Asymmetric Impact of Exchange Rate Changes on Inflation: Evidence from Selected Developing Countries

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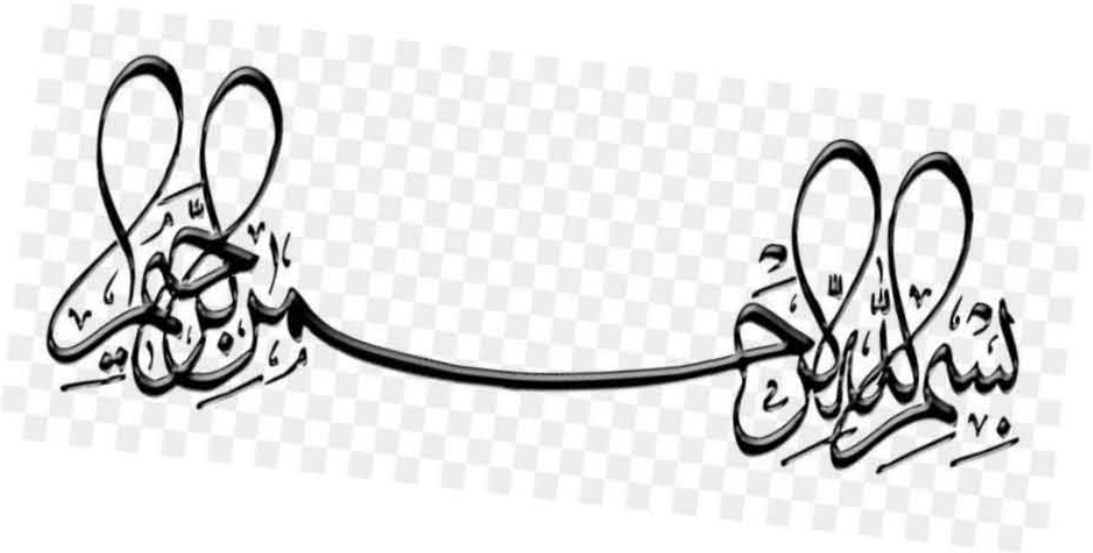

Dedication

I dedicate this humble work to **Allah (SWT)** The Almighty who bestowed me with the capacity to undertake this study. May HE have his blessings upon us forever.

(Attique Ur Rahman)

Certificate

This is certified that the dissertation titled **"Agricultural Export and Economic growth: Evidence from Pakistan"** by **Attique Ur Rahman** S/O **Muhammad Anwar** (Registration No. 02091813010) is accepted in its present form by the School of Economics, Quaid-i-Azam University, Islamabad as satisfying the dissertation requirements for the degree of Master of Philosophy in Economics.

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Declaration Form

I ATTIQUE UR RAHMAN, son of MUHAMMAD ANWAR, bearing Registration No. 02091813010, candidate of M.Phil Economics at School of Economics, Quaid-i-Azam University, Islamabad do hereby declare that the thesis titled "*Asymmetric Impact of Exchange Rate Changes on Inflation: Evidence from Selected Developing Countries"* submitted for the partial fulfillment of Master of Philosophy (M.Phil) degree in Economics, is my own work. All the errors and omission are lonely goes to me and I also somberly pronounce that it will not be submitted for attaining any other degree in the future from any institution.

ATTIQUE UR RAHMAN

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All praises and thanks to **ALLAH ALMIGHTY** The compassionate, The merciful, The only creator of the universe, and the source of all knowledge and wisdom Who blessed me with Good health, thoughts, talented teachers, co-operative friends and opportunity to make some contribution to the already existing ocean of knowledge. I offer my humblest thanks to the greatest social reformer, **The Holy Prophet Hazrat Muhammad (PBUH),** for His humanity.

I deem it my utmost pleasure in expressing my cadies gratitude with the profound benedictions to **Dr. Javed Iqbal**, Associate Professor, School of Economics, Quaid-i-Azam University Islamabad, for providing me with strategic command at every step. I extend deep emotions of appreciation, gratitude and indebtedness for his valuable guidance.

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Abstract

This study is conducted to investigate the impact of exchange rate fluctuations on consumer price inflation in selected group of 13 developing countries for period ranging from 1980 to 2019. The study also tests for the existence of asymmetric effects of currency appreciation and depreciation on consumer price inflation. The essence of such asymmetric effects is the downward rigidity of consumer prices as proposed by Keynesian economics. Linear Auto-regressive and Distributed Lag Model (ARDL) is used to estimate the short run and long-run pass-through to consumer prices while non-linear ARDL is used to check the existence of asymmetric effects. The empirical evidence establishes partial pass-through to consumer prices in the selected countries. We found strong evidence of existence of asymmetric effects of exchange rate fluctuations on consumer price inflation in all of the countries used in the study. Based on the established results the study suggests keen vigilance of monetary authorities to ensure exchange rate stability.

Chapter 1
INTRODUCTION

1.1 Background and Motivation

Among all the macroeconomic indicators, inflation is probably the most widely noticed indicator as it is perceived, understood and felt by every individual in the society. A common citizen judges government's economic performance by less other than inflation. Besides, it has far reaching socio-economic implications. It has a huge social cost associated with it as a rise in inflation further aggravates poverty especially in developing countries. This may results a rise in crimes, political unrest and at times violent conflicts. On the other side, rise in inflation results in allocative inefficiency and hoarding of durable goods leading to shortage and further rise in price level. High inflation also leads to increase in cost of production due to the shoe-leather cost and menu-cost incurred by businesses. Given the wide range of repercussions associated with it inflation has remained the most widely researched subject in economics.

Though price level has kept fluctuating over the course of time yet the first ever known notable inflation is the 'Spanish Price Revolution[1]'. This high inflation in second half of 15th century is mostly attributed to the influx of gold and silver from the New-World. Price level become more volatile since fiat money was adopted in 18th century. Since then, price level has been fluctuating across the globe though with an upward trend. In the course of time several cases of very high inflation, commonly known as hyperinflation have also been witnessed. The latest being in Venezuela where hyperinflation rose to 10 million percent[2] since 2018. Owing to its prevalence and impacts several economic theories have been developed to explain the factors contributing to inflation.

[1] Spanish Price Revolution
https://en.wikipedia.org/wiki/Price_revolution
[2] https://www.cnbc.com/2019/08/02/venezuela-inflation-at-10-million-percent-its-time-for-shock-therapy.html

Among the most important methods explaining inflation, one is the pass-through of exchange rate fluctuation to domestic consumer prices. Exchange rate pass through (ERPT) is an open-economy phenomenon whereby exchange rate fluctuations are transmitted to the domestic price level. The Exchange rate fluctuations are transmitted to domestic price level via both indirect and direct channels. Through direct channel, exchange rate depreciation makes import of finished goods and input more expensive thus increasing the overall price level. While the exchange rate depreciation raises the domestic and foreign demand of locally produced goods leading to an increase in aggregate demand. Domestic wages also increase as a result of higher demand for labour. This surge in aggregate demand translates into higher domestic prices. Recent studies suggest that the improvement in competitiveness of local manufactures without doing much discourages their incentive to cut down production cost. This results to higher inflation in the long-run. The Exchange rate appreciation works via the similar channels in the opposite direction, and is expected to lower domestic inflation. The degree of exchange rate pass through to different price indices differs in magnitude, with ERPT being higher to import price and lower to consumer prices. When variations in exchange rate are fully transmitted to domestic prices then it's known as Complete ERPT. Some studies bifurcate the pass through process into two stages where the pass through to import prices is called the first stage, while the pass through to consumer prices is known as second stage pass through. However, the degree of exchange rate is ultimately determined by the pricing decision of the exporter firms. It is often implicitly assumed that the exporters shall adjust home price of their product such that price remains more or less the same in wake of local currency depreciation. Nevertheless, this adjustment of price at cost of lower profit margin for the exporter firm.

Another important debate in the literature regarding exchange rate pass through is whether the asymmetric effect of exchange rate fluctuations on domestic prices exists. Two different strands of asymmetric effect of exchange rate pass through on domestic prices emanating from

size (large vs. small) and direction (depreciation vs. appreciation) have been identified. In essence, the asymmetric effects take root from the Keynesian assumption of price rigidity (especially downwards). Growing number of studies explore the existence and nature of non-linear effects of exchange rate fluctuations.

Lately the factors determining exchange rate fluctions to domestic price have been popular subject of empirical research. Some of the factors thus identified include trade openness, composition of imports, globalization, stance of monetary policy, independence of the central bank, transparency of monetary policy, inflationary environment of the country, exchange rate volatility, expectations about exchange rate policy, size of current account balance, oil prices and level of dollarization of the country.

