of the economy. This will provide a background to the possible channels of ERPT in Kenya and the role that inflation plays in investigating ERPT in Kenya

3.2 Trends in Inflation: developed and developing Nations

This section reviews the historical trend in inflation and related policies from the time that Kenya gained independence in 1964 till today. The reason for this is to identify the possible channels of ERPT, because as seen in Section 2.2.2 the responsiveness of prices to exchange rate fluctuations depends positively on inflation. Thus it is important to see whether most of the inflation experienced in the nation is positively affected by the movements of exchange rates to domestic prices.

In recent years there has been an overall global decline in inflation more especially in the industrialized economies. According to Boake and Rebei (2007:250), this is due to many countries adopting inflation target regimes. However, there are many other attributing factors to this decline.

Mccarthy (1999) brings forth a hypothesis that particularly explains this decline for the United States (U.S) and United Kingdom (U.K). He explains it as the impact of exchange rate appreciations and import price deflation. This is coupled by the greater openness of the United States which is indicative of increased foreign competitive pressure limiting U.S

domestic inflation. Taylor (2000) observed that one resultant effect of the low inflationary environment has been a decline in the pass-through to aggregate prices. This implies that a high inflationary environment would tend to increase ERPT. Barhoumi (2006: 938) argues that ERPT depends on the policy regime. A credible low inflation regime will in turn achieve a low pass-through

In developing nations, though there has been a decline in inflationary levels and there are still quite a number of countries finding various ways in which to control their high inflationary levels. In Africa, South Africa and Ghana have adopted inflation target regimes at levels that will not infringe on the development of the nation. Kenya is yet to adopt an inflation target regime, but according to the Monetary Policy Statement (2009:15), the country is moving towards a policy objective of a 5% inflation level.

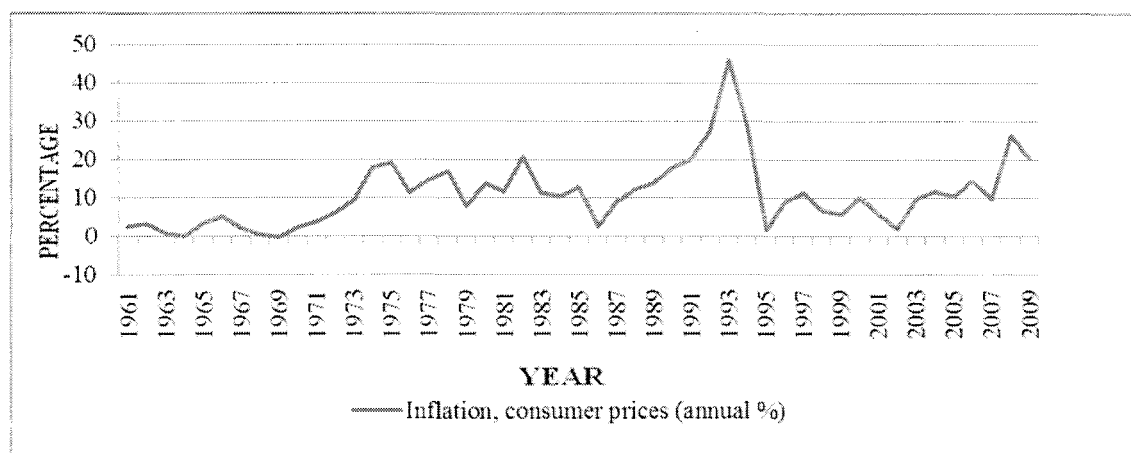
Historically, the Kenyan economy has never experienced hyper inflationary levels; in fact for the most part Inflation rates have rarely risen above 20 percent. One of the reasons for this is that one of the principle objectives of the Central Bank of Kenya as stated by the Monetary Policy Statement (2009:3) is to formulate and implement monetary policy directed to achieving and maintaining stability in the general level of prices. It, therefore, follows that the Central Bank of Kenya aims to formulate and conduct monetary policy in such a way that it keeps inflation low and stable.

Figure 3.1 below, is a chart reflecting the movement of Kenya's consumer price inflation from 1961 -2009. It reflects that to date one of the few periods that Kenya experienced very high levels of inflation was in the early 1990's when the levels rose to as high as 45 percent. According to Pollin and Heintz (2007: 6) this level corresponded to a devaluation of the Shilling which was associated with the implementation of a series of measures to liberalize specific areas in the economy such as the financial sector, exchange rate policies and trade regimes.

Specifically, one of the areas that were targeted in the financial reform process was the liberalization of interest rates. Prior to this, the financial sector according to Ngugi (2001:4) was characterized by financial repression with selective credit controls and fixed interest rate

spreads. From 1974 to 1991 the financial sector went through various changes in their policies until the liberalization of interest rates in 1991.

Figure 3.1: Inflation, consumer prices (%)



Source: The World Bank

In the beginning of 1980's as seen by Figure 3.1, there was inflationary pressure caused by two main factors, an increase in money supply and the second oil crisis that occurred at the end of the 1970's. Thus in 1983 the minimum reserve requirement was increased and a tight fiscal policy was adopted, that brought inflation down. However, this policy was not sustained as an expansionary fiscal policy was again experienced in the mid 1980's making the effectiveness of monetary policy difficult (Ngugi, 2001: 7).

Interest rates were liberalized in July 1991. This was done amidst increasing inflationary pressure and a deterioration of economic conditions in Kenya due to political pressures of the first multi-party presidential election in 1992. As explained by Ngugi (2001: 8), the inflationary pressure was attributed to the expansionary fiscal policy which saw an increase in money supply. To combat this, the cash ratio which had been earlier deactivated was reactivated and raised up to a level of 20 percent in 1994. This was later on reduced up to a low of 12 percent in 1998. Although the tight monetary policy seemed to reduce the money supply, its effectiveness was not felt to a great extent due to the presence of an expansionary fiscal policy. However by 1996, Kenya in its aims to develop the economy had a well-developed financial system with an increase in the number of financial institutions available.

Also 1996 marked the introduction of the repo rate as a way in which the Central Bank could enforce its monetary policy effectively.

In recent times, one of the primary objectives of the Central Bank of Kenya (CBK) as stated by the Monetary Policy Statement (2009: 3) is to maintain price stability. One of the ways it has proposed to do this is to minimise demand driven inflation while ensuring that there is adequate liquidity to support growth of economic activity. This is coupled with moving towards a 5 percent inflation target regime. This is yet to be realised because according to the CBK Annual Report (2009: 3) the overall inflation on average for 2008/2009 was 25.3 percent compared to 18.2 percent in 2007/2008. The underlying inflation also increased to 8.5 percent from 6.0 percent over the above stated periods.

According to the Monetary Policy Statement (2009:15), the government is expected to ensure that there is a reduction in the cost of funds that fed into the cost of doing business which in the past had caused high inflation. Also the bank is to take steps to moderate volatility in foreign exchange rates and reduce imported inflation so as to maintain confidence and promote productive activities without necessarily defending the exchange rate level/direction, but building foreign exchange reserves to counter any shocks that would promote exchange rate instability and consequently destabilise domestic prices.

3.3 The Exchange rate policy in Kenya: Past and Present

The shift from a fixed to a flexible exchange rate regime has been one that many developing countries in recent years have been adopting. According to Were et al (2001: 1), exchange rate regimes determine the ability of an economy to effectively respond and adjust to exogenous shocks. In developed countries the shift in exchange rate regimes occurred in the 1970's after the collapse of the Bretton Woods System which had been in existence since the end of World War II.

According to Nandi (2008:2), one of the objectives of the Bretton Woods System was to maintain a fixed exchange rate. This was essential at the time as there was an urgent need to take care of the international payments system that was vital for world trade and commerce. The United States being the dominating power at the time and the biggest trader of gold

resulted in most of the currencies maintaining a fixed parity with the US dollar. As Europe began to gain competitive strength in the late 1960's, the dollar began to be perceived as overvalued. This was coupled with a surge in inflation levels around the world, which resulted in a rising outflow of gold from the United States as gold was perceived to be relatively cheap at the price it was being maintained at. In order to prevent this massive outflow, the Bretton Wood System collapsed and the floating era began.

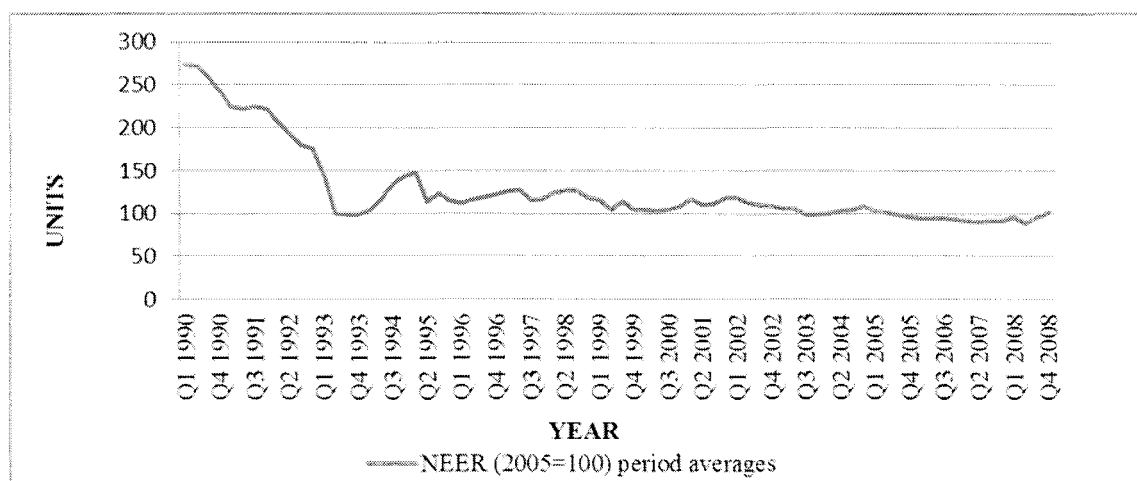
According to Were et al (2001:2), although the Bretton Wood System collapsed, most developing countries continued to peg their exchange rates to either a key single currency, especially the United States or the French Francs or to a basket of currencies such as the International Monetary Fund (IMF) special drawing rights. Developing countries only started explicitly shifting to flexible regimes around the 1980's.

In Kenya, the exchange rate regimes have evolved along general macroeconomic policies that have been put in place since the country gained its independence in 1964. According to Ndung'u (2000:2), since independence to 1974, the exchange rate for the Kenya shilling was pegged to the US dollar, but after discrete devaluations the peg was changed to the special drawing rate (sDR). However, during the period of 1974 and 1981 the movement of the nominal exchange rate relative to the dollar was very volatile. This resulted in the shilling depreciating even further when the shilling was devalued again in 1982. However according to Pollin and Heintz (2007:23) the exchange rate regime was changed to a crawling peg in real terms at the end of 1982. This regime was in place until 1990 when a dual exchange rate system was implemented. This lasted until October 1993, when, after further devaluations, the official exchange rate was merged with the market rate and the shilling was allowed to float.

Following the years after the liberalization of the shilling, the real exchange rate has gone through several phases, most of which have been depreciations due to a number of factors. During the period between January 1995 to October 1999 the shilling real exchange rate depreciated by 21.0 percent. The Shilling declined even further due to the major drought in 1999 to 2000 coupled by increases in the cost of fuel products. There was also an increased demand for foreign currency to cover the rising import bill, brought about by the increased oil

price and food imports to mitigate the supply shortage caused by drought. According to CBK Annual Report (2000: 5) the NEER declined by 16.1 percent in 1999 and 3.5 percent in 2000. The depreciation was moderated due to inflows associated with the IMF Poverty Reduction and Growth Facility (PRGF).

Figure 3.2: Nominal Effective Exchange Rates: Period Averages (2005=100)



Source: Computed by Author with data from Bahmani-Oskooee and Gelan (2007) and The Central Bank of Kenya

In 2002, the Shilling began to depreciate and this was mainly due to speculative pressures associated with the general election that was to take place in December 2003. This obliged the Central Bank to intervene periodically to smooth out volatility. Speculation on the Kenyan shilling eased from September 2004 following a positive assessment of the economy by the IMF. In 2005 according to the CBK Annual Report (2005: 7), the shilling appreciated by 3 per cent against the US dollar as a result of strong export receipts and capital inflows in response to the relatively high domestic interest rates. The key exports areas being horticulture, tea, coffee and tourism.