This study explores the impact of exchange fluctuations to consumer prices in a set of 13 carefully selected developing countries. Existing literature indicate that average ERPT to consumer price in 27 emerging countries is about 22%[3]. However, the estimation of ERPT is highly sensitive to the methodology, sample and country[4]. Aziz et al (2013) found quite high ERPT to consumer prices (around 59%) for Bangladesh in the long-run. Helmy et al (2018) and Awad (2019) investigated the exchange rate fluctuations to consumer prices in Egypt which follows managed the floating exchange rate regime. Though, the former found substantial ERPT to consumer price the later found pass through to be significant only for a sub-period (2013-16) under study. Indonesia has been subject to especial attention of researchers due to soaring inflation in 1997-98 in the wake of high depreciation. Kohlscheen (2010) found the moderate impact of exchange rate fluctuations to consumer prices in Indonesia, while Sahminan (2005) found complete ERPT to consumer prices in Indonesia. Kurniati (2007) argued short-run ERPT to consumer prices has fallen significantly in the post-

[3] PIDE Knowledge Brief, *No. 5:2020*
[4] Ibid. p. 3

crisis period. Ito and Sato (2008) found the response on consumer prices due to exchange rate shocks were positive, large and significant. The study argued that passive monetary policy along with a huge response of consumer prices led to 'Depreciation-Inflation spiral'. Prasertnukul et al (2010) explored the effects of adopting inflation targeting exchange rate regime on ERPT and exchange rate volatility. Though inconclusive about the impact on ERPT the study found evidence of reduction in exchange rate volatility.

ERPT literature for the Indian sub-continent also remains inconclusive and open to new work. Khundrakpam (2007) studied the impact of exchange rate fluctuations to consumer prices in the aftermath of major devaluation of Indian Rupee in 1991. The study found no evidence in support of fall in ERPT. Further, the study found asymmetric effect with respect to size and direction of exchange rate fluctuation. Bhattacharya et al (2008) found significant but incomplete pass-through in the post reform period. Adekunle et al (2018) investigated the existence of asymmetric ERPT into consumer prices in Nigeria. The study found partial effect to consumer prices in the short-run while the estimates increased when the asymmetric effect of exchange rate were also taken into account. In the same vein, Musti and Siddiki (2018) found high and statistically significant long-run effects on consumer prices while the short-run results come out to be slow and insignificant. Ahmed et al (2018) investigated the ERPT to consumer prices, oil prices, interest rates and money supply. The study estimated degree of response to consumer prices around 7 percent. This point is also reiterated by Hyder and Shah (2004) who witnessed the moderate impact of exchange rate fluctuations to consumer prices in Pakistan. Both of the studies employ recursive VAR as suggested by McCarthy (2000). Finally, Minhaj and Nishat (2018) found negligible pass-through during low inflationary regime while about 2 percent pass-through during high inflation regime.

We have carefully selected a group of 13 emerging countries to ensure meaningful cross-country comparison. The sample includes populous but growing countries like India, Indonesia, Pakistan and Nigeria. Though there have been some studies on these countries, but the existence literature is not suffice to give clear vision of the situation. This study is motivated by the idea of exploring ERPT dynamics of selected prospectful Asian and African countries.

1.2 Research Gap

There is extensive literature available that analyzes the impact of exchange rate fluctuations to variety of domestic price indices including consumer prices, producer prices, wholesale prices, import prices and oil prices. As mentioned earlier the ERPT analysis is found to be highly sensitive to methodology and sample that is why quite different results have been observed in literature. There have been some studies for the countries included in our sample set. However, the existing literature explores only the linear relationship between exchange rate fluctuations and inflation and fails to take into account the asymmetric effects. It is now established that exchange rate fluctuations to inflation exhibit asymmetric behaviour with respect to size and direction. Failure to account for such asymmetries may contaminate the analysis.

This study is an attempt to ascertain the degree of ERPT in 13 selected developing countries after taking into account the non-linear effects. The sample includes some of the important regional economic players in Asia and Africa with large population e.g. India, Indonesia, Pakistan and Nigeria. The list has been carefully selected to ensure cross-country comparison.

1.3 Research Objectives

The objective of this study is to analyze the impact of exchange rate fluctuations to consumer price inflation in selected developing countries. Moreover, the study also investigates whether

exchange rate fluctuations do have asymmetric effect on domestic inflation. The objectives of the study are summarized as follow.

1. Does exchange rate fluctuation is passed through to consumer prices in selected developing countries? Is there any short-run and long-run relationship between exchange rate fluctuation and consumer price inflation?
2. Do exchange rate fluctuations have asymmetric or symmetric impact on consumer prices inflation? Is the exchange rate effect of appreciation and depreciation on consumer prices inflation is same?

1.4 Significance of the Study

The study of exchange rate fluctuations to domestic inflation holds vital importance in open-economy macroeconomics. Price stability is one of the most widely read and perceived macroeconomic indicator and needs especial consideration during formulation of economic policies. High inflation can have severe repercussions for the economy especially in developing countries. In such countries a rise in inflation can trigger inflationary expectations leading to hyperinflation in some cases. Besides, it results in allocative inefficiency, hoarding of durable commodities, decline in savings and increase in cost of businesses. In developing countries there is a huge social cost associated with any rise in inflation. An increase in inflation can push a large segment of society below the poverty line. Given the associated economic repercussions understanding the factors contributing to inflation is of paramount importance. Taylor (2000) hypothesized that decline in ERPT leads to decline in inflation from the study of United States in 1990s. The hypothesis has been validated by many studies including Faruqee et al. (2002), Campa and Goldberg (2002), and Takhtamanova, (2010).

Further, the exchange rate fluctuations serve as the transmission channel of several important policy indications. For example, currency depreciation is thought to make domestic products

cheaper as compared to imports thus increasing domestic production. However, if foreign exporters are concerned about retaining trade volume they will adjust their profit margin downwards to keep import price almost same for consumers. Consequently, the 'expenditure-switching'[5] effect will be relatively low, thus having little effect on domestic production.

This study investigates the impact of exchange rate fluctuation to consumer prices in selected developing countries. The degree of short-run and long-run pass through to consumer prices after taking into account the asymmetric behaviour can help monetary authorities in formulation of right policy measures. Moreover, the regional and cross-country comparison can help us better understand the pass-through dynamics.

The existing literature on ERPT particularly for selected emerging countries has largely failed to account for the non-linear effects of exchange rate pass-through. This study is unique as it investigates the symmetric as well as the asymmetric exchange rate pass-through for a set of 13 carefully selected developing countries.

1.5 Layout of the Study

Chapter 2 summarizes the existing literature on the topic. Data and Methodology of the study is discussed in chapter 3. The estimation results and discussions are presented in Chapter 4. Key findings and policy suggestions are outlined in Chapter 5.

[5] Devereux and Engel (2002)

Chapter 2

LITERATURE REVIEW

Extensive literature is available to examine the impact of currency depreciation on inflation. The existing literature is divided into two broad categories. Section 2.1 enlists studies investigating the symmetric effect of exchange rate fluctuations to domestic prices. While, studies exploring the asymmetric effect of exchange rate fluctuations are outlined in section 2.2. Studies conducted for the countries included in our sample are separately listed in section 2.3.

2.1 Symmetric Effect of Exchange Rate fluctuations to Consumer Prices

Initial studies have mostly employed linear framework to explore the exchange rate fluctuations to domestic consumer prices. Though later academic work has established that employment of linear framework might be misleading given the non-linear relation, yet these studies serve as the first step in the investigation of ERPT. Kotil (2020) studied the exchange rate fluctuations to consumer and producer price indices in Turkey using monthly data for period 2005 to 2019. The study found that the impact is higher to producer prices as compared to consumer prices. This validates the hypothesis that producers don't completely pass-on the effect of exchange rate fluctuations to consumers. Moreover, empirical evidence suggests the pass-through to be relatively short-lived as the effect of depreciation fades off after only three months.

Kassi et al. (2019) investigated the asymmetric impact of exchange rate fluctuations to consumer prices in Emerging and Developing Asian countries. The study found evidence of existence of asymmetric effect for emerging Asian sub-region for both short as well as long-run, while in developing Asian sub-region only long-run effect was witnessed. Emerging Asian sub-group included China, India, Indonesia, Malaysia and Thailand. The developing Asian sub-region included Bangladesh, Cambodia, Fiji, Lao, Nepal and Sri Lanka. The study finds

significant and complete pass through during appreciations as compared to depreciation in the long-run. Moreover, the study strongly rejects the popular finding in the literature that pass through has been declining.

Mirdala (2014) investigates the effect of exchange rate to exogenous price shock and unexpected shifts in exchange rate to consumer prices. The study found lower expected vulnerability of exchange rate to external price shock in countries with nominal exchange rate anchoring. Lower exchange rates under rigid exchange rate arrangements contribute to stability in domestic prices by reducing inflationary effect as well as disinflationary effect on domestic consumer prices.

Exchange rate regime in place at a country significantly affects the ERPT to domestic prices. Junior (2007) examined the existence of exchange rate fluctuations to domestic prices before and after inflation targeting. The study found that ERPT declined in the aftermath of inflation targeting. However, the existence of ERPT, especially in the long-run can't be ruled out.

Jiang and Kim (2013) studied the impact of exchange rate fluctuations to producer price index (PPI) and retailer price index (RPI) in China, in the presence of domestic monetary policy. They observe that fluctuations in exchange rate are incompletely passed to RPI and PRI, while the pass through to PPI is larger than that to RPI. The study attributes price stability in China to the relatively stable exchange rate. Yanamandra (2015) studied the effect of exchange rate fluctuations to import prices of India. Using both trade-weighted and bilateral USD exchange rate they found complete ERPT to import prices in short run, while some evidence of even larger pass-through in the long run. The larger ERPT is accredited to the 'inflation hystereses due to current higher inflation fanning expectations of even higher inflation in the future.

McCarthy (2007) studied the exchange rate fluctuations impact on consumer prices in nine developed countries using VAR model. Cholesky decomposition was used to identify the

structural shocks available in the data. While VAR model allows to track the effect from exchange rate fluctuations on each stage in the distribution chain. The study uses two set of statistics to measure the effects from exchange rate fluctuation to domestic inflation. Firstly, the impulse responses to exchange rate fluctuations and import price shocks are estimated for a period of two years. Second, variance decomposition is used to measure the forecast variance in domestic inflation indices that can be attributed to the exchange rate fluctuation and import price shock. The study found that impulse responses show exchange rate fluctuation do have modest affect on domestic inflation across the countries, while import prices shock appear to have larger effect. Countries having larger import share are found to have higher pass-through of import prices to domestic inflation. On the other hand, variance decomposition method suggests that the exchange rate fluctuations and import prices shocks explain little of the fluctuation in domestic inflation.

Karagoz et al. (2016) study the pass-through in two groups of countries from Latin America and Asia Pacific. The study employs panel VAR due to both time series and cross section dimension of the data. It is observed that exchange rate fluctuations effect is lower in Asia Pacific countries as compared to the Latin American countries. The authors refer this lower exchange rate fluctuations to the lower historical inflation in those countries. The study also finds that the most relevant factor in explanation of WPI and CPI fluctuation is the inflationist expectation. Variance decomposition analyses show that commodity price based shocks have negative effect on inflation in both of the groups, especially WPI.

Chabot and Khan (2015) examine the exchange rate fluctuations to domestic inflation in Canada. A 10% depreciation of Canadian dollar is found to boost CPIX and CPI inflation by 3 and 6 percent, respectively. However, the study believes the effect of exchange rate fluctuations is transitory only.

Campa and Goldberg (2005) examined the extend of exchange rate fluctuations into consumer prices in 23 OECD countries. The study found that the average exchange rate fluctuations impact to consumer prices is 0.46 in the short-run and 0.64 in the long-run. United States if found to have lower pass-through, while France and Germany tend to have larger pass-through. The study also tested for stability of exchange rate fluctuations and found that long run impact of exchange rate fluctuations is stable, while shows a gradual decline in short runs. At disaggregate level, the study found different level of exchange rate fluctuations impact across industries.

The impact of exchange rate fluctuations in some developing countries contributes to inflation more than the money supply. For instance, a study by Adeyemi and Samuel (2013) for exchange rate fluctuations shock to consumer prices in Nigeria found that money supply accounts for only for 4 to 15 percent of variation in price level, while exchange rate shocks explain for about 6 to 25 percent of variation in prices. Given the magnitude of pass-through, the authors suggest strict monetary surveillance and exchange rate stability to ensure price stability.

Mawejje and Lawanga (2016) investigated the determinants of inflation in Uganda. The study controlled for seasonal, historical and policy factors effecting inflation and found that money supply and agriculture sector shock affect inflation in long run. While inflation inertia, money supply, real output and seasonal factors affect inflation in the short-run. Besides, the study also found evidence of partial effect of exchange rate fluctuations to consumer prices with time lag. The study also found that import prices also significantly feed domestic inflation in Uganda.

Rajan and Yanamandra (2015) examined the ERPT to import prices and asymmetric effects in India using monthly data from January 2003 to March 2013. Using VAR model the study found complete pass-through to import prices in short run, while evidence of even greater pass

through in long-run. The study seconds Patnaik (2013) finding that higher pass through in long run might be due to the inertial effect of inflation, as higher prices incite expectation of higher inflation in future. Moreover, they also found evidence of asymmetric impact of exchange rate fluctuations with respect to the direction of exchange rate movements. ERPT to import prices during appreciations is significantly higher than pass-through during depreciation.

Ho and Hafrad (2020) investigate the ERPT to consumer prices in Vietnam during 2000 to 2018 using ARDL. The study found existence of both long-run and short-run exchange rate fluctuations to consumer prices in Vietnam. Besides, the study also found evidence of asymmetric effect of exchange rate fluctuations both with respect to direction and size of exchange rate movement. Depreciation and large exchange rate movements tend to have higher impact as compared to appreciation and smaller exchange rate movements. In line with the existing literature, they found ERPT to be higher in long run as compared to short-run. Moreover, prices of foreign competitors are also found to significantly affect the domestic price level of Vietnam.

Ho and Vo (2019) quantify the magnitude and speed of effect of exchange rate fluctuations to domestic consumer prices at both aggregate and disaggregate level in Vietnam. The study found incomplete pass-through at aggregate level of CPI. While at disaggregate level the degree of pass-through considerably varies across the sub-sectors. Housing and construction materials Index tend to have highest level of ERPT.

Aron et al. (2014) explore the impact of exchange rate fluctuations to domestic prices at highly disaggregate data of product and outlet level in South Africa. The study found that medical care, clothing and footwear, health expenses, beverages and tobacco have relatively lower pass-through rate (below 5 percent after a year). Personal care and transport have medium pass-through while finance and bank charges; insurance; membership and professional fee have

relatively high impact on consumer prices. About 50 percent of the changes are passed-through to consumer prices within the first year.

The impact of exchange rate fluctuations on various consumer price indices has been a popular subject of economic research. Bacchetta and Wincoop (2003) in a theoretical model offer alternative explanation of the fact that ERPT to consumer prices tend to be lower as compared to import prices. The model considers a domestic firm importing intermediate goods from a foreign firm priced at exporter's currency. The domestic firm adds value to the intermediate good and sells in the local market. Given the competitive pressure the domestic firm prefer to price in domestic currency. Thus, ERPT to import prices tend to be higher than consumer prices.

Chung et al. (2011) analyze the impact of exchange rate fluctuations to consumer prices in Australia over inflation-targeting period. The study found relatively low pass-through at aggregate level, however at disaggregate level the manufactured goods which are largely imported tend to have faster and larger pass-through. Based on the empirical evidence the study makes a quiet forward looking projection that impact of exchange rate fluctuations shall be rapid and large in future due to growth of internet and ability to purchase from overseas.

Devereux and Engel (2002) validate the 'exchange rate discount' hypothesis which expounds that local currency pricing eliminates the impact of exchange rate fluctuations to consumer prices, thus making exchange rate less relative to other macroeconomic variables. As a result exchange rate becomes highly volatile. Besides local currency pricing as proposed by Obstfeld and Rogoff (1995), the study identifies other factors as well.

Zorzi et al. (2007) investigate the effect of exchange rate fluctuations into domestic and import prices in a diverse set of 12 emerging markets in Asia, Europe and Latin America. The study rejects the conventional belief that ERPT in emerging market is always higher than developed

countries. In emerging markets, especially in Asia, the effect of exchange rate fluctuation is found to be low like developed countries. The study also validates Taylor hypothesis of positive relation between ERPT and inflation with the exception of Turkey and Argentina. Finally, little evidence of positive relation between trade openness and ERTP is observed.

Hufner and Schroder (2002) investigated the ERPT to consumer prices in Euro Area. Initially, the paper estimates ERPT to consumer prices for five large European countries; Germany, France, Italy, Spain and Netherland. Harmonized Index of Consumer Prices (HICP) is computed on the basis of weighted average of country results. The study found low pass-through to the HICP, as HICP increase by 0.4 percent in response to a 10 percent devaluation. Consumer prices adjust in three years with 0.8 percent rise in HICP in the aftermath of 10 percent devaluation.