From December 2004 to December 2007, the shilling real exchange rate appreciated by 30 percent representing a major deviation from its past levels. According to Kiptui and Kipyegon (2008:3) this appreciation of the shilling real exchange rate has attracted public attention especially from exporters who have argued that the strengthening shilling is eroding their competitiveness.

Due to the global financial crisis the NEER began to decline by 1.1 percent between June 2007 and June 2008 by 16.6 percent between June 2008 and June 2009 (CBK Annual Report, 2009: 23). The depreciation of the shilling against the US dollar, which mainly occurred during the first half of the fiscal year 2008/09, initially triggered sale of shares allocated to foreign investors after the shares commenced trading at the Nairobi Stock Exchange. The foreign investors were mostly speculating and this led to huge outflows of foreign exchange. The depreciation of the local unit was further amplified by the international financial crisis (CBK Annual Report, 2009: 23).

Analysing the Kenyan shilling further, the policy of a market determined shilling and the relaxation of exchange controls has exposed the currency to domestic and external shocks consequently increasing its volatility (Monetary Policy Statement, 2009:3). However, Kenya maintains a flexible exchange-rate system to complement its trade reforms and to ensure appropriate economic incentives for producers. Figure 3.2 shows the behaviour of the NEER from 1990 – 2008. Although the volatility of the shilling has increased considerably since the Central Bank allowed the exchange rate to freely float, the general trend of the NEER has been depreciating apart from the short period of appreciation from 2005-2007. The implications of the exchange rate volatility for ERPT are that the greater the volatility the more importers become wary of changing prices and the more willing they become to adjust profit margins accordingly to either an appreciation or depreciation.

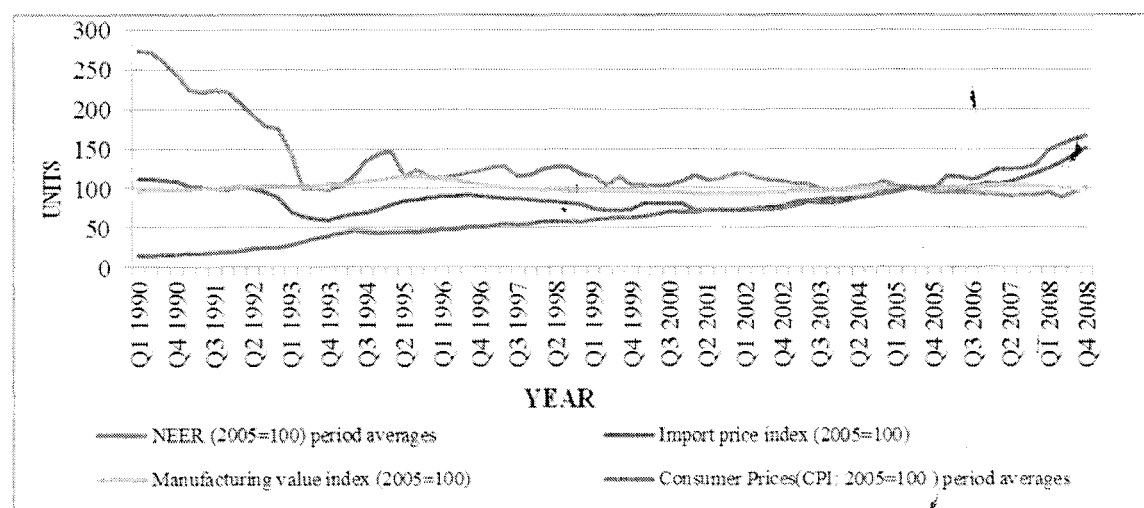
The implication of such a downward trend in the NEER for ERPT to domestic prices is that these prices will rise as more Kenyan Shillings are needed to purchase the same imported goods and services. The size, speed and asymmetry of the pass-through will depend on the channel of pass-through as determined by, amongst other thing factors the nature of imported goods and services. As explained by Hyder and Shah (2004: 3), if imported commodities are primarily capital goods and/ or raw materials the pass-through follows the following trend. The currency depreciation will increase import prices, which will in turn increase producer prices and then consumer prices. This is because importers pass on some of the costs incurred by the depreciation to consumers. On the other hand if imported commodities are primarily

finished goods and services, pass-through will be transmitted directly from the change in NEER to import prices then to producer and finally, consumer prices.

According to the CBK Annual Report (2009: 34), the highest imported commodities are oil, chemicals and manufactured goods. According to the World Bank (2007: 27) much of the manufacturing goods are imported from Asia with also a sizable amount of imports of non-durable consumer goods which compete against Kenya's domestically produced products. Apriori, the expectation is that Kenya experiences a direct transmission of ERPT to domestic prices, however due to the fact that a large number of manufacturing goods are from Asia with a large number of Kenyan businesses dominating Kenyan markets, there may be indirect channels of producer prices inversely affecting import and consumer prices.

Figure 3.3 below illustrates the behaviour of the NEER versus that of domestic prices from 1990 -2008. As expected, domestic prices have been increasing as NEER has been decreasing. This suggests that the cost implications of the depreciation in the shilling may have to a degree been passed on to domestic prices. However visual observation is not sufficient to determine the rate of pass-through of changes in the NEER to domestic prices. This is fully investigated in Chapter 4 and 5.

Figure 3.3: Trend of NEER verses domestic prices, 1990 - 2008



Source: International Monetary Fund (2010) and World Bank

After investigating the relationship between the exchange rate and the domestic prices in Kenya, and identifying the possible channels, Section 3.4 below gives a clearer picture of ERPT in Kenya through an examination of the country's trade policies, structure and composition.

3.4 Kenya's trade policy, Trade Composition and Market Competitiveness

The magnitude, speed and asymmetry of pass-through at the aggregate level are also affected by the structure of the economy, with respect to trade and market competitiveness. The objective of this section is to determine the extent of ERPT and model of its channel(s) in Kenya by investigating the extent of trade liberalisation, the size of trade versus total GDP, the size and composition of imports versus exports and the level of competition in Kenyan markets.

3.4.1 Trade Policy

Kenya trade policy is one that has evolved from the colonial era, until now. It has applied import restrictions widely to close the gap between the demand for imports, supply of foreign exchange and the protection of domestic industries from as early as the 1970's. According to Were et al (2002: 11), the economy adopted an industrialized policy at independence that was based on an import-substitution strategy. At the time the government was using this strategy to achieve economic independence and promote ownership, management and production locally. This policy was highly comprised by protective trade barriers.

These barriers were further tightened in 1971 when Kenya experienced its first balance of payment (BOP) problem. As explained by Mwega (1993: 383), there was a major run-down of foreign exchange reserves due to an expansionary fiscal policy that the country had adopted. This problem was also aggravated by a decline in trade. This is because as stated by Mwega (1993: 382), the volume of trade had traditionally depended on the amount of foreign exchange that importers could get and priority is attached was to the various imports in foreign exchange allocation.

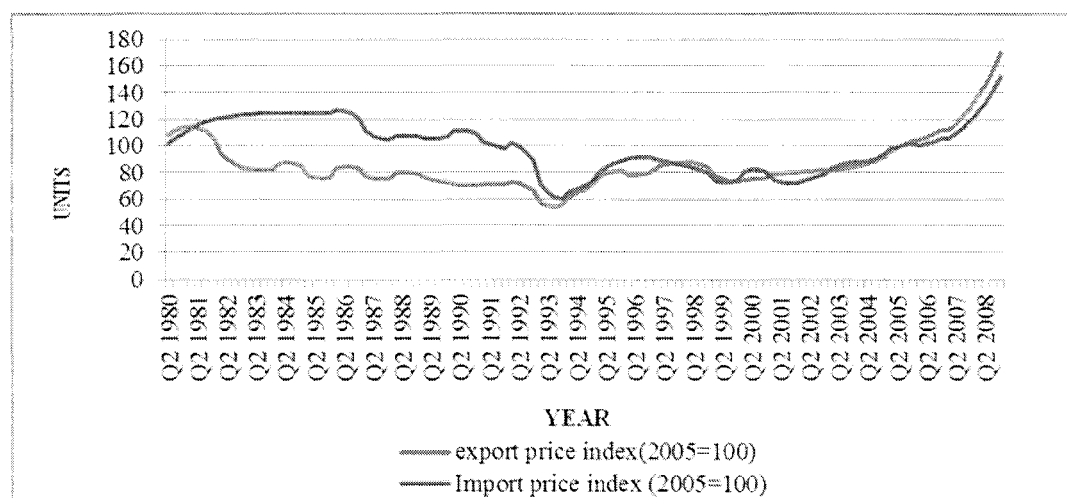
There were a number of shocks in the 1970's like the oil crisis of 1973 that revealed the inefficiency of the import-substitution policy. According to Were et al (2002: 12) these shocks adversely affected the performance of the import substitution enterprises. Due to the high import costs and limited market at the time, there was an excess of production and major inefficiencies. This gave rise to looking at export-oriented strategies, to counteract the problems being experienced.

The 1980's were characterized by the country attempting fairly sustained efforts to trade liberalization. This, however, was not successful at the time due to large macro imbalances that the country experienced. According to Were et al (2002: 12), there was also a shift from import substitution strategies to export oriented strategies. This was seen during the period of 1988 to 1992. Reinikka (1996:446) explains that there was a relaxation of import controls and promotion of export measures. This implied that imports were liberalized. This however was not very effective in terms of exports due to the high rates of protection to domestic industries, high costs of imported inputs, foreign exchange controls and administrative delays.

Despite these outcomes, the levels of reserves were sustained due to large inflows of policy based external aid. According to Reinikka (1996:450) this aid contracted in late 1990 which resulted in a fall in reserves. This was also influenced by the political turmoil surrounded by the first multi-party election in Kenya. The most significant shift in the trade policy regime as stated by Were et al (2002: 14) occurred in May 1993 when the trade licensing requirements were abolished and the exchange rate was allowed to float. This improved the level of reserves to levels of the mid-1970s during the coffee boom.

Over the 1993-94 period, all current account and virtually all capital account restrictions were lifted. Looking at Figure 3.4 below, the response on the imports and exports was immense but according to Were et al (2002: 15), the export response appeared to have been combined with a price effect due to a steep devaluation of the Kenya shilling in 1993. Never the less the overall outcome as shown Figure 3.4 shows that the liberalization seemed to raise export earnings because export earnings rose from 13 percent of GDP in the early 1990s to 20 percent between 1993 and 1996.

Figure 3.4: Import and Export Price indices 1980 – 2008



Source: The World Bank

In the post liberalization era, Kenya has become more liberalized in terms of trade barriers. According to the African Economic Outlook (2006: 303), Kenya and its partners in the East African Community in 2005 began the implementation of the Common External Tariff (CET) which binds the tariff at a maximum rate. Thus in the case of Kenya the tariff rates were lowered from 35 percent to 25 percent. The only sector with a high degree of tariff protection is the agricultural sector which according to World Bank (2010: 1) is at 19.9 percent compared to the non-agricultural sector at 6.8 percent. This is because Kenya is a very agricultural based economy thus one of the government's objective has been that of attaining and maintaining food security.

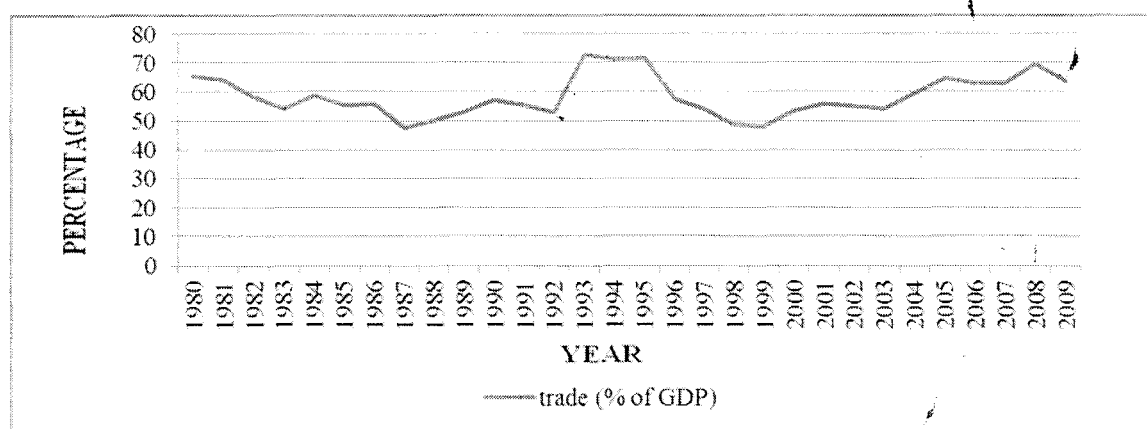
Currently, Kenya's Tariff Trade Restrictiveness Index (TTRI) is currently 8.2 percent (World Bank, 2010:1). The TTRI according to the World Bank (2010: 1) calculates the equivalent uniform tariff that would keep domestic welfare constant. It is weighted by import shares and import demand elasticity. This percentage indicates a more open economy than that of an average Sub-Saharan Africa or low-income country which is currently at 11.3 percent and 11.6 percent, respectively (World Bank, 2010:1). Based on the TTRI, Kenya is ranked 84th out of 125 countries (where 1st is least restrictive).