Colicev et al. (2019) study the pass-through of large (about 50%), overnight and unanticipated depreciation of Kazakh Tenge into consumer prices. The authors exploit the shift from fixed to floating exchange rate regime and the ensuing large depreciation of local currency to measure the degree of ERPT to domestic consumer prices. Empirical results suggest relatively large and fast effect of exchange rate fluctuations to consumer prices, as after 12 months the ERPT ranges between 25 percent and 34 percent.

Sek and Kapsalyamova (2008) undertook a rather comprehensive analysis of effect of exchange rate fluctuations to consumer prices in four Asian countries, namely Singapore, Korea, Malaysia, and Thailand. Results of the study are consistent and robust to alternative methodologies, i.e. Structural VAR and Single Equation Approach. The degree of pass-through varies across the countries and is often incomplete. Overall, the ERPT is higher to import prices, moderate to producer prices and lower to consumer prices. The study found weak

evidence of correlation between trade openness and exchange rate pass-through to consumer prices.

Domestic inflation in Brazil had been consistently low even in the aftermath of significant depreciation of domestic currency in 2001-02. However, when Brazilian central bank missed the inflation target for the second year in 2002, speculations of rise in ERTP circled in academia. Blaisch (2003) using monthly data of 1999 to 2002 showed that ERTP has in fact fallen as compared to estimates of other studies for earlier time period and remains lower than Latin American countries. The study found that about 6 percent of exchange rate shock passes to consumer prices within the first quarter and about 17 percent within a year. However, pass-through to whole-sale price index is larger and rapid. Much of the pass-through to consumer prices is absorbed in the supply chain as business preserve trade volume at the cost of reduced margins. Other explanations are availability of domestic substitutes and expectations of depreciation being temporary.

Leigh and Rossi (2002) explored the exchange rate fluctuations effect to consumer prices in Turkey in the aftermath of adopting inflation targeting regime.

2.2 Asymmetric Effect of Exchange Rate Pass-through to Consumer Prices

Lately, there has been a great surge in studies accounting for the asymmetric effects of the exchange rate fluctuations. Besides asymmetry with respect to direction of exchange rate fluctuation, studies have identified asymmetry emanating from size as well. Still there is a room and need to re-evaluate the exchange rate pass-through via non-linear framework.

Musa et al. (2019) investigated the asymmetric impact of currency depreciation on inflation in Malaysia, using Non-linear ARDL model. The study found that currency devaluation is indeed inflationary in both short-run and long-run, while revaluation is not significantly related to

inflation. The study further infers that exchange rate is flexible to upward movements, while having resistance in downward movement, showing asymmetric affect.

Yanamandra (2015) found evidence of asymmetric effect with respect to the change in the direction of exchange rate in India. In case of appreciation, exporters may pass-through more as compared to depreciation due fear of losing market share.

Baharumshah et al. (2017) investigated the asymmetric response of consumer prices to exchange rate movements in Sudan, using non-linear autoregressive lag model (NRDL). The study confirms the existence of asymmetric response, as depreciations are associated with moderate inflation but no material effect of appreciations was witnessed in short run. Moreover, the pass-through is found to be significantly higher in long run. Kandil (2000) examine the asymmetric response of exchange rate on prices real and output in developing countries. The study found that overall contribution of exchange rate shocks to price inflation is positive. In 16 countries out of 22, the exchange rate shocks positively affected price inflation, with strongest evidence observed in Turkey.

Soon and Baharumshah (2017) examine the exchange rate pass-through (ERPT) in Malaysia for quarterly data of 1990 to 2015. The study bifurcates sample period into 'stable' and 'unstable' regime based on exchange rate fluctuations. Results indicate asymmetric effect of exchange rate depreciation; as depreciation during unstable regime is found to be inflationary while it dampens inflation during the stable regime. Overall, the ERPT found in both regimes is very low.

Amoah and Aziakpono (2017) re-examine the speed and magnitude of exchange rate fluctuations impact on consumer prices in Ghana. The study found no long run relationship between exchange rate fluctuation and price level. Regarding the asymmetry in direction (appreciation and depreciation) the study found that pass-through to consumer prices is much

greater for depreciation about 53%, while it is mere 2.8% for appreciations. The study also found strong asymmetry in size, as large movements in exchange rate results larger pass-through to the consumer prices as compared to smaller changes.

Benlialper and Comert (2015) studied the asymmetric stance of central bank towards exchange rate for inflation targeting. The study using vector autoregressive model (VAR) found that supply-side factors are the main inflation determinants in Turkey, such as international commodity prices and exchange rate fluctuations. The study also found that the appreciation of Turkish Lira is result of deliberate asymmetric response of central bank to exchange rate appreciation. It is shown via empirical results and descriptive statistics that appreciation of Turkish Lira was accommodated while the depreciation was averted pre-emptively. The over-appreciated Lira was maintained to help curbing inflation. The study suggests that asymmetric approach towards appreciations is not peculiar with Turkey; rather most of the inflation targeting regime countries has maintained over-valued currency.

2.3 Studies for Selected Developing Countries

This section enlists studies conducted for developing countries included in our sample. A brief survey of existing literature shall enable us learn from them and overcome drawbacks. Starting with Algeria, Allaoua and Achouche (2018) followed McCarthy (2007) to investigate the effect of exchange rate fluctuations to producer and consumer prices. The study found that depreciation of Algerian Dinar against US dollar incites significant inflation in producer price in the short run, while the impact is passed-on to consumer prices within a year. However, the study found no significant pass-through of Euro/Dinar

Hyder and Shah (2014) investigated the impact of exchange rate fluctuations into WPI and CPI in Pakistan during 1988 to 2003. Employing recursive VAR the study explores quite a few aspects of ERPT in Pakistan. Overall the ERPT is found to be moderate, with relatively larger pass-through to WPI as compared to CPI. Further, the impact of pass-through spreads over a year however decreasing after first four months. The free float of Dollar/Rupee parity in 2000 has further weakened the impact of pass-through. Moreover, at disaggregate level the pass-through is stronger in 'Fuel and Lightning' group followed by 'Manufactures' and 'Transport' sectors. Finally, the study found quite strong ERPT in inflationary era of 1988 to 1997 as compared to years with relatively lower inflation.

Jaffri (2010) investigated the effect of exchange rate fluctuations to consumer prices in Pakistan from 1995 to 2009 in the presence of exchange rate misalignment. Exchange rate misalignment refers to the difference between equilibrium level of effective exchange rate and actual exchange rate. The study also uses alternative specifications to ascertain the impact of exchange rate regime in place. Based on the results, the study establishes that ERPT to domestic prices in Pakistan is very low (almost negligible). However, in managed exchange rate regime the previous misalignments do have significant effect on domestic inflation. The ER misalignment is not significant in the overall sample containing both fixed and managed exchange rate regime.

Helmy et al (2018) studied the ERPT to different price indices in Egypt for quarterly data from 2003 to 2015. The study found substantial effect of exchange rate fluctuations to consumer prices, import prices and producer price index. However, unlike the popular case impact on consumer price is largest owing to the large rage of commodities included in consumer basket. On contrast Awad (2019), found that exchange rate pass through to domestic prices in Egypt for period 2006 to 2016 is insignificant. However, the study found that ERPT is significant for a sub-period of 2011 to 2016. Egypt follows managed floating exchange rate regime.

Chapter 3

Methodology and Data

3.1 Introduction

This chapter shows the experimental framework used in the study. The monetarist theory of inflation as presented by Ball and Romer (1987) states that inflation is solely the result of increase in money supply beyond the requirement of the economy. Whereas Keynes (1936) maintains that the excess demand is the sole cause of inflation. However, owing to the increasing globalization and larger international trade in the modern era, several other determinants of inflation are being investigated. Among them, effect of exchange rate fluctuations on domestic inflation holds central importance. It is commonly believed that the high rate of inflation in several developing countries is widely caused and explained by excessive exchange rate depreciation. The notion has been empirically validated by Demirel et al. (2016), Rossi and Leigh (2002) and Ogundipe (2003). On the other hand, Yanamandra (2015) and McCarthy (2007) maintain that currency depreciations are largely disinflationary based on the example of depreciation followed by lesser inflation in some of the emerging and industrialized nations. Campa and Goldberg (2005) argue that the consequences of currency depreciation vary across countries based on the features and economic conditions. This chapter builds upon the important explanatory variables and methodology identified in the survey of existing literature.

3.2 Empirical Model

Based on the survey of literature we use exchange rate, GDP, money supply and oil prices as explanatory variables. We estimate the following standard model

$$Inf_t = \alpha_\circ + \alpha_1 ER_t + \alpha_2 GDP_t + \alpha_3 MS_t + \alpha_4 OP_t + \varepsilon_t \ldots (1)$$

Where, Inf_t is the inflation rate in time t, ER_t is the exchange rate in time t, GDP_t refers to GDP in time t and OP_t is the global price of crude oil.

To estimate the short-run and long-run effects of exchange rate fluctuations to consumer prices we use ARDL bound testing approach by Pesaran et al. (2001). The error correction model is identified as:

$$\Delta Inf_{i,t} = \alpha_1 + \sum_{j=1}^{n1} \alpha_2 \Delta Inf_{t-j} + \sum_{j=0}^{n2} \alpha_{3j} \Delta ER_{t-j} + \sum_{j=0}^{n3} \alpha_{4j} \Delta GDP_{t-j} + \sum_{j=0}^{n4} \alpha_{5j} \Delta MS_{t-j} + \sum_{j=0}^{n5} \alpha_{6j} \Delta OP_{t-j} + \partial_1 Inf_{t-1} + \partial_2 ER_{t-1} + \partial_3 GDP_{t-1} + \partial_4 MS_{t-1} + \partial_5 OP_{t-1} + \varepsilon_t \ldots (2)$$

In equation (2) the summation symbols tell us about error correction dynamics while the second portion of equation indicates the long-run relationship among variables. α_1 is drift while $\varepsilon_t$is the error term. The bound test maintains following Null hypothesis, H_0: $\partial_1 = \partial_2 = \partial_3 = \partial_4 = \partial_5 = 0$, which means no cointegration. When cointegration exists there is an error correction representation which can be estimated using the following equation.

$$\Delta Inf_{i,t} = \alpha_1 + \sum_{j=1}^{n1} \alpha_2 \Delta Inf_{t-j} + \sum_{j=0}^{n2} \alpha_{3j} \Delta ER_{t-j} + \sum_{j=0}^{n3} \alpha_{4j} \Delta GDP_{t-j} + \sum_{j=0}^{n4} \alpha_{5j} \Delta MS_{t-j} + \sum_{j=0}^{n5} \alpha_{6j} \Delta OP_{t-j} + \beta ECM_{t-1} + \varepsilon_t \ldots (3)$$

Equation (3) is used to estimate the symmetric effect of exchange rate fluctuations to consumer prices in developing countries. As we aim to validate the asymmetric pass through to consumer prices we need to estimate a non-linear ARDL model. We bifurcate the exchange rate into appreciations (ER^+) and depreciations (ER^-) using Shin et al. (2014). The non-linear model is as follow.

$$\Delta Inf_{i,t} = b_1 + \sum_{j=1}^{n1} b_2 \Delta Inf_{t-j} + \sum_{j=0}^{n2} b_{3j} \Delta ER_{t-j} + \sum_{j=0}^{n3} b_{4j} \Delta GDP_{t-j} +$$

$$\sum_{j=0}^{n4} b_{5j} \Delta MS_{t-j} + \sum_{j=0}^{n5} b_{6j} \Delta OP_{t-j} + \sum_{j=0}^{n2} b_{7j} \Delta ER_{t-j}^{+} + \sum_{j=0}^{n2} b_{8j} \Delta ER_{t-j}^{-} + \partial_1 Inf_{t-1} +$$

$$\partial_2 ER_{t-1} + \partial_3 GDP_{t-1} + \partial_4 MS_{t-1} + \partial_5 OP_{t-1} + \partial_6 ER_{t-1}^{+} + \partial_7 ER_{t-1}^{-} + \varepsilon_t .. (4)$$

Equation (4) is the nonlinear ARDL model for the asymmetric effects of exchange rate fluctuations to consumer prices. The error correction model for nonlinear ARDL is as follow.

$$\Delta Inf_{i,t} = b_1 + \sum_{j=1}^{n1} b_2 \Delta Inf_{t-j} + \sum_{j=0}^{n2} b_{3j} \Delta ER_{t-j} + \sum_{j=0}^{n3} b_{4j} \Delta GDP_{t-j} +$$

$$\sum_{j=0}^{n4} b_{5j} \Delta MS_{t-j} + \sum_{j=0}^{n5} b_{6j} \Delta OP_{t-j} + \sum_{j=0}^{n2} b_{7j} \Delta ER_{t-j}^{+} + \sum_{j=0}^{n2} b_{8j} \Delta ER_{t-j}^{-} + \beta ECM_{t-1} +$$

$\varepsilon_t ..$ (5)

3.2 Stationarity of the Time Series Data

Granger and Newbold (1974) maintain that statistical tests between the two non-stationary variables may give spurious results. The Variables of the time series data will be stationary if mean and variance are constant while the covariance between them does not depend on the point of time at which they are being considered but should depend on the length of the period between them. The unit root tests are applied to check the stationarity of the variables.

3.3 Autoregressive Distributed Lag Approach

In order to investigate the symmetric effects of exchange rate volatility in the short run and also in the long run, the study uses linear model of Pesaran et al (2001) known as Autoregressive Distributed and Lag Model (ARDL). It is also known by bound test for cointegration.

The ARDL approach has many advantages. The most important one is that the same order of integrated variables are not required in this approach, while the second advantage of the ARDL methodology is it gives result for both short and long-run by using bound testing approach

Pesaran et al (2001). According to Baek (2006) the ARDL has proper number of lag selection to capture the best response of the variable. Pesaran and Shin (1999) concluded that ARDL methodology is better for the small sample size in comparison to other cointegration techniques. The methodology is also found to be robust. Javed and Farooq (2009) argue that ARDL approach also incorporates endogeneity problem, it means that the focused variables are exogenous.

3.4 Nonlinear Autoregressive Distributed Lag Model to Cointegration

The main assumption in the linear ARDL is that the exchange rate volatility affects inflation in a symmetric manner. Ball and Romer (1987) believe that the currency appreciation and depreciation affects the inflation in an asymmetric manner. For this reason we follow Shin et al (2014) partial sum concept to separate the currency depreciation from currency appreciation.

The ARDL approach is best irrespective of the size of the sample whether it is small or large. We start with the bound test to calculate the long run relationship among the variables, by using F test. The critical region is given by I(0) as lower bound and I(1) as upper bound (Pesaran et ai, 2001). If F-stat value exceeds the upper bound I(1) then null hypothesis that no co-integration is rejected. While If the value of F-stats is below the lower bound I(0) then we accept the null hypothesis that there is no co-integration among the variables or there is no long run relationship. On the third option if the value of F-stats lies between the upper bound I(1) and the lower bound I(0) then the result will become inconclusive.

The SBC and AIC can be used to select the lag length in the model. The SBC selects the minimum lag length; it means it is a parsimonious model. On the other hand AIC is renowned for the selection of maximum lags. If the model estimates the long run relationship among the variables, then it identifies the error correction representation. If there is negative value of ECM

and it is also immensely significant, it concludes about the long run relationship among variables. The divergence of the speed of adjustment is justified too.

The robustness of the model can be checked by applying the stability tests. The CUSUM and CUSUMSQ technique by Brown et al, (1975) can be used to confirm model stability. If the data plots are laid between upper and lower bound at 5 percent significance level, it means that our model is stable structurally (Ilyas et al, 2010). We can also apply the Wald test to check whether increased fluctuations is equal to decreased fluctuations in the short and long run.

The main focus of the study is to check the asymmetric effect of exchange rate fluctuations on inflation in selected developing countries. The study also estimates the symmetric effects of exchange rate fluctuations. We want to estimate the long run relationship between exchange rate fluctuations and inflation. To achieve our goal we use ARDL approach. First the unit root test is applied to check the stationarity of different variables. Secondly, to check the existence of co-integration the study applies bound test. Thirdly, the long run and short run estimates are calculated. Fourthly, to confirm the stability of the model, the CUSUM and CUSUMSQ tests are applied. Finally, the nonlinear ARDL model is used by replacing exchange rate variable with positive and negative variables. The positive and negative variables are generated by using partial sum concept of Shin et al (2014). According to Pesaran et al (2001) the bound test is same for the linear and non linear ARDL. We also estimate for error correction model and get ECM value. The Wald-S is applied for short symmetry and Wald-L for long symmetry in nonlinear model.

3.5 Variables

Consumer price index (CPI) inflation is used as dependent (explained) variable. The variable is measured in percentage. While real effective exchange rate, GDP growth, money supply and oil prices are used as explanatory variables. Money supply refers to the broad money as

percentage of GDP. Oil price denotes the price of crude oil in international market. Except oil price, all the variables are extracted from World Development Indicators (WDI) database of the World Bank. The study uses annual data from 1980 to 2019 for 13 selected developing countries. Complete list of the countries under study is attached in appendix.

Chapter 4

Results and Discussion

This chapter presents the estimation results and discussion ensuing. The first section present results of unit root test. Results of linear and non-linear ARDL are presented in the second section. Section 4.3 presents non-linear ARDL multiplier graphs for sample countries.

4.1 Unit Root Test

Unit root test (ADF) for the selected developing countries to check the stationarity results on I(0) and I(1).