Although Kenya has a liberal trade policy regime for services relative to most Sub Saharan African economies, there is a wide gap between actual liberalization and its multilateral commitments, which according to the World Bank (2010: 1) is reflected by its relatively low overall GATS commitments index. In a nutshell, the openness and liberalization of trade in Kenya is expected to have an increasing effect on the size and speed of ERPT. As more imports are brought into the country at different stages of production, and firms pass on the costs to consumers, the more likely changes in the exchange rate are reflected on domestic prices.

3.4.2 Trade Structure and Composition

As stated in the previous chapter, the size of trade relative to a country's economy is important in assessing the presence and importance of ERPT within that economy. If international trade by a country, that is, importing and exporting activity is minimal, then ERPT will not be as important as domestic prices will not be considerably influenced by fluctuations in the country's exchange rate. However, if the ratio of trade to the country's gross domestic product (GDP) is high, the country is likely to experience notable levels of pass-through. In the case of Kenya, trade plays an important role in the growth of the economy. As seen in Figure 3.5 below, the ratio of trade relative to GDP is high. According to the CBK Annual Report (2009) the percentage of its GDP was at 64.4% in 2008.

Figure 3.5: Total Trade (% of GDP)



Source: World Bank

Table 3.1 below shows the percentages of total imports and total exports to GDP in the past decade from 1998 to 2008. The table shows that the ratio of imports to total GDP has been trends upwards thus by implication the import component of GDP has increased.

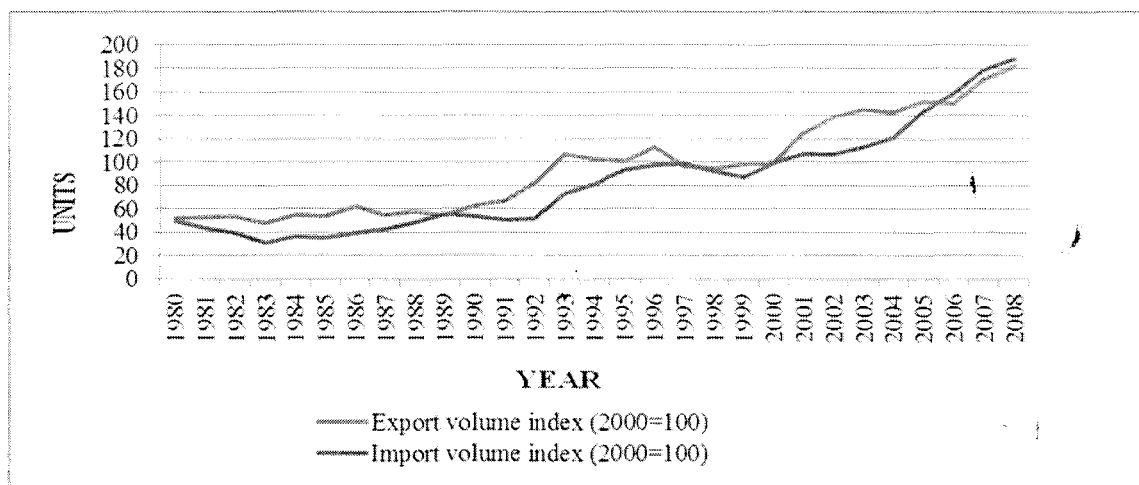
Table 3.1: Exports and Imports as a % of GDP

	GDP%					
	1998	2000	2002	2004	2006	2008
Exports of Goods and Services	24.77	26.55	26.01	26.35	27.11	28.40
Imports of Goods and Services	-32.39	-36.36	-31.45	-34.20	-37.83	-42.74

Source: Central Bank of Kenya

Over recent the years, trade growth (in nominal terms) have remained relatively stable. As noted by the World Bank (2010 :1) it has been growing at an estimated rate of 17.6 percent in 2008 compared to 17.7 percent in 2007, driven by strong growth in both exports and imports (15.8 percent and 18.8 percent, respectively). Figure 3.6 shows the import and export trade volumes that show a positive and increasing trend in the volume of trade.

Figure 3.6: Total trade Volumes in Kenya



Source: World Bank

Theoretically, the significant growth in the volume of imports relative to exports would suggest that Kenya is vulnerable to the effects of exchange rate movements. According to

Akofio-Sowah (2009:303), the very definition of trade openness is the sum of exports and imports of goods and services measured as a share of GDP. Thus the more a country is open (i.e. a large presence of imports and exports) the more movements in the exchange rate are transmitted via import prices into domestic prices.

Kenya is heavily dependent on imported capital goods and services, with much of the country's imports concentrated on machinery and transport equipment, oil, manufactured goods, chemicals and other products. According to the CBK Annual Report (2008: 42), these items accounted for 28.1 percent, 24.9 percent, 15.3 percent, 13.4 percent and 18.3 percent respectively. Given these percentages this would imply that ERPT to domestic prices in Kenya would be expected to flow directly from import prices and then to consumer prices. However, because of the upward trend in exports as seen in Figure 3.6, it would imply an indirect transmission of ERPT to producer and consumer prices can also be identified in the case of Kenya. Hyder and Shah (2004:3) suggest that as the demand for local exports increases, the price of substitute goods and the exports themselves increase in local currency terms. The end result is an increase in domestic price levels.

3.4.3 Market Competitiveness

Kenya's economy is market based with some state owned infrastructure enterprises. The economy is heavily dependent on the agriculture and tourism sector which leaves the economy vulnerable to cycles of booms and busts. In terms of business, according to the World Bank (2010: 1), Kenya is ranked 95th in the Ease of Doing Business index in 2009, which compares the business environment of 183 countries.

One of the recent developments within the country in an effort to facilitate trade amid the global financial crisis, has been the creation of an Export and Import (Exim) Bank to provide trade and investment finance. Furthermore, an Investment Climate Action Plan (ICAP) was put in place to coordinate reform by government ministries and public agencies to provide immediate benefits to private enterprises (World Bank, 2007:11). The ICAP focuses on a number of priority areas organised into clusters including: controlling rampant and escalating insecurity; addressing the poor state of roads; fast-tracking construction approvals; removing inefficient, unnecessary, unfriendly and cumbersome licensing procedures; improving

business registration; improving land administration; updating the Company Law; and improving customs and tax administration (World Bank 2010:2).

However, many of the government's own actions seem to run counter to its declared intention of fostering private sector development. This was seen clearly when the Parliament failed to pass the Privatisation Bill that has been present since 2003. This makes the government's intentions unclear. The government acknowledges publicly that poor performance of key enterprises earmarked for privatisation continue to undermine Kenya's competitiveness. The government appears to favour public-private partnerships and performance contracts in the reform of these enterprises.

On a positive note, the government has been pursuing financial sector reform to strengthen the financial system and to increase the predictability of the business environment in the financial sector. Towards this end, the government has prepared a comprehensive financial sector strategy aimed at improving efficiency in financial intermediation. According to the African Economic Outlook (2007:303), as part of the strategy, the government expects to restructure and privatise state-owned banks. In 2005, a Bank Restructuring and Privatization Unit were set up in the Ministry of Finance to develop and implement the reforms in state-owned banks. Furthermore, efforts were made to strengthen the capacity to detect and prevent money laundering and financing of terrorist activities, through the drafting of the Anti-Money Laundering (AML) and Proceeds of Crime Bill. Additionally, the Capital Markets Authority (CMA) that regulates the stocks and equities market was reinforced in 2005 to strengthen investor confidence (African Economic Outlook, 2007: 303).

In summary, Kenya's trade and industrial policies have been set to encourage openness of trade and competition within the economy. The openness of the economy allows for more participation of foreign players and increased import of capital and intermediate and final goods and services. However, Kenyan markets are still largely oligopolistic in nature with state owned enterprises and thus it would be expected that ERPT in Kenya would be relatively high but incomplete.

3.5 Summary

Kenya's macroeconomic policies have evolved since independence, and there was a dramatic shift in the 1990's when the controls placed on major areas in the economy were liberalized. With the liberalization, Kenya has been opened to the rest of the world with a movement to globalization. This, however, has also left Kenya vulnerable to shocks in the global economy including the volatility of the exchange rate. Looking at the trade structure and the trade deficit between imports and exports, there shows an influx of capital and imported goods.

Taking all the factors previously discussed into account, it reveals that Kenya's main channel of pass-through is a direct one, where a change in the exchange rate is passed on directly to import prices, then to producer prices and lastly consumer prices. However, given the increasing competitiveness in the country's business environment, factors such as market share, menu costs and binding quantity constraints may be taken into account including the asymmetric pass-through of changes in the exchange rate to import prices.

CHAPTER 4:

ANALYTICAL FRAMEWORK

4.1 Introduction

In this chapter the theoretical and empirical framework that will be used to analyse ERPT to domestic prices in Kenya is discussed. As previously explained in Chapter 2, ERPT is defined as the percentage change in local currency import prices following a one percentage change in the exchange rate between importing and exporting countries. Empirically, this is estimated by regressing changes in the prices to movements in the exchange rate to find the pass-through coefficient. Across literature, authors have used different models and techniques to estimate ERPT³. Out of which the common techniques have been ordinary least squares (OLS) regression technique, variations of the vector auto regressive (VAR) models and cointegration techniques based on Johansen and Engel-Granger. This thesis will use the VAR technique with impulse response and variance decomposition functions with the Johansen (1988) cointegration techniques combined with error correction modelling. The following sections will discuss the conceptual framework for both symmetric and asymmetric pass-through, the econometric technique and data used in the analysis.

4.2 Analytical Framework

4.2.1 Symmetry modelling technique

In modelling the first stage of ERPT (the transmission of exchange rate fluctuations to import prices) the theoretical background is based upon the law of one price that various authors (e.g. Al-Arbi and Goodwin (2009), Karoro et al (2009), An Li (2006) Campa and Goldberg (2002) have used. The law of one price as briefly discussed in chapter 2 viewed under the assumption of costless arbitrage where identical products are sold for the same currency price in different countries. Akofio-Sowah (2009: 297) depicted this theory with the following equation

³ See table 1 on the summary of findings to see the different estimation techniques that authors have used.

$$p_i = e p_i^* \quad (4.1)$$

Where p_i is the home currency price of the good in the local country, p_i^* is the foreign currency price of the good in the foreign country and e is the exchange rate of the local currency per unit of the foreign currency. Equation 4.1 can be expressed in terms of import prices (p^{IMP}) as:

$$p^{IMP} = p^{EX} e^{NEER} \quad (4.2)$$

Where e^{NEER} is the nominal effective exchange rate and p^{EX} represents export prices. According to Al-Abri and Goodwin (2009:144) export prices are a function of both a mark-up (θ) and the producer's marginal cost (c^{EPC}). Thus export prices can be written as

$$p^{EX} = \theta c^{EPC} \quad (4.3)$$

Under the assumption of costless arbitrage (i.e. no mark-up), import prices in local currency become:

$$p^{IMP} = p^{EX} e^{NEER} = e^{NEER} c^{EPC} \quad (4.4)$$

The implication of Equation 4.4 is that import prices are affected by both the exchange rate and the foreign costs of production. In the long run, the pass-through relationship of exchange rate changes to import prices can be estimated using a log-linear transformation of equation 4.4 which allows for constants. Thus equation 4.4 becomes:

$$\text{Log} p_i^{IMP} = \beta_1 + \beta_2 \text{Log} c_i^{EPC} + \beta_3 \text{Log} e_i^{NEER} + \varepsilon_i \quad (4.5)$$

Where ε_i is the stochastic error term, β_2 is the coefficient of exporters' production cost and β_3 represents the elasticity of exchange rate pass-through to import prices. It is expected that β_3 is between zero and one i.e. $0 \leq \beta_3 \leq 1$. A one to one response of import prices to exchange rate changes is known as complete pass through i.e. $\beta_3 = 1$. If the coefficient is less than 1 then there is incomplete pass-through, however if $\beta_3 = 0$ then there is no pass-through. The findings of many authors e.g. (Campa and Goldberg, 2005) suggest that ERPT is mostly incomplete. The coefficient β_2 also affects import prices such that a rise in production costs

will affect import prices. If the Law of One Price holds, then $0 \leq \beta_2 \leq 1$ and $\beta_2 = \beta_3$. This implies that the coefficient of exporters' costs should be equivalent in magnitude to the exchange rate coefficient.

4.2.2 Asymmetric modelling technique

The previous section restricted pass-through to be identical regardless of whether the Kenyan shilling is appreciating or depreciating. However, we need to ascertain to what degree changes in the exchange rate with respect to appreciation and depreciation as well as size of a change affect long-run pass-through to import prices. In order to establish this, new variables are constructed to capture periods of appreciation and depreciation as well as large and small changes. Following Pollard and Coughlin (2004), Webber (2000) and others⁴, the asymmetries are estimated by interaction of the exchange rate variable with appropriate dummies in the following manner.

4.2.2.1 Asymmetry with respect to appreciation and depreciation

To determine if ERPT is asymmetric with respect to the direction of change in the exchange rate, two dummies are created that separate the quarters in which the shilling is appreciating and depreciating. This is expressed in the form below

$$D_A = \begin{cases} 1 & \text{.....for } \Delta e > 0 \\ 0 & \text{.....otherwise} \end{cases} \quad D_D = \begin{cases} 1 & \text{.....for } \Delta e < 0 \\ 0 & \text{.....otherwise} \end{cases}$$

Where D_A represents the dummy for the appreciating periods and D_D represents the dummy for the depreciating periods. Interaction of the above dummies with exchange rate change yields three different models that will be estimated in chapter 5.

$$\text{Log}p_t^{\text{IMP}} = \beta_4 + \beta_5 \text{Log}c_t^{\text{EPC}} + \beta_6 \text{Log}e_t^{\text{NEER}} + \beta_7 \text{Log}e_t^{\text{ACC}-D} + \varepsilon_t \quad (4.6)$$

⁴ Karoro et al (2009), Wickremasinghe and Silvapulle (2004) as well as Prystupa and Wróbel (2009) and Khundrakpam (2007) who followed similar frameworks in their studies as the one described by Pollard and Coughlin (2004).

This model is estimated to investigate the magnitude of the long-run and short-run pass-through of the Shilling's appreciation and depreciation to import prices. This approach follows Karoro et al. (2009), Wickremasinghe and Silvapulle (2004) and Webber (2000) where they include one of the series either relating to a depreciation or appreciation in the pass-through equation. Thus the variable ACC_D is included in the long-run pass-through equation (4.5) as represented by equation (4.6) above. Where $(\beta_6 + \beta_7)$ and β_6 are the long run coefficients corresponding to currency depreciations and appreciations respectively. Placing a restriction on β_7 such that long-run depreciation pass-through is equal to zero ($\beta_7 = 0$) tests the long-run asymmetry of the import price to exchange rate fluctuations

The second model as represented by equation (4.7) also follows Webber (2000: 76) which is similar to the first model only that the variable capturing depreciation has been replaced with the variable ACC_A to capture asymmetry with respect to appreciation.

$$Logp_t^{IMP} = \beta_8 + \beta_9 Logc_t^{EPC} + \beta_{10} Loge_t^{NEER} + \beta_{11} Loge_t^{ACC_A} + \varepsilon_t \quad (4.7)$$

According to Webber (2000:76), the extent of long run appreciation import pass-through is $(\beta_{10} + \beta_{11})$ and β_{10} captures the extent of long-run depreciation import pass-through. Placing a restriction on β_{11} such that long run appreciation is equal to zero ($\beta_{11} = 0$) tests the long-run asymmetry of the import price to exchange rate fluctuations.

The third model differs slightly from the previous two in such that the model captures not only periods that are depreciating but that are also appreciating. Thus ACC_D replaces $Loge_t^{NEER}$ in Equation 4.7 to yield:

$$Logp_t^{IMP} = \beta_{12} + \beta_{13} Logc_t^{EPC} + \beta_{14} Loge_t^{ACC_A} + \beta_{15} Loge_t^{ACC_D} + \varepsilon_t \quad (4.8)$$

with ACC_A and ACC_D providing the separate pass-through coefficients for appreciation and depreciation that were created by a cumulative sum of the respective periods. Placing a restriction on either $\beta_{14} = 0$ or $\beta_{15} = 0$ tests long run appreciation or depreciation asymmetry of the import price to exchange rate fluctuations and equating β_{14} to β_{15} i.e. $\beta_{14} = \beta_{15}$ tests the hypothesis that appreciation and depreciation have the same

magnitude. If this hypothesis is true, then it will indicate that appreciation or depreciation has no significant impact in Kenya.

Once the models have been estimated and coefficients obtained, interpretations will be made given the theoretical expectations of the models. If the β coefficients indicate that appreciation is greater than depreciation then one would expect that there is either production switching or firms are trying to maintain a market share objective. According to Knetter (1994: 56) pass through is higher for appreciation than depreciation when firms are building up a market share. Thus in the case of an appreciation in the domestic country, firms will lower import prices to increase their market share but not in the case of a depreciation as firms want to maintain their market share.

Under production switching, foreign firms use imported inputs and depending upon the price they switch between imported and domestically produced goods. According to Webber (2000: 73), when there is importing, a country's currency appreciates, foreign firms use only the input produced in their country and the extent of pass-through depends on the elasticity of the mark-up. In the case of depreciation foreign firms use inputs produced from the depreciating currency country and thus no pass-through occurs.

If however the β coefficients indicate that depreciation is greater than appreciation then one would expect that there are binding quantity constraints. In the case of an appreciation in the importing country's currency, Pollard and Coughlin (2004:2) explain that foreign firms would tend to lower the import prices but due to capacity constraints the increase of sales through the lower price would be limited. Instead, firms raise their mark-ups to keep import prices fixed, maintain the volume of sales and have an increased profit margin. In the case of depreciation firms reduce their mark-up to absorb part of the impact of depreciation but sometimes even this does not stop import prices from rising. Thus pass-through is higher for depreciation than appreciation.

4.2.2. Asymmetry with respect to size of exchange rate changes

In determining if ERPT is asymmetric with respect to the size of a change in the exchange rate be it large or small, two dummies are generated by separating the quarters in absolute

terms of the changes of the natural logarithm of the nominal effective exchange given a 3% threshold. This is expressed in the form below.

The dummies for absolute large and small changes respectively are:

$$D_L \begin{cases} 1 \dots \dots \text{for } \Delta e > 3\% \\ 0 \dots \dots \text{otherwise} \end{cases} \quad D_S \begin{cases} 1 \dots \dots \text{for } \Delta e < 3\% \\ 0 \dots \dots \text{otherwise} \end{cases}$$

Interaction of the above dummies with exchange rate change yields:

$$\text{Log}p_t^{\text{IMP}} = \beta_{16} + \beta_{17} \text{Log}c_t^{\text{EPC}} + \beta_{18} \text{Log}e_t^{\text{NEER}} + \beta_{19} \text{Log}e_t^{\text{ACC}_S} + \varepsilon_t \quad (4.9)$$

$$\text{Log}p_t^{\text{IMP}} = \beta_{20} + \beta_{21} \text{Log}c_t^{\text{EPC}} + \beta_{22} \text{Log}e_t^{\text{ACC}_S} + \beta_{23} \text{Log}e_t^{\text{ACC}_L} + \varepsilon_t \quad (4.10)$$

With ACC_L and ACC_S providing separate pass through coefficients for large and small changes respectively. The two models are estimated with a similar framework as that discussed in Section 4.4.2.1. In Equation 4.9 the variable ACC_S is included in the long run pass-through equation (4.5) where $(\beta_{18} + \beta_{19})$ and β_{18} are the long run coefficients corresponding to small and large changes respectively. Placing a restriction on β_{19} such that long run depreciation pass-through is equal to zero ($\beta_{19} = 0$) tests the long-run asymmetry of the import price to exchange rate fluctuations. In Equation 4.10 the coefficient β_{22} is equated to β_{23} i.e. $\beta_{22} = \beta_{23}$ to test the hypothesis whether large and small changes in the exchange rate have the same impact on import prices. If this hypothesis is true, then it will indicate that large or small changes in the exchange rate have no significant impact on import prices in Kenya.

Once the models have been estimated and coefficients obtained, interpretations are made given the theoretical expectations of the models. The asymmetry with respect to the size of a change in the exchange rate is explained by the presence of menu costs and the type of price invoicing involved. Given that menu cost is a form of fixed cost, changing invoice price is worthwhile only if the exchange rate is above a certain threshold. According to Pollard and Coughlin (2004) if the price invoicing is in the importers currency then it is expected that ERPT is greater when exchange rate changes are large. However if the price invoicing is in

the exporters currency then it is expected that ERPT is greater when exchange rate changes are small.

4.3 Second Stage ERPT

The second stage of ERPT (the transmission channel of exchange rate fluctuations and import prices to domestic prices – producer and consumer prices) is determined by estimating impulse response functions, variance decompositions and conducting block exogeneity Wald tests based on the VAR system represented by Equations (4.11 – 4.14) This is done by setting up an unrestricted VAR framework similar to those used by other authors (Karoro et al, 2009; Mwase, 2006; Hyder and Shah, 2004; McCarthy, 2000). The framework incorporates a distribution chain of prices, modelling inflation at each distribution stage – import, producer and consumer. The VAR model comprises four variables in the following order, in log difference form. The nominal effective exchange rate (Δp_t^{NEER}), import prices (Δp_t^{IMP}), producer prices (ΔLp_t^{PPI}) and consumer prices (ΔLp_t^{CPI}).

$$\Delta Lp_t^{NEER} = \sum_{i=1}^k \gamma_{11}^i \Delta Lp_{t-i}^{NEER} + \sum_{i=1}^k \gamma_{12}^i \Delta Lp_{t-i}^{IMP} + \sum_{i=1}^k \gamma_{13}^i \Delta p_{t-i}^{PPI} + \sum_{i=1}^k \gamma_{14}^i \Delta Lp_{t-i}^{CPI} + \varepsilon_{1t} \quad (4.11)$$

$$\Delta Lp_t^{IMP} = \sum_{i=1}^k \gamma_{21}^i \Delta Lp_{t-i}^{NEER} + \sum_{i=1}^k \gamma_{22}^i \Delta Lp_{t-i}^{IMP} + \sum_{i=1}^k \gamma_{23}^i \Delta p_{t-i}^{PPI} + \sum_{i=1}^k \gamma_{24}^i \Delta Lp_{t-i}^{CPI} + \varepsilon_{2t} \quad (4.12)$$

$$\Delta Lp_t^{PPI} = \sum_{i=1}^k \gamma_{31}^i \Delta Lp_{t-i}^{NEER} + \sum_{i=1}^k \gamma_{32}^i \Delta Lp_{t-i}^{IMP} + \sum_{i=1}^k \gamma_{33}^i \Delta p_{t-i}^{PPI} + \sum_{i=1}^k \gamma_{34}^i \Delta Lp_{t-i}^{CPI} + \varepsilon_{3t} \quad (4.13)$$

$$\Delta Lp_t^{CPI} = \sum_{i=1}^k \gamma_{41}^i \Delta Lp_{t-i}^{NEER} + \sum_{i=1}^k \gamma_{42}^i \Delta Lp_{t-i}^{IMP} + \sum_{i=1}^k \gamma_{43}^i \Delta p_{t-i}^{PPI} + \sum_{i=1}^k \gamma_{44}^i \Delta Lp_{t-i}^{CPI} + \varepsilon_{4t} \quad (4.14)$$

The variables at time (t) are determined by the previous period's expectation and their respective shocks, or expectation errors, $\varepsilon_{mt} \sim \text{i.i.d}$ (independent and identically distributed).

γ_{nm}^i represents parameters to be estimated, and k is the maximum lag length.