Table: 4.1. Unit root test

Country Name	Variable Name	At Level		At 1st difference		Conclusion
		Intercept	Trend and intercept	Intercept	Trend and intercept	
Algeria	CPI			✓		I(1)
	ER		✓			I(0)
	GDP			✓		I(1)
	MS			✓		I(1)
	OP			✓		I(1)
Bangladesh	CPI	✓				I(0)
	ER		✓			I(0)
	GDP				✓	I(1)
	MS			✓		I(1)
	OP			✓		I(1)
Burkina Faso	CPI	✓				I(0)
	ER			✓		I(1)
	GDP				✓	I(1)
	MS			✓		I(1)
	OP			✓		I(1)
Cameroon	CPI	✓				I(0)
	ER		✓			I(0)
	GDP			✓		I(1)
	MS			✓		I(1)
	OP			✓		I(1)
Egypt	CPI			✓		I(1)
	ER			✓		I(1)
	GDP			✓		I(1)
	MS	✓				I(0)
	OP			✓		I(1)
India	CPI	✓				I(0)
	ER			✓		I(1)
	GDP			✓		I(1)
	MS			✓		I(1)
	OP			✓		I(1)
	CPI	✓				I(0)

Indonesia	ER			✓		I(1)
	GDP			✓		I(1)
	MS			✓		I(1)
	OP			✓		I(1)
Kenya	CPI	✓				I(0)
	ER			✓		I(1)
	GDP				✓	I(1)
	MS			✓		I(1)
	OP			✓		I(1)
Morocco	CPI		✓			I(0)
	ER			✓		I(1)
	GDP		✓			I(0)
	MS			✓		I(1)
	OP			✓		I(1)
Nepal	CPI	✓				I(0)
	ER			✓		I(1)
	GDP				✓	I(1)
	MS			✓		I(1)
	OP			✓		I(1)
Nigeria	CPI	✓				I(0)
	ER			✓		I(1)
	GDP			✓		I(1)
	MS			✓		I(1)
	OP			✓		I(1)
Pakistan	CPI	✓				I(0)
	ER			✓		I(1)
	GDP			✓		I(1)
	MS		✓			I(0)
	OP			✓		I(1)
Srilanka	CPI	✓				I(0)
	ER			✓		I(1)
	GDP				✓	I(1)
	MS			✓		I(1)
	OP			✓		I(1)

Table 4.1 indicates that for the all countries selected variables are stationary at level or at the first difference. Thus, we can proceed to use ARDL.

4.2 Linear and non-Linear ARDL

Results of linear and non-linear ARDL are presented in following tables for each country. Each table is then further divided into three panels; A, B and C. Panel A contains the short-run results while long-run results are given in Panel B. Finally, Panel C presents the results of diagnostic tests. The non-linear multiplier graphs for each country are given in the appendix.

Table:4.2 Empirical Results for Algeria

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	0.0699 (0.2913)	-0.2760 (-1.6103)					
ΔGDP	0.3010 (1.0266)	-1.1490 (-1.9011)*	0.0010 (2.2591)**				
ΔMS	-0.2267 (-1.4588)	-0.2688 (-1.4139)	0.4374 (2.2953)**	-0.2142 (-1.3239)			
ΔOP	-0.0835 (-0.9898)						
Panel B: Long run results							
Constant	ER ALG	GDP ALG	MS ALG	OP			
21.7953 (3.6495)***	-0.2883 (-1.5669)*	0.6410 (1.1884)	-0.3811 (-1.4938)	-0.1169 (-1.0692)			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
3.2721*	1.1097	-0.7145***	2.9251**	S	US	0.79	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	0.3385 (1.4513)	-0.5676 (-2.7558)**					
ΔER-	-0.6421 (-0.9084)	0.2741 (2.0107)**					
ΔGDP	0.9210 (1.1760)	-0.5810 (-1.6480)	0.0312 (2.1959)**				
ΔMS	-0.1055 (-0.7542)	-0.2574 (-1.4040)	0.2835 (1.9883)**				
ΔOP	0.0056 (0.0657)						
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
-30.9597 (-0.9452)	-0.4924 (-1.5822)**	0.6589 (0.9963)*	0.8310 (1.3961)	0.1707 (0.5071)*	0.0120 (0.0653)		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
3.9933**	0.3482	-0.4650***	3.7407	S	S	0.78	2.5474*

Table 4.2 indicates the results of linear and non-linear ARDL for Algeria. A quick glance at the estimation results shows that the magnitude of exchange rate appreciation and depreciation differ quite substantially, adding support to the existence of asymmetric effects. In the linear specification, a unit appreciation of domestic currency leads to 28% decrease in the consumer inflation. On the other hand, in the non-linear specification, appreciation of domestic currency by 1 unit leads to 49% decrease in the consumer inflation. The pass-through of exchange rate depreciation is further larger, amounting to about 65%. The finding is also confirmed by the Wald-test for symmetry which rejects the null hypothesis of symmetric effect. GDP and oil price exhibit no significant relation with in both specification, while money supply has significant positive relation only in the non-linear specification. Bound's test confirms the existence of long-run relationship among the variables. These findings are in line with Mohammed and Benhabib (2016) who found similar results for Algeria using only linear ARDL.

LM test for serial correlation rejects the existence of any serial correlation. The speed of correction to the long-run equilibrium is 71% in the linear framework, while it reduces to 46% in the non-linear model. Ramsey RESET test however rejects the null hypothesis of correct specification in the linear model, while it indicates correct specification in the non-linear model. Besides, the CUSUM and CUSUM-Squared test show the model to be largely stable.

Table:4.3 Empirical Results for Bangladesh

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	-0.2287 (-2.8968)**						
ΔGDP	-0.7811 (-1.8862)*						
ΔMS	-0.0625 (-0.3676)	0.1364 (0.5498)	-0.1898 (-0.8063)	0.4553 (2.7020)**			
ΔOP	0.0716 (2.9792)***						
Panel B: Long run results							
Constant	ER_{BNG}	GDP_{BNG}	MS_{BNG}	OP			
7.4778 (9.5428)***	-0.1509 (-2.8876)***	-0.1511 (-1.8652)*	0.2239 (2.5992)**	0.0472 (3.5044)***			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
8.0700***	0.0743	-1.5161***	0.0168	S	S	0.40	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	-0.4783 (-2.8822)**	0.7541 (3.1348)**	-0.0392 (-3.0941)**	-0.3906 (-2.4338)**			
ΔER-	0.8566 (2.6233)**	-0.8890 (-1.4553)	0.6452 (0.9232)	0.0093 (1.3914)			
ΔGDP	0.5610 (0.3606)	-0.4609 (-0.9475)	0.8609 (1.3330)	0.8309 (1.2701)			
ΔMS	-0.0903 (-0.3544)	-0.0577 (-0.1835)	-0.1960 (-0.6343)	0.7548 (1.9719)*			
ΔOP	0.1683 (2.0434)*	-0.1586 (-1.5034)	-0.0806 (-1.2530)	0.0759 (1.9719)*			
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
-0.1463 (-0.4039)	-0.5061 (-1.1826)*	0.7368 (0.9109)**	0.8110 (1.4038)	0.3318 (0.7269)	0.0040 (0.0300)		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
4.2131***	0.4244	-1.237***	0.0501	US	S	0.50	1.8698***

Table 4.3 outlines the linear and non-linear estimation results for Bangladesh. In the linear specification, a unit appreciation of exchange rate leads to 15% decrease in consumer inflation in the long-run. GDP also has a negative significant long-run relationship with consumer inflation in the linear specification. Money supply positively effects consumer inflation with significant lags. Besides, oil price also impacts consumer inflation positive however the magnitude is quite low. The non-linear specification indicates that a unit appreciation of domestic currency lowers consumer inflation by 50% in the long-run, while exchange rate depreciation increases consumer inflation by 73% in the long-run. These findings are in complete accordance with Aziz et al. (2013) and Khondker et al. (2012) who estimate the pass-through to be around 60% in Bangladesh. Wald's test indicates statistically different asymmetric effect of exchange rate pass-through. Bound's test confirms the existence of cointegration among the variables.

LM test indicates that both linear and non-linear model do not suffer from serial correlation. Besides, Ramsey test indicates both of the models are correctly specified. The value of error correction term is greater than 1 in both linear and non-linear framework, indicating an oscillatory adjustment path. The models are found to be largely stable with CUSUM and CUSUM-Squared tests. The value of R-Square increases significantly in the non-linear specification.