The ordering of the variables is specific because the model assumes that causality runs from the nominal effective exchange rate to import, producer and then consumer prices, and that the degree of endogeneity increases in that order. Furthermore, the model assumes that pricing decisions at the import and production stages can have simultaneous impact on consumer prices but not vice versa (McCarthy, 2000 and Bhundia, 2002). However, Bhundia (2002) notes that there is a potential weakness in the recursive structure of the model because prices can feed back to the exchange rate within one period of time as determined by the frequency of the data set - in this case one month. To overcome these drawbacks, Bhundia (2002) suggests estimating alternative orderings of the variables to verify the robustness of the initial ordering.

4.4 Econometric Technique

4.4.1 Data

For the empirical analysis, quarterly data spanning 15 years (60 observations) from the first quarter of 1993 to the fourth quarter of 2008 is used. The starting year of 1993 was chosen because that was when the Kenyan economy was fully liberalised and the Kenyan Shilling was allowed to freely float. The sources of data are from International Financial Statistics IFS and The World Bank African development indicators, unless otherwise indicated. The variables used in the model are:

Import Price Index (IMP): Import prices are used as a measure of price levels to examine pass through of exchange rate movements into domestic prices. The import price index is seasonally adjusted expressed on the base (2005=100). The import price index is sourced from The World Bank African development indicators.

Nominal Effective Exchange rate (NEER): The NEER is calculated as the trade weighted average of the country's exchange rate against other currencies and it was chosen as a measure of the exchange rate rather than the bilateral exchange rate *vis-à-vis* the United States Dollar because countries engage in trade with more than one country implying that one should consider not only how changes in the bilateral rate affects prices but how changes in the currency *vis-à-vis* the currencies of its trade partners affect consumer prices. In the case of Kenya data on NEER was unavailable, however Bahmani-Oskooee and Gelan (2007) did a

study on real and nominal effective exchange rates for African countries in order to construct the NEER for most African countries that the data was unavailable. Thus NEER was constructed for 21 African countries including Kenya from 1971: 1 to 2004: 3. This was the data used, however since it was only constructed till 2004 the remaining years were constructed using the same formula and due consideration was taken in the selection of the countries to include. Thus starting from 2003:1⁵ NEER was calculated using Kenya's top trading partners using the formula below:

$$NEER = \sum_{i=1}^s \lambda_{ij} \left(\frac{E_{ijt}}{E_{ij2003}} \times 100 \right) \quad (4.15)$$

Where:

λ_{ij} = is the trade share of imports for trading partner i with country j such that $\lambda_{ij} = 1$

E_{ij} = is the nominal bilateral exchange rate defined as number of units of trading partners i 's currency per unit of j 's currency.

The table below shows the countries used and the weights included:

Table 4.1: Top import trading partner weights (%)

Country (source of imports)	Weights (%)
Euro Zone (EU27) ⁶	24
India	15
China	14
U.A.E	12
S.A	12
Saudi Arabia	8
US	8
Japan	7

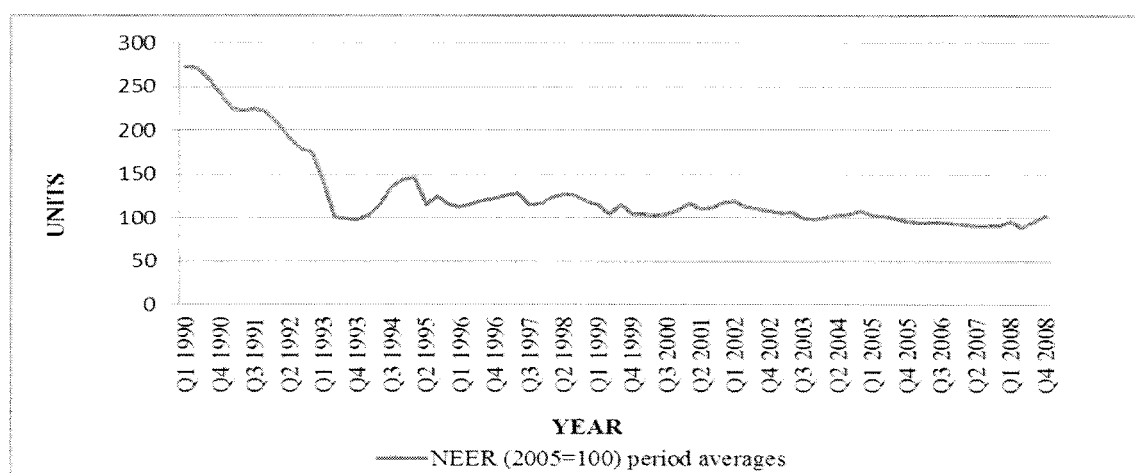
Source: DG Trade Statistics (2009).

⁵ This start date was chosen to ensure that the results obtained coincided with the study done by Bahmani-Oskooee and Gelan (2007)

⁶ The Euro Zone is used for consistency as it captures the imports of not only UK and Germany but other European countries that were included in the calculation of NEER by Bahmani-Oskooee and Gelan (2007)

The weights were sourced from DG Trade Statistics (2009) with the bilateral exchange rate data sourced from the Central Bank of Kenya. The Index is expressed on the base 2005 = 100 period averages. The graph below shows the NEER series obtained as previously represented in Chapter 3:

Figure 3.3: Nominal Effective Exchange Rates: Period Averages (2005=100)



Source: Computed by Author with data from Bahmani-Oskooee and Gelan (2007) and The Central Bank of Kenya

Exporters Production Cost (EPC): This is proxied by the export price index of foreign producers of Kenya's imports. It is calculated by finding the weighted mean of the export price index for Kenya top trading partners. The countries included were China, South Africa, Japan, U.S, U.K. and Germany (which acts as a proxy for the European Union)⁷. These are seen on table 4.2 below.

The weights used for EPC are derived from calculating the total annual average imports (1993 – 2008) of six of the largest trading partners of Kenya and allocating the weights according to the percentage input of total imports from each country. For all six countries the export price indices are (2005=100) period averages, obtained from the IMF International Financial Statistics (IFS)

⁷ India, UAE and Saudi Arabia were not included in the construction of EPC due to availability of export price indices for the period required. However this does not majorly affect the analysis as the rest of the countries capture most of the trade flow in Kenya

Table 4.2: EPC weights (%)

Country (source of imports)	Weights (%)
	EPC
UK	20
US	18
S.A	18
Japan	17
China	16
Germany	10

Source: Central Bank of Kenya and IMF International Financial Statistics

Consumer Price Index (CPI): reflects the average change over time in the prices of a specified set of final commodities and services representing the market of a given group of consumers. This is expressed as an index (2005 =100), period averages. The consumer price index was sourced from the IMF International Financial Statistics series code 66464...ZF

Manufacturing Value Index (MVI): Used as a proxy for production prices as the producer price index is unavailable for Kenya. This proxy is used in line with other studies such as Olinlola and Babatunde (2009) and Barhoumi (2006) that used manufacturing output prices and manufacturing production prices as a proxy for producer prices. This variable is expressed as an index (2005=100). It was sourced from the World Bank African development indicators.

4.4.2: Methodology

Different models and techniques have been used to estimate ERPT. Most of the earlier studies (e.g. Knetter, 1994) used the ordinary least squares (OLS) method as it seemed appropriate to explain pass-through since the fundamental principle in regression analysis is to describe the relationship between a given variable and other variables within the same system. Johansen (2000: 361) explains that this simultaneous relationship between variables was based upon the theory that process was stationary i.e. the means and variances of these variables being tested are constant over time, however most of the macroeconomic time series variables are non-stationary. Thus in recent years many studies have used vector autoregressive (VAR) and cointegration methods in the estimation of the long-run relationship between the variables.

In this study the Johansen (1991) and (1995) cointegration techniques with impulse response and variance decomposition functions together with block exogeneity Wald tests based on a VAR framework will be used to estimate the first and second stages of ERPT. The estimation will be done in the following steps

1. Test the stationarity of the data series
2. Test for cointegration using Johansen methods;
3. Obtain long-run and short-run estimates of ERPT
4. Determine the second-stage of ERPT by estimating the impulse responses, variance decompositions and block exogeneity Wald tests based on the VAR system of equations

4.4.2.1: Testing for Stationarity

In this thesis, two tests are performed to test the data for stationarity. The Augmented Dickey-Fuller (ADF) test and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test. The ADF test is a widely used test in the literature to test for unit roots. The null hypothesis is that the series X_t has a unit root i.e. non-stationary. On the other hand the KPSS stationarity test is different from the ADF unit root test in that the ADF null hypothesis states that the series is non-stationary while in the KPSS the null hypothesis states that the series is stationary.

4.4.2.2: Cointegration and Vector Error Correction Modelling

The Johansen procedure is a procedure based on maximum likelihood estimates using a VAR framework. It is a method used to establish whether there are any cointegrating relationships among the variables under consideration and to test whether a long-run relationship exists among them. The advantage of the Johansen (1991) and (1995) procedure is that it permits the identification of all cointegrating vectors within a given set of variables as opposed to methods such as the Engle-Granger approach that is unable to detect more than one cointegrating relationship in a model.

As mentioned the Johansen (1991) and (1995) procedure uses a maximum likelihood approach. The procedure is specified using Equation 4.18 below:

$$y_t = z + \sum_{i=1}^p \Lambda_i y_{t-i} + \varepsilon_t \quad (4.18)$$

Where y_t is an $n \times 1$ vector of first differenced $I(1)$ variables such that $y_t = [\text{Log (IMP)}, \text{Log (EPC)}, \text{Log (NEER)}]$ with a vector auto regressive (VAR) model of order k . ε_t is a $(n \times 1)$ vector of deterministic trend variables.

Equation (4.18) is converted to a vector error correction model (VECM) to estimate for the short term dynamics. It is estimated by equation 4.19 below

$$\Delta y_t = z + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-1} + \varepsilon_t \quad (4.19)$$

where Δy_t is the differenced form of y_t , thus representing all $I(0)$ variables. Δ is the first difference operator, Π is a $(n \times n)$ coefficient matrix whose rank determines the number of cointegrating relationships among the variables. Thus if Π is of full rank, that is, $r = n$, this suggests that the variables are level stationary, and if $r = 0$, this means that there are no cointegrating vectors. However if Π has a reduced rank $r \leq (n - 1)$, then it can be re-written in the following form as represented by Equation 4.20 below:

$$\Pi = \alpha\beta \quad (4.20)$$

Where α is a $n \times r$ matrix of error correction, representing the model's speed of adjustment to the preceding period's deviation from the equilibrium relationship. β is a $r \times n$ matrix of long-run coefficients.

In order to test for the rank of Π matrix to determine the number of cointegrating vectors one has to firstly determine the optimal lag length. The optimal lag length is found by using the information criteria (IC) which selects the number of parameters that will minimise the value of the IC.

Once the optimal lag length has been obtained and the appropriate assumption selected, the rank of Π matrix can be tested. This is done by two different likelihood tests provided by Johansen (1988) to determine the value of r . The trace test is represented by Equation 4.21 and the maximum eigenvalue test is represented by Equation 4.22 below

$$\lambda_{trace}(r) = -T \ln(1 - \lambda_i) \quad (4.21)$$

$$\lambda_{max}(r, r+1) = -T \ln(1 - \lambda_{r+1}) \quad (4.22)$$

where r is the number of cointegrating vectors under the null hypothesis and λ_i is the i -th largest eigenvalue of the Π_i matrix in Equation 4.18. The trace test (λ_{trace}) is a joint test where the null hypothesis is that the number of cointegrating vectors is less than or equal to r , against an unspecified alternative that there are more than r . The maximum eigenvalue test (λ_{max}) on the other hand tests the null hypothesis that the number of cointegrating vectors is r against the alternative of $r+1$. (Brooks, 2008: 351) If the test statistic is greater than the critical values, the null hypothesis is rejected.

Once the number of cointegrating vectors is identified, the VECM (see Equation 4.19) is estimated to find the short-run dynamics. This is done by specifying the number of cointegrating vectors and normalising the model on the true cointegrating relationship(s).

4.4.2.3 Impulse response, Variance decomposition and Block exogeneity Wald test

The second stage of ERPT is analysed by estimating the impulse response and variance decompositions of the domestic prices to shocks from exchange rate and import price changes, as well as block exogeneity Wald tests. These tests are important in determining whether changes in the exchange rate have a positive or negative effect on domestic prices, and how long that effect would take to be fully reflected in the economy.

Impulse response

The impulse response traces out the responsiveness of the dependent variables in the VAR to shocks to each variable. So for each variable from each equation separately, a unit shock is applied to the error, and the effects upon the VAR system are noted over time (Brooks, 2008:

299). In the case of this thesis, the impulse response function will be able to reveal the sign, size and persistence of shocks from the exchange rate and import prices to domestic prices.

Variance Decomposition

The variance decomposition offers a slightly different method for examining VAR system dynamics. They give the proportion of the movements in the dependent variables that are due to their own shocks versus shocks to the other variables (Brooks 2008:300). In this case, the variance decomposition shows the importance of shocks within the domestic prices themselves versus shocks from the exchange rate and import prices.

Block exogeneity Wald tests

This test is done to determine which set of variables have a significant effect on each dependent variable by placing zero restrictions on the lags of the independent variables (Brooks 2008: 297). This test helps to determine whether changes in one variable may cause changes in another based on the significance effect of the first variable to the other variable. It is important to note that though the tests identify the variables that are statistically significant in the model, they do not show whether the effect is positive or negative. The impulse response functions help in this regard.

4.5 Conclusion

In this chapter the conceptual framework, data as well as the analytical framework was discussed in order to investigate the symmetric and asymmetric pass-through of exchange rate movements to domestic prices. The two main stages of ERPT were discussed in terms of the techniques that will be used in the analysis which will entail the use of the Johansen (1991) and (1995) cointegration techniques for stage one and impulse response functions, variance decomposition and block exogeneity Wald tests for stage two. Asymmetric pass-through is estimated using the approach noted in Pollard and Coughlin (2004) to see the effect of appreciation or depreciation and large or small changes on pass-through. The next chapter reports the results obtained from these estimation techniques with the aim of achieving the goals of this study.

CHAPTER 5:

EMPIRICAL ANALYSIS AND RESULTS

5.1 Introduction

In this chapter, the results of the empirical analysis based on the econometric framework in Chapter 4 are reported. The following sections will cover the steps involved in the analysis beginning with the long-run pass-through results based on the Johansen (1991) and (1995) cointegration methods. The symmetric and asymmetric pass-through results are reported in terms of appreciation and depreciation and in relation to size - small and large. The transmission of the nominal effective exchange rates and import price changes to domestic prices is then explored to determine the main channels of ERPT in Kenya, the magnitude of pass-through and how long it persists. This is done by employing impulse response and variance decomposition functions as well as block exogeneity tests based on the VAR framework outlined in Chapter 4 to estimate the second stage of pass-through.

5.2: First Stage Pass-Through Results

This section reports the results of long-run symmetric and asymmetric pass-through using the Johansen (1991) and (1995) cointegration methods. The section begins by reporting the unit root test results then presents the results of the cointegrating relationship between exchange rate, import prices and exporter production costs which determine the magnitude and speed of long-run ERPT in Kenya. It then proceeds to establish the asymmetric properties of the long-run pass-through in order to determine whether the direction of change in the exchange rate (appreciation or depreciation) and the size of change (large or small at a 3% threshold) have an effect on the pass-through of exchange rate changes to import prices. This analysis follows the framework used by Pollard and Coughlin (2004).

5.2.1 Unit Root Test Results

The initial steps employing the Johansen cointegration technique is to establish the order of integration of the series by undertaking stationarity tests and thus determining the existence or otherwise of unit roots in the series. This study uses one formal unit root test and one

stationarity test, Augmented Dickey-Fuller (ADF) test and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test respectively. To begin the analysis, one has to firstly establish the relevant trend and or intercept assumption, the results for the conditional hypothesis tests are reported below in Table 5.1 below.

Table 5.1: Conditional Hypothesis testing results

Variable	Intercept only	stochastic trend	Deterministic trend	Decision rule
LCPI	-0.25590	1.278448	1.343901	None
LEPC	-0.978511	0.152788	1.334397	None
LIMP	-0.394776	0.604700	1.340694	None
LNEER	3.211447	4.051282 ^a	-2.434809 ^a	Trend and Intercept
LMVI	2.015298	2.366871 ^a	-1.243615	Intercept

Notes: a, b, c denotes the level of significance at 1%, 5%, 10% level respectively.

The results show that most of the series apart from the nominal effective exchange rate (LNEER) have no intercept or trend, while the nominal effective exchange rate (LNEER) has an intercept and trend component. Thus both trend and intercept are included in the test equations for all series using ADF test. The unit root test results are indicated in table 5.2 below

Table 5.2: Unit Root and Stationarity Test Results

			LCPI	LEPC	LIMP	LNEER	LMVI
Test Method							
ADF	Level	Intercept	0.72	0.10	0.44	-3.22 ^a	-2.02
		Intercept & Trend	-1.22	-0.16	-0.63	-4.09 ^a	-2.37
	1 st Diff	Intercept	-6.58 ^a	-5.08 ^a	-2.38	-9.92 ^a	-1.88
		Intercept & Trend	-6.57 ^a	-5.34 ^a	-2.60	-9.81 ^a	-2.26
	2 nd Diff	Intercept			-5.41 ^a		-9.68 ^a
		Intercept & Trend			-5.42 ^a		-4.11 ^a

Test: a, b, c denotes the level of significance at 1%, 5%, 10% level respectively.

From Table 5.2 the results of the unit root test show all the series are integrated of order one (I (1)) with the exception of the import price index (LIMP) and the manufacturing value index (LMVI) which are of order two (I(2)).

5.2.2: Cointegration results

Given that the ADF test results indicate that all the variables are non-stationary, the next step is to investigate whether there are any cointegrating relationships among the variables i.e. Nominal effective exchange rate, import prices and exporters production. This is represented by the Equation 4.5 below (previously represented in chapter 4)

$$\text{Log}p_t^{\text{IMP}} = \beta_1 + \beta_2 \text{Log}c_t^{\text{EPC}} + \beta_3 \text{Log}e_t^{\text{NEER}} + \varepsilon_t \quad (4.5)$$

The results of the cointegration tests and the relevant residual diagnostic tests are summarised in Tables 5.3 and 5.4 below. The aim of the cointegration analysis is to establish the extent to which fluctuations on the nominal effective exchange rate are passed on to import prices in Kenya after controlling for other variables in the model. The results in both Table 5.3 and 5.4 are based on Equation 4.5 represented above with lag to selected by the Final prediction error (FPE), AIC (Akaike information criterion), Schwarz information criterion (SC) and HQ (Hannan – Quinn information criterion)

Table 5.3: Johansen Cointegration tests results: VAR= {LIMP, LEPC, LNEER}

	Variable			Trace statistics under the H0: rank=r			Max-Eigen statistics under the H0: rank=r		
	Obs	K	A	$r = 0$	$r \leq 1$	$r \leq 2$	$r = 0$	$r \leq 1$	$r \leq 2$
Equat. 4.5	61	2	3	36.83[0.01]	11.91[0.16]	1.82[0.18]	24.93[0.01]	10.09[0.21]	1.82[0.18]

Notes: K: Lag length A: Deterministic trend assumption of the test

A lag length of two was chosen and both the Johansen trace and maximum Eigen value test indicate one cointegrating relationship at 5% level for Equation 4.5. Table 5.4 shows that the weak exogeneity tests indicate that import prices are endogenous. Given the error-correction term as well as the weak exogeneity test, LIMP is normalised to obtain the long run pass-through terms. This is represented by Equation 5.1 below:

$$\text{Log}p_t^{\text{IMP}} = 2.72 \text{Log}c_t^{\text{EPC}} - 0.36 \text{Log}e_t^{\text{NEER}} + \varepsilon_t \quad (5.1)$$

Table 5.4: Cointegration Analysis of LIMP, LEPC and LNEER

	obs	r	K	A	Const	ECM	LNEER	EPC	$\alpha=0$	β_2	β_3	$\beta_2=\beta_3$	LC
Equat 4.5	62	1	2	3	0.36	-0.12(-3.14)	-0.36(1.502)	2.72(-5.25)	4.84[0.03]	1.03[0.31]		4.30[0.04]	13.07[0.16]

Note: r: number of cointegrating vectors, K: lag length, A: deterministic trend assumptions

Equation 5.1 indicates that a 100 percent change in the Kenyan Shilling will result in a decrease in import prices by 36%. This implies that symmetric pass-through of exchange rate changes to import prices is incomplete and low. These results differ with other findings such as Kiptui et al (2005) who found the long-run pass-through coefficient to be 71%. This study spanned from 1972-2002. Possible factors may be attributed to this decline. One of which is the period of study chosen for the analysis. In the study done by Kiptui et al (2005), the period of study included both the period before and after the Kenyan economy was fully liberalised in 1993. As discussed in Chapter 3 of this study, Kenya went through a number of changes that would attribute to the high level of pass-through including the oil shocks of the 1970's as well as the high inflationary levels in the late 1980's and early 1990's. In this study the period captured (1993-2008) reflects times of more economic stability and lower inflationary levels. This seems to support Taylor's (2000) argument that ERPT is higher in environments with high inflationary levels.

To test whether the law of one price holds, a likelihood ratio test is conducted. It tests whether the coefficients of import prices and exporters' production costs are equal. The null hypothesis states that $\beta_2 = \beta_3$. As seen on Table 5.4, the null hypothesis is rejected with the likelihood ratio statistic for $\beta_2^* = \beta_3$ distributed as $\chi^2(1)$ is 4.30 [0.04]. This indicates that in the case of Kenya, the law of one price does not hold. There may be a number of reasons why this is so, among which are transaction costs, differences in monetary policies and management of exchange rates between Kenya and its trading partners.

The coefficient of EPC, β_2 as shown in Table 5.4 shows that there is positive relationship between exporters' production costs and import prices. However, the

relationship is not statistically significant. Furthermore, the error correction coefficient of LIMP is correctly signed and highly significant. On average, in the short-run Kenya's import prices adjust to equilibrium by about four percent of any disequilibrium in the long-run relationship each month.

5.2.3 ERPT Asymmetry

This section establishes the asymmetric properties of the first stage of ERPT to Kenya. The analysis follows the approach used by Pollard and Coughlin (2004). Thus this section aims to establish whether the direction of change in the exchange rate i.e. appreciation and depreciation and size changes - large and small (at a three percent threshold) have an effect on ERPT to import prices.

To begin the analysis, unit root and stationarity tests are conducted on the four constructed variables, ACC_A, ACC_D, ACC_L and ACC_S. The results of are reported in Table 5.7 below. All series are found to be non-stationary at level

Table 5.5: Unit root and stationarity test results for asymmetry series

			ACC_A	ACC_D	ACC_S	ACC_L
Kenya						
ADF	Level	Intercept	-3.21 ^b	1.30	-1.92	0.63
		Intercept & Trend	-2.74	-1.76	-1.72	-2.04
	1 st Diff	Intercept	-5.31 ^a	-7.85 ^a	-5.47 ^a	-2.23
		Intercept & Trend	-5.76 ^a	-7.92 ^a	-5.62 ^a	-2.39
	2 nd Diff	Intercept				
		Intercept & Trend				
KPSS	Level	Intercept	0.98 ^a	1.10 ^a	0.24	0.72 ^a
		Intercept & Trend	0.23 ^a	0.08 ^a	0.22	0.12
	1 st Diff	Intercept	0.46 ^c	0.30	0.22	0.32
		Intercept & Trend	0.09	0.13 ^c	0.05	0.12
	2 nd Diff	Intercept				
		Intercept & Trend				

Test: a, b, c denotes the level of significance at 1%, 5%, 10% level respectively. For KPSS, critical value for 1%, 5%, 10% levels for the model with no trend are 0.739, 0.463, and 0.347 and with trend are 0.216, 0.146, and 0.119 respectively.