Table:4.4 Empirical Results for Burkina Faso

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	-0.0681 (-6.2753)***	-0.0387 (-1.6428)	0.0335 (1.3724)	-0.0356 (-1.4290)	-0.0204 (-0.9131)		
ΔGDP	0.2009 (0.4266)	-0.6508 (-1.9326)*	0.4508 (1.6841)				
ΔMS	0.7998 (1.6011)	0.5511 (1.0270)	-0.5605 (-1.3296)	-0.5256 (-1.5412)	-0.8719 (-1.5412)		
ΔOP	0.2190 (2.8434)**	0.0189 (0.2376)	-0.1222 (-1.4703)	-0.0043 (-0.0407)	-0.2372 (-2.1293)*		
Panel B: Long run results							
Constant	ER_{BKF}	GDP_{BKF}	MS_{BKF}	OP			
6.2577 (0.8786)	0.0440 (0.5300)	0.4710 (0.6545)	0.3971 (1.0547)*	-0.0823 (-0.9648)			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
3.1520*	0.9935	-0.5289***	9.8332	S	S	0.60	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	0.1022 (9.8721)***	-0.0877 (-4.2117)***	0.0940 (4.4013)***	-0.0821 (-3.6376)***	-0.0723 (-3.1808)**		
ΔER-	0.0927 (3.0946)**	0.0426 (1.3967)	-0.0389 (-1.3754)	0.0235 (0.9891)			
ΔGDP	-0.2009 (-1.2258)	-0.9008 (-4.6533)***	0.1608 (5.8265)***				
ΔMS	-0.9573 (-2.0997)*	0.1561 (3.0501)**	-0.1258 (-3.7906)**	0.7920 (2.0487)*	-0.0080 (-3.6443)**		
ΔOP	0.2294 (4.4303)***	-0.0946 (-1.7668)	-0.2280 (-3.8902)**	0.1183 (1.5074)	-0.3411 (-5.0782)***		
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
5.0944 (0.6765)	-0.0577 (-1.8675)*	-0.0823 (-1.9377)*	0.1109 (1.9681)*	-0.4382 (-1.8492)	0.1975 (1.9194)*		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
9.3305***	1.9709	-0.7948***	3.3719	S	US	0.87	21.039***

Table 4.4 shows results of both linear and non-linear ARDL for Burkina Faso. Exchange rate appreciation has no significant long-run relationship with inflation in the linear specification, while a unit appreciation leads to only 5% reduction in the consumer inflation in the long-run. A 1 unit depreciation of domestic currency leads to only 8% of increase in consumer inflation. Wald's test and the asymmetric multiplier confirm the existence statistically significant exchange rate pass-through. Besides, oil price also positively contribute to consumer inflation in Burkina Faso. Bound's test indicates the existence of cointegration among the variables used.

LM test for serial correlation rules out the existence of any serial correlation in both of the models. The Ramsey test indicates correct model specification in the non-linear framework. Besides, the ECM value also increases showing a speedy convergence to long-run equilibrium. CUSUM and CUSUM-squared test show the models to be stable at large. The adjusted R-square improves indicating better fit as we account for the non-linear effects.

Table:4.5 Empirical Results for Cameroon

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	0.0352 (2.3292)**						
ΔGDP	0.1709 (1.1638)	-0.1609 (-1.6771)					
ΔMS	0.6616 (1.2533)	-0.1115 (-2.5640)**	0.4857 (1.7273)*	0.1850 (0.2237)	0.5051 (2.3921)**		
ΔOP	0.1016 (2.0479)*						
Panel B: Long run results							
Constant	ERCAM	GDP CAM	MS CAM	OP			
-17.8873 (-1.9437)*	-0.0242 (-2.2432)**	-0.8010 (-4.8896)***	0.1849 (3.8268)***	0.0697 (2.0018)*			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
9.5079***	0.6754	-0.4566***	3.3478**	S	S	0.60	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	0.0875 (3.0787)**	0.0908 (2.0387)	-0.0109 (-0.3623)	-0.1334 (-5.5603)***	-0.0282 (-0.9661)		
ΔER-	-0.1079 (-3.6481)**	-0.0636 (-2.2126)*	0.1029 (3.7191)**	-0.0662 (-1.9456)	-0.0751 (-2.2323)*		
ΔGDP	-0.5409 (-4.7588)***	0.4309 (3.4860)**	0.9409 (3.0967)**	-0.5609 (-1.7773)	-0.0308 (-5.9966)***		
ΔMS	0.6470 (4.3908)**	0.6199 (0.4893)	-0.4948 (-2.3732)*	0.7195 (2.4743)*	0.4838 (4.2614)**		
ΔOP	-0.0236 (-0.4409)	-0.0155 (-0.2416)	0.0054 (0.1286)	-0.3135 (-5.2482)***	-0.1319 (-1.1366)		
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
-19.8720 (-1.6019)	0.0018 (0.1788)	0.0707 (4.9894)***	-0.3609 (-4.1495)**	0.6856 (2.9361)**	-0.1613 (-2.0747)		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
15.6089***	2.1770	-0.9696***	1.4105	S	S	0.93	14.89***

Table 4.5 shows results of both linear and non-linear ARDL for Cameroon. The non-linear model shows that exchange rate appreciation doesn't have any significant long-run relationship with consumer inflation. While a unit depreciation of local currency leads to only 7% increase in consumer inflation. The asymmetric effect is has found to be statistically significant by Wald's test. The linear specification shows that one unit appreciation of domestic currency leads to 2% decrease in consumer inflation in long-run. Besides, GDP also exhibits significant negative long-run relationship with inflation. However, money supply and oil price positively contribute to consumer inflation in the long-run. Bound's test confirms the existence of cointegration among variables.

LM test shows none of the models suffer from problem of serial correlation. The speed of adjustment is 45% in the linear specification, while it increases to 96% in the non-linear model. RESET test shows that the linear model is not correctly specified while we fail to reject the null hypothesis of correct specification in the non-linear model. CUSUM and CUSUM-Square show that both of the models are inherently stable. The value of adjusted R-square significantly increases in the non-linear specification.

Table:4.6 Empirical Results for Egypt

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	0.2075 (1.166403)	-0.8543 (-0.6713)*	-0.0468 (-1.0925)	-0.0228 (-0.0058)			
ΔGDP	-0.1710 (-1.0009)	0.0309 (1.2443)	-0.8610 (-1.2602)				
ΔMS	-0.0765 (-0.3313)	0.6943 (2.6364)**	0.2214 (0.5661)	-0.2980 (-0.8630)	0.3788 (1.8002)*		
ΔOP	0.0101 (0.1536)	0.0081 (0.1048)	0.1618 (1.7565)				
Panel B: Long run results							
Constant	ER EGY	GDP EGY	MS EGY	OP			
6.57086 (2.3327)***	-0.1847 (-0.0337)	0.1609 (0.0328)	0.6082 (-2.4324)**	-0.4167 (-0.0324)			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
2.4173***	2.9177	0.6497***	0.9644	US	S	0.74	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	0.9685 (2.8387)**	0.7302 (1.9904)*	-0.7800 (-4.0014)***				
ΔER-	0.1881 (2.9205)**	0.1725 (2.1342)*	-0.8990 (2.7037)**	-0.5337 (-1.8477)*	0.7739 (1.7122)		
ΔGDP	-0.1509 (-1.4996)	0.2310 (0.7020)	-0.0909 (-1.9993)*	0.0510 (1.1337)			
ΔMS	0.6071 (2.8665)**	0.4934 (2.3488)**	0.5992 (1.5991)	0.5444 (1.5502)	-0.0761 (-2.3008)**		
ΔOP	-0.2828 (-2.2985)*	-0.2321 (-1.9589)*					
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
19.9604 (1.9498)*	-0.1999 (-3.2813)***	0.2162 (3.0713)***	-0.0711 (-1.9043)*	0.1279 (2.1386)**	-0.1863 (-0.1583)		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
5.6760***	2.5986	-0.7624***	2.7149	US	S	0.87	6.3274***

Table 4.6 indicates results of both linear and non-linear ARDL for Egypt. The asymmetric effect of exchange rate fluctuation is evident from the non-linear model. A one unit appreciation of local currency leads to 19% decrease in consumer inflation, while a one unit depreciation of local currency results in 21% increase in consumer inflation in the long-run. The non-linear effects are found to be statistically significant by the Wald's test. Money supply exhibits positive long-run relation in both linear and non-linear specification. GDP however results in quite nominal decrease in consumer inflation. Bound's test confirm the existence of long-run relation in both of the models.

LM test rules out the existence of serial correlation in both of the models. The speed of adjustment significantly increases in non-linear model indicating speedy recovery. Ramsey RESET test indicates that both of the models are correctly specified. The value of adjusted R-Square significantly increases in the non-linear specification.