5.2.3.1: Asymmetry – Appreciation versus Depreciation

In Chapter Four, it was established that two alternative models are estimated to investigate the size of the long-run and short run pass-through of the Shilling's appreciation and depreciation to import prices. The three models are represented below:

$$\text{Log}p_t^{\text{IMP}} = \beta_4 + \beta_5 \text{Log}c_t^{\text{EPC}} + \beta_6 \text{Log}e_t^{\text{NEER}} + \beta_7 \text{Log}e_t^{\text{ACC-D}} + \varepsilon_t \quad (4.6)$$

$$\text{Log}p_t^{\text{IMP}} = \beta_8 + \beta_9 \text{Log}c_t^{\text{EPC}} + \beta_{10} \text{Log}e_t^{\text{NEER}} + \beta_{11} \text{Log}e_t^{\text{ACC-A}} + \varepsilon_t \quad (4.7)$$

$$\text{Log}p_t^{\text{IMP}} = \beta_{12} + \beta_{13} \text{Log}c_t^{\text{EPC}} + \beta_{14} \text{Log}e_t^{\text{ACC-A}} + \beta_{15} \text{Log}e_t^{\text{ACC-D}} + \varepsilon_t \quad (4.8)$$

All three equations are estimated using the Johansen Cointegration (1991) and (1995) methods and the results are presented in Table 5.8 below for Equation 4.6, 4.7 and 4.8 respectively. For Equation 4.6, two cointegrating vectors were found at lag length of two with a deterministic trend assumption of three. The β coefficients β_6 and $(\beta_6 + \beta_7)$ represent the long-run pass-through coefficients corresponding to appreciation and depreciation respectively. The results show that the depreciation coefficient was approximately 0.72 while the appreciation coefficient was 1.10. The error correction coefficient for import prices is significant and correctly signed implying that import prices do adjust to equilibrium aftershocks in the explanatory variables.

The likelihood test was performed to confirm whether the appreciation and depreciation coefficients are significantly different. The null hypothesis of $\beta_7 = 0$ was tested to ascertain whether there is long-run asymmetry of import prices to exchange rate changes. The likelihood ratio test statistic for $\beta_7 = 0$, distributed as $\chi^2(1)$ is 14.85 [0.00]. Thus the null hypothesis ($\beta_7 = 0$) is rejected. Suggesting that $\beta_7 \neq 0$ and therefore $(\beta_6 + \beta_7) \neq \beta_6$. Thus there is long-run asymmetry to exchange rate pass-through to import prices.

Equation 4.7 is tested in a similar way and only one cointegrating vector was found at a lag length of two and a deterministic trend of three. The β coefficients $(\beta_{10} + \beta_{11})$ and β_{10} represent the long-run pass-through coefficients corresponding to appreciation and depreciation respectively. The results show that for a 100% change in exchange rate, pass-

through will be greater for depreciation than appreciation. The likelihood test for model C with the null hypothesis stating that $\beta_{11} = 0$ was done. The likelihood test statistic for $\beta_{11} = 0$, distributed as $\chi^2(1)$ is 7.02 [0.00]. The null hypothesis is rejected, suggesting that $\beta_{11} \neq 0$ and therefore $(\beta_{10} + \beta_{11}) \neq \beta_{10}$. Thus there is long-run asymmetry to exchange rate pass-through to import prices.

In model D, the long-run ERPT coefficients, β_{14} and β_{15} are found to be approximately 1.55 and 0.52 respectively. In this estimation, only one cointegrating vector was found at a lag length of two and a deterministic trend of four. As with the previous models, the error correction coefficient of import prices is significant and correctly signed. In this model three likelihood ratio tests were performed. The following restrictions were placed on the β coefficients, $\beta_{14} = 0$, $\beta_{15} = 0$ and $\beta_{14} = \beta_{15}$. The likelihood ratio test results are presented below in Table 5.8.

The results reveal that when the depreciation variable is included in the same model with the appreciation variable the long-run depreciation pass-through coefficient β_{15} is insignificant⁸. However the long-run appreciation pass-through coefficient β_{14} was found to be significant with the likelihood ratio test statistic distributed as $\chi^2(1)$ being 8.85[0.00]. Furthermore the null hypothesis $\beta_{14} = \beta_{15}$ is rejected⁹, implying that there is long-run asymmetry in the adjustment of import prices to exchange rate changes and the results further suggest that pass-through is greater when the Kenyan shilling is appreciating than when it is depreciating.

Given the results of pass-through asymmetry with respect to appreciation and depreciation, pass-through asymmetry is present and it appears that pass-through is greater when the Shilling is appreciating rather than depreciating. Following the theory presented in Chapter Two and as summarized in Chapter Four, it would appear that in the case of Kenya, firms have a market share objective and production switching is present when especially when

⁸ The likelihood ratio test statistic for $\beta_{15} = 0$, distributed as $\chi^2(1)$, is 0.57[0.45].

⁹ The likelihood ratio test statistic for $\beta_{14} = \beta_{15}$, distributed as $\chi^2(1)$ is 3.71[0.05].

foreign firms use imported inputs and depending upon the price, thus they switch between imported and domestically produced goods.

5.2.3.2: Asymmetry: Size – Large verses Small

The analytical framework of Pollard and Coughlin (2004) and Webber (2000) are adapted here to investigate the pass-through of large and small changes in the exchange rate to import prices. Equations 4.9 and 4.10 below represent the two models that were used in the estimation of pass-through asymmetry with respect to large and small changes in the exchange rate. The results are presented in Table 5.8 below:

$$\text{Log}p_t^{\text{IMP}} = \beta_{16} + \beta_{17}\text{Log}c_t^{\text{EPC}} + \beta_{18}\text{Log}e_t^{\text{NEER}} + \beta_{19}\text{Log}e_t^{\text{ACC-S}} + \varepsilon_t \quad (4.9)$$

$$\text{Log}p_t^{\text{IMP}} = \beta_{20} + \beta_{21}\text{Log}c_t^{\text{EPC}} + \beta_{22}\text{Log}e_t^{\text{ACC-S}} + \beta_{23}\text{Log}e_t^{\text{ACC-L}} + \varepsilon_t \quad (4.10)$$

Both equations are estimated using the Johansen cointegration (1991) and (1995) methods. One cointegrating vector is found in both equations. The lag length and deterministic trend assumptions chosen for both Equation (4.9) and (4.10) are two and three respectively. As with the previous models, the error correction coefficient of import prices is significant and correctly signed. The long-run ERPT coefficients in Equation (4.19) are $(\beta_{18} + \beta_{19})$ and β_{19} , which represent small and large exchange rate changes respectively. The results of Equation 4.9 in Table 5.8 indicate that the small ERPT coefficient is approximately 3% while large changes are approximately 61%.

The likelihood test was performed to confirm whether the small and large coefficients are significantly different. For model E, the null hypothesis of $\beta_{19} = 0$ was tested to ascertain whether there is long-run asymmetry of import prices to exchange rate changes. The likelihood ratio test statistic for $\beta_{19} = 0$, distributed as $\chi^2(1)$ is 0.60 [0.44]. Thus we fail to reject the null hypothesis. This implies that $(\beta_{18} + \beta_{19}) = \beta_{19}$. Thus there is no long-run asymmetry with respect to the size of change in the exchange rate

Table 5.6: Estimated long-run and short run parameters for ERPT Asymmetry: Direction and Size.

	Obs	K	r	A	Const	ECM	LNEER	EPC	ACC_D	ACC_A	ACC_S	ACC_L	LM			
Model													$\alpha=0$	$\beta_1=0$	$\beta_j=0$	$\beta_1=\beta_j$
Equat. 4.6	61	2	2	3	-10.95	-0.09(-3.35)	1.10(2.31)		-0.38(-4.39)				11.08[0.00]	14.85[0.00]		19.03(0.27)
Equat. 4.7	62	2	1	3	-12.43	-0.02(-1.89)	-3.32[0.40]	1.91(1.23)		0.98(3.74)			2.49[0.11]	7.02[0.00]		22.79(0.12)
Equat. 4.8	61	2	1	4	-15.85	-0.08(-3.58)		-2.33(-2.41)	0.52(0.81)	1.55(3.86)			6.45[0.01]	8.85[0.00]	0.57[0.45]	3.71[0.05]
Equat. 4.9	62	2	1	3	3.61	-0.12(-3.39)	-0.64(2.90)	2.42(-5.10)			0.61(1.22)		8.15[0.00]	0.60[0.44]		13.64(0.63)
Equat.4.10	62	2	1	3	9.43	-0.14(-4.08)		-3.02(-4.95)			1.92(2.86)	0.37(1.36)	2.99[0.08]	1.23[0.27]	1.10[0.30]	0.99[0.32] 11.01(0.81)

Notes: r: number of cointegrating vectors, K: deterministic trend assumption of the test, A: lag length, ECM: error correction model. Model B-F represent results for equation 4.6-10 respectively. The restrictions $\beta_1=0$ and $\beta_j=0$ represent the likelihood ratio test estimates for each of the models estimated. $\alpha=0$ restriction tests the endogeneity of the import price variable. The parentheses [] are used to denote probability values while () represent t-values. LM represents the residual diagnostic test for serial correlation

The results for Equation 4.10 as shown in Table 5.8 show that the long-run ERPT coefficients, β_{22} and β_{23} are found to be approximately 1.92 and 0.37 respectively. Three likelihood ratio tests were performed and following restrictions were placed on the β coefficients, $\beta_{22} = 0$, $\beta_{23} = 0$ and $\beta_{22} = \beta_{23}$. The likelihood ratio test results are shown above in Table 5.8. For all three tests we fail to reject the null hypothesis i.e. the β coefficients were found to be insignificant and therefore this implies that size changes in the Kenyan shilling has no significant effect on ERPT in Kenya.

In summary, the tests for ERPT asymmetry in Kenya shows that based on the direction and size of change have shown that in the long-run, pass-through is significantly greater when the Shilling appreciates. In terms of size changes the results have shown that there is no significant difference with regard to size, therefore whether there are large or small changes in the exchange rate it does not significantly affect long-run asymmetry

5.3 Second Stage Pass-Through Results

The second stage of pass-through describes the transmission of the NEER and import price changes to producer and consumer prices. The objective is to determine whether the main channel of ERPT in Kenya and to establish the magnitude of the pass-through and how long it persists. This analysis is based on the impulse and variance decomposition functions as well as block exogeneity Wald tests on the VAR system which are represented by Equations 4.11 -4.14 in Chapter Four.

The first two tests will help to investigate the magnitude and speed of pass-through respectively while the third test will help to establish the possible channels of ERPT of import prices to domestic prices. The expected outcome is a direct transmission of ERPT to prices as this is what appears to be the case in Kenya as discussed in Chapter three. It is also expected that the size of exchange rate pass-through will decline with each level of prices i.e. magnitude will decline as it moves down the pricing chain from import to producer to consumer prices.

5.3.1 Impulse Response Results

In this section the responses of Kenyan prices (import and consumer prices) to a one-period standard deviation shock in the innovations of the VAR system. The VAR system is estimated using impulse response functions based on the Cholesky decomposition. The impulse response functions are illustrated in Figure A. (see appendix 1). The result of the impulse response is consistent with that of the long-run model as discussed earlier. For instance, import price has a low and negative response to a change in exchange rate. The response did not commence until after five months, thereafter it responded gradually and persistently to the change in exchange rate.

5.3.2 Variance Decomposition Results

The variance decomposition results of exchange rates (LN_NEER), import prices (LN_IMP), producer prices (LN_MVI) and consumer prices (LN_CPI) are represented in Table 5.5 below. In panel I the variance estimates indicate that a greater portion of the variation in the NEER is due to its own innovations, though producer prices by the 25th month seem to explain about 20 percent of the variation. By the 25th month innovation of the NEER accounts for 59 percent of its own variation while the other variables account for the balance of 41 percent. The variance due to other variables (import and consumer prices) is very small.

Panel II indicates that in the first 5 months the greater proportion of the variation in import prices is due to its own innovations, however by the 25th month producer prices explain about 73 percent of the variation in import prices and exchange rate shocks about 6 percent while consumer prices account for about 11percent. This shows that import prices is highly endogenous determined largely by the domestic producer prices. This may reflect the structure of the manufacturing sector which is dominated mainly a cartel of Asian businesses. Given the structure of the manufacturing sector, it is possible for the manufacturers to influence both domestic and import prices in Kenya as evident from the results.

In Panel III, the results show that the innovations of manufacturing prices accounts for 79 percent of its own innovation the 25th month, while exchange rate explains about 3 percent and import prices accounts for about 12 percent while domestic consumer prices accounts for

about 6 percent of innovations by the 25th month. It is striking to note that the producer prices accounts for more variation in the other variables including exchange rate than any other variables explain variation in the producer price. Similarly, apart from innovation originating from each variable (with the exception of import prices), innovation from the manufacturing price account for more variation in all the other variables than any other variable accounted. Thus, the manufacturing prices are the most endogenous price of all the prices and seem to determine the behaviour of other prices including the exchange rate.

Table 5.7: Variance Decomposition Results

Panel	Period	D(LN_NEER)	D(LN_IMP)	D(LN_MVI)	D(LN_CPI)
I LN_NEER	1	100.000	0.000	0.000	0.000
	5	75.669	2.458	20.306	3.818
	10	68.083	6.109	18.969	6.839
	15	64.088	7.428	18.560	9.924
	20	59.403	7.925	20.047	12.624
	25	59.403	7.925	20.048	12.623
II LN_IMP	1	0.195	99.805	0.000	0.000
	5	0.124	68.847	8.906	21.122
	10	1.238	19.060	64.949	14.752
	15	2.258	10.629	76.771	10.342
	20	5.781	9.680	73.595	10.943
	25	5.781	9.680	73.594	10.944
III LN_MVI	1	5.690	0.030	94.280	0.000
	5	4.898	4.450	90.638	0.015
	10	3.062	11.210	85.097	0.631
	15	2.983	14.665	79.611	2.740
	20	3.145	14.013	77.715	5.125
	25	3.294	11.609	79.166	5.930
IV LN_CPI	1	0.516	1.780	3.836	93.868
	5	26.186	10.653	9.353	53.808
	10	27.270	15.299	14.045	43.386
	15	25.804	14.358	19.994	39.844
	20	24.661	12.806	25.400	37.133
	25	24.273	11.852	28.348	35.527

Note: Panel I – IV represent variance decomposition functions of D(LN_NEER), D(LN_IMP), D(LN_MVI) and D(LN-CPI) respectively.

The results in panel IV show that by the 25th month consumer prices accounts for about 35 percent of its own innovation, followed by a 28 percent innovation from manufacturing price, while 24 percent is accounted for by innovations from exchange rate and the remaining 12% is accounted for by import price. This further confirms the dominance of innovation from the manufacturing price.

5.3.3 Block Exogeneity Wald Test Results

The results of the block exogeneity tests are reported in Table 5.6 below. This test is used to determine whether changes in one variable may cause statistically significant changes in another variable within the system. Further, in conjunction with the results of the variance decomposition could be used to establish the transmission channel of exchange rate changes.

The results for panel I reveal that import prices and consumer prices do not have a significant impact on NEER. But consistent with the earlier results of the variance decomposition analysis, the manufacturing price has a significant effect on NEER. Panel 2 results indicate that manufacturing prices have the most significant effect on import prices, followed by consumer prices. Panel 3 shows that consistent with variance decomposition results, none of the other variables has a significant effect on the producer prices. Thus confirming, again, the strong exogeneity of the producer prices and its dominance in influencing other prices, including the exchange rate.

In panel IV, the results show exchange rate a significant effect on consumer prices while the other variables are not significant.

Table 5.8: Block Exogeneity Wald Test Results

Panel	Dependent Variable	Excluded Variable	Probability
I	D(LN_NEER)	D(LN_IMP)	0.154
		D(LN_MVI)	0.017
		D(LN_CPI)	0.470
II	D(LN_IMP)	D(LN_NEER)	0.369
		D(LN_MVI)	0.000
		D(LN_CPI)	0.000
III	D(LN_MVI)	D(LN_NEER)	0.983
		D(LN_IMP)	0.235
		D(LN_CPI)	0.415
IV	D(LN_CPI)	D(LN_NEER)	0.000
		D(LN_IMP)	0.206
		D(LN_MVI)	0.476

With regards to the channel of transmission, the results suggest that the driving force of the transmission is the domestic producer prices, which is largely due to the structure of the

manufacturing sector dominated by the Asia manufacturers, which acts like a cartel and it appears to be very strong. There is some indication of direct transmission channel from exchange rate through import prices to consumer prices. However, there is no direct transmission channel from exchange rate through import prices to producer prices, instead an inverse transmission appear to occur, from producer prices to import prices and then exchange rate.

In summary the findings of the cointegration analysis, impulse response, variance decomposition and block exogeneity Wald tests suggest that ERPT in Kenya is incomplete and low. The results also reveal some of evidence of a direct and an indirect channel of exchange rate fluctuations to prices. The results also strongly suggest the producer prices as the main driver of domestic prices including exchange rate.

CHAPTER 6:

SUMMARY, POLICY RECOMMENDATIONS, LIMITATIONS AND CONCLUSION

6.1: Summary of Findings

This thesis analysed the pass-through of exchange rate fluctuations to domestic prices in Kenya. The study also investigated long run ERPT asymmetry to import prices. The study began with a review of the theoretical and empirical literature on ERPT followed by an analysis of the Kenyan macroeconomic environment with regard to exchange rate and trade policies from the 1970's to 2000's. The relevant data available for Kenya guided the construction of the empirical framework that was used to carry out the study.

A background look into the Kenyan economy showed that Kenya's macroeconomic policies have evolved over the years. Since independence in 1964, there have been efforts to liberalise the economy. Up till 1993, the country went through various changes and shocks that affected key areas in the economy for example, during the late 80's and early 90's inflation rates were extremely high, affecting the country adversely. However in 1993, the Kenyan Shilling was allowed to freely float and Kenya adopted an open trade policy. Thus the country became fully liberalized. As advantageous as this was to the country, it left the domestic economy vulnerable to shocks in the global economy as well as fluctuations in the exchange rate, thus an analysis into the effect that exchange rate movements would have on prices is important aspect for empirical analyses.

Various models and data specifications have been used to investigate ERPT across the world, and the findings of most studies reviewed in this thesis have indicated that ERPT is incomplete in both developed and developing countries with varying magnitude from country to country. Furthermore, the literature on currency appreciation versus depreciation, reports contrasting results and provides no clear evidence on the direction of asymmetry. In some cases the pass-through associated with appreciation exceeds depreciation (e.g. Khundrapam, 2007 and Wickremasinghe and Silvapulle, 2004) and in other cases depreciation exceeds

appreciation (Webber, 2000) and Knetter (1994) finds that for most cases there is no evidence of pass-through asymmetry.

Empirically, the Johansen (1991) and (1995) cointegration methods were used to analyse ERPT to import prices in Kenya. The analysis began by looking into the long run symmetric pass-through of exchange rate changes to import prices. The results showed that ERPT to import prices is incomplete and low at 36%. This result was attributed to the decline in inflationary levels which are consistent with the argument by Taylor (2000) that higher pass-through levels are experienced when there is a high inflationary environment in the economy. The results showed that in the short run, Kenyan import prices were found to adjust to equilibrium by about 4 percent of any disequilibrium in the long-run relationship each month.

The long run asymmetric results with respect to direction and size changes revealed that there is pass-through asymmetry in Kenya with respect to direction but not with size. These were analysed by five models based mainly the frameworks of Pollard and Coughlin (2004) and Webber (2000). With regard to the direction of change in the exchange rate, the results showed that in the long run, pass-through is greater when the Shilling is appreciating than when it is depreciating. Theoretically as discussed in Chapter 2 and Chapter 4, the results support the market share and binding quantity constant theory. In the case of the size of exchange rate changes, the results revealed that size changes do not have a significant impact on import prices i.e. large or small changes do not play a significant role in pass-through asymmetry in Kenya.

The analysis further explored the transmission channels of ERPT to import, producer and consumer prices. This was analysed using impulse response, variance decomposition and block exogeneity tests. The results reveal that there is some indication of direct transmission channel from exchange rate through import prices to consumer prices. However, there is no direct transmission channel from exchange rate through import prices to producer prices, instead an inverse transmission appear to occur, from producer prices to import prices and then exchange rate, which is attributed to the structure of the manufacturing sector dominated a cartel of Asian manufacturers.

6.2: Policy Implications and Recommendations

There are various factors that may motivate the study of ERPT from a policy-makers point of view. Given that in recent years many economies have adopted a freely floating exchange rate and an open trade policy, this has made economies vulnerable to exchange rate fluctuations as well as international shocks. Therefore the degree of pass-through may be used as an approximation of the international macroeconomic transmission as monetary authorities generally perceive exchange rates as one of the major monetary transmission channels.

Another aspect that the study of ERPT brings forth is the outlook that ERPT will bring into international market power, structure and competitiveness of local industries. This is especially important when dealing with pass-through asymmetry when firms choose whether or not to adjust their mark-ups depending on the perceptions they have on the fluctuations of the ERPT. Thus aspects such as maintaining market power, binding quantity constraints and menu costs come into consideration.

Furthermore, ERPT has implications on trade flows depending on how open a country's trade policies are. According to Akofio-Sowah (2009:303) trade openness has an effect on the transmission of exchange rate changes to domestic prices. The more a country is open (i.e. there is a large presence of imports and exports) the more movements in the exchange rates are transmitted through import prices to consumer prices.

In looking at the findings of this study, it shows that ERPT has declined in Kenya, and it can be partly attributed to the inflationary environment in Kenya. The results also strongly suggest the producer prices as the main driver of domestic prices including exchange rate, this is due to the dominating presence of the cartel of Asian manufacturers. Thus policy makers need to create an environment of greater diversification and promotion of domestic industries in Kenya and furthermore, a continual strive to maintain their goals of price stabilization and implementation of an inflation targeting regime which is yet to be realized in Kenya.

The findings of this study also revealed that ERPT is greater when the Kenyan Shilling is appreciating than when it is depreciating. This brings aspects such as binding quantity constraints which the Ministry of trade in Kenya can help minimise by improving competitiveness in Kenyan markets. This can be done by establishing more trust and confidence within the domestic and international business sectors. In particular political stability and the reduction of corruption will assist in improving the economic environment in Kenya.

In a nutshell, given the findings of this study, Kenya's monetary, trade and industry authorities ought to work together to improve the global competitiveness of Kenya which will have a beneficial impact in the economy. Furthermore more local industries need to be encouraged to develop, and thus bring a more competitive atmosphere within the Kenyan markets.

6.3: Limitations of the Study and Areas for Further Research

One of the greatest challenges that affect Kenya and Africa as a whole is the availability of data. This was found to be a challenge in carrying out this study as some of the variables listed in the empirical model such as the producer price index had to be proxied by the manufacturing value index as the production price index is currently unavailable for Kenya. Furthermore some variables had to be constructed such as the NEER and the exporters' production cost (EPC) as they were unavailable for Kenya. This invariably may affect the accuracy of the model to fully capture the trend under review, however, these problems did not significantly affect the findings of this study as the results were consistent with theoretical literature as well as other empirical research done for Kenya.

In looking at areas of further research, one might consider exploring the effects of volatility of the exchange rate on the pass-through to domestic prices given the fact that the effect of exchange rate volatility on pass-through depends on whether exchange rate movements are perceived to be transitory or persistent. As explained by Akofio-Sowah (2009) when exchange rate volatility is high, the cost of price adjustment also increases. If the exchange rate shock thought to be transitory, exporters (or importers) would be more willing to adjust

their profit margins rather than adjust their prices thus reducing the extent of pass-through but if, however the shock is perceived to be more permanent then exporters and importers would be more likely to change prices than adjust profit margins. Another area of consideration is exploring ERPT at a more disaggregate level, concentration more on specific sectors such as transport and machinery and the manufacturing sector as much of the imports in Kenya comprise of these sectors.

6.4: Conclusion

The intention of this study was to investigate the long-run symmetric and asymmetric ERPT of domestic prices in Kenya. This was because since 1993 Kenya fully liberalized its economy leaving domestic prices vulnerable to the effects of exchange rate fluctuations. The study estimated different models of symmetric and asymmetric ERPT using the Johansen maximum likelihood approach and quarterly data from 1993:1 – 2008:4

The results obtained indicated that long-run symmetric ERPT to import prices is incomplete and low. This decline has been attributed to lower inflationary levels. The results also confirm a significant asymmetry with respect to the direction of changes in exchange rates with pass-through greater when the value of the Kenyan Shilling appreciates than when it depreciates. The results also show that there was no significant asymmetry with respect to size of the change in exchange rates, suggesting that in monitoring exchange rate movement, attention should be placed more on the direction of change rather than the size of change.

As the body of literature continues to grow in the understanding of the influence of exchange rate changes on the prices, particularly in developing countries, it is recommended that future research on ERPT in Kenya should explore the effects of volatility of the exchange rate on the pass-through to domestic prices and industry specific pass-through to explore pass-through effects at a more disaggregated level.

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APPENDIX

Appendix 1: Impulse Response Test Results

Figure A: Impulse response functions