Table:4.7 Empirical Results for India

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	-0.3795 (-1.3873)	0.0122 (0.0356)	0.0912 (-2.4030)**	-0.4970 (-3.3920)***	0.7490 (2.6432)**		
ΔGDP	-0.4811 (-1.6375)	-0.5711 (-1.0021)	0.8110 (3.2770)***	-0.6210 (-2.9870)***			
ΔMS	-0.3499 (-0.7964)	-0.6837 (-1.1291)	0.6987 (2.9798)***	-0.4456 (-1.0066)			
ΔOP	-0.1286 (-2.0694)*	0.0043 (0.0673)	0.2204 (3.1423)***	-0.1608 (-2.7133)**			
Panel B: Long run results							
Constant	ER IND	GDP IND	MS IND	OP			
-0.3241 (-0.0220)	-0.0557 (-0.1816)*	-0.8712 (-0.3927)	0.5099 (0.8806)	-0.1504 (-0.7025)			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
2.4739***	1.1967	-0.6301***	1.0606	S	S	0.50	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	-0.0616 (3.6672)***						
ΔER-	-0.1980 (-3.6711)***	-0.3172 (-3.6146)***	-0.7389 (-0.9580)	-0.7452 (-2.4075)**			
ΔGDP	-0.2711 (-2.3390)*	1.1711 (0.2944)	2.9311 (0.7080)	-3.9511 (-0.9759)	1.3811 (0.5034)		
ΔMS	-0.3906 (-2.2304)**						
ΔOP	-0.1723 (-3.6615)***	-0.0363 (-0.7639)	-0.0118 (-0.2420)	-0.0648 (-1.3612)	-0.0917 (-2.3875)**		
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
28.0808 (5.8465)***	-0.2805 (-3.3236)***	0.3158 (3.4145)***	-0.0311 (-2.8684)***	0.1834 (2.8925)**	0.1770 (3.3052)***		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
5.6165***	1.7920	-0.7801***	1.4279	S	S	0.68	7.17***

Table 4.7 shows results of both linear and non-linear ARDL for India. The non-linear specification indicates that a 1 unit appreciation of Indian currency is associated with 28% decrease in consumer inflation in the long-run. The long-run pass-through of one unit depreciation of domestic currency leads to 31% increase in consumer inflation. The parity in coefficients of exchange rate fluctuations is found to be statistically significant by Wald test. The long-run pass-through of exchange rate appreciation is relatively smaller in the linear specification amounting only 5% decrease in consumer inflation. Besides, GDP slightly lowers consumer inflation in India over the long-run. Money supply and oil price contribute positively to consumer inflation in the long-run. Bound's test confirms the existence of long-run relationship among the variables.

LM test accepts the null hypothesis of no serial correlation in both of the models. The speed of adjustment to the long-run equilibrium is 63% in the linear model while 78% in the non-linear specification. Ramsey RESET test indicates that both of the models are correctly specified. CUSUM and CUSUM-Square show that both of the models are stable inherently. The value of adjusted R-Square significantly increases in the non-linear specification.

Table:4.8 Empirical Results for Indonesia

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	0.0028 (2.5819)**	-0.0020 (-1.7068)	-0.2305 (-0.1167)	-0.0013 (-2.1679)**			
ΔGDP	-0.1210 (-3.9621)***	0.2110 (3.7885)***					
ΔMS	-0.2826 (-1.1157)	0.3552 (0.9515)	-0.4583 (-1.2385)	0.5396 (2.2617)**			
ΔOP	0.1482 (3.4737)***	0.1144 (2.5939)**					
ΔOP	0.1482 (3.4737)***	0.1144 (2.5939)**					
Panel B: Long run results							
Constant	ER INS	GDP INS	MS INS	OP			
8.0838 (3.9487)***	-0.0005 (-1.4588)*	0.1312 (1.0493)	0.1206 (2.6316)**	0.0264 (1.0462)			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
19.5314***	0.5317	-0.6756***	5.4314	S	S	0.92	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	0.0010 (0.6120)	-0.0230 (-1.9919)*					
ΔER-	0.0010 (0.4545)	0.0031 (1.1218)	-0.0023 (-0.8206)	-0.0015 (-1.0083)	0.0033 (2.3401)**		
ΔGDP	-0.1110 (-3.4395)***	0.4910 (1.5028)	-0.1013 (-1.0863)	0.0210 (2.8628)**			
ΔMS	0.2463 (0.8462)	0.2638 (0.6945)	-0.6613 (-1.7532)*	0.7747 (2.9259)***			
ΔOP	0.1349 (2.6519)**						
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
1.1257 (0.6566)	-0.0069 (-1.9701)*	0.0660 (2.1885)**	0.0711 (2.6635)**	0.3273 (4.7090)***	0.0708 (3.0430)***		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
8.3731***	2.4391	-0.9046***	1.2440	S	US	0.93	2.3777*

Table 4.8 shows results of both linear and non-linear ARDL for Indonesia. The pass-through of exchange rate appreciation is almost nominal in Indonesia. While a one unit depreciation of domestic currency leads to 6% increase in consumer inflation. Wald's test confirms the existence of asymmetric effects. Besides, GDP, money supply and oil price show significant and positive relationship with consumer inflation. Bound's test indicates the cointegration among variables in the long-run.

LM test accepts the null hypothesis that there is no serial correlation. The error correction term shows that speed of adjustment is 67% in the linear specification while it rose to 90% in the non-linear specification. Ramsey RESET test shows that both of the models are correctly specified. CUSUM and CUSUM-Square show the both of the models are inherently stable. Adjusted R-Square shows that both of the models are good fit.

Table:4.9 Empirical Results for Kenya

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	0.3778 (1.9576)*	-0.0370 (-5.7457)***					
ΔGDP	-0.9709 (-2.8482)**	0.2409 (0.9965)					
ΔMS	-0.0140 (-2.4316)**	0.6618 (3.6175)***	0.1500 (0.3301)	-0.6080 (-1.5487)			
ΔOP	0.4464 (5.8676)***	-0.4888 (-4.8851)***	0.3377 (3.1946)***	-0.1266 (-1.5141)	-0.3285 (-3.4435)***		
Panel B: Long run results							
Constant	ER KEN	GDP KEN	MS KEN	OP			
-19.1549 (-0.9988)	-0.8683 (-4.2759)***	0.6309 (3.8048)***	0.2633 (0.3844)	0.2217 (2.0594)*			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
9.6232***	0.4888	-0.7207***	3.3596	S	S	0.84	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	-0.8984 (-3.9209)***	-0.5197 (-3.4718)***	-0.3513 (-1.8779)*				
ΔER-	-0.7115 (-1.6983)	0.6878 (2.7817)**	0.9632 (2.0038)*	-0.6773 (-1.4061)	0.3792 (5.9351)***		
ΔGDP	-0.3309 (-3.0134)**	0.4709 (1.9352)*	0.2109 (1.9269)*				
ΔMS	-0.6939 (-1.9338)*	0.7442 (2.5590)**	-0.5357 (-1.6960)	-0.6590 (-1.9991)*	0.2159 (0.8052)		
ΔOP	0.4722 (3.9383)***	-0.2592 (-3.6047)***	0.1473 (1.9456)*	0.2421 (3.2061)**	-0.1186 (-1.7122)		
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
-13.0326 (-1.0500)	-0.0282 (-0.2769)*	0.7429 (3.5953)***	0.4209 (4.6398)***	0.9545 (1.7254)	0.4973 (3.0520)**		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
14.2225***	3.4600	-0.9728***	1.0381	S	S	0.95	16.205***

Table 4.9 elaborates result of both linear and non-linear ARDL for Kenya. The estimation results show that the impact of exchange rate fluctuations to consumer prices is quite substantial and asymmetric in Kenya. A one unit appreciation of local currency leads to 2% decrease in consumer inflation while unit depreciation is associated with 74% increase in consumer inflation in the long-run. Oil price also contribute positively to consumer inflation in the long-run. Bound's test indicates that the co-integration exists among the variables.

LM test rules out the serial correlation in both of the models. The speed of adjustment is 72% in the linear model and 97% in the non-linear specification. Ramsey RESET test shows both of the models are correctly specified. CUSUM and CUSUM-Square show the both of the models happen to be stable. R-Square show that both of the models are good fit.

Table:4.10 Empirical Results for Morocco

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	-0.3052 (-1.9852)*	0.8492 (1.0412)	-0.8383 (-1.0069)	-0.4432 (-0.7831)			
ΔGDP	0.4411 (0.9570)						
ΔMS	-0.1302 (-1.2081)	0.2602 (1.8766)*	-0.2429 (-2.0868)**				
ΔOP	0.0270 (0.9243)						
Panel B: Long run results							
Constant	ERMOR	GDP MOR	MS MOR	OP			
14.8364 (2.9723)***	-0.2601 (-1.9547)*	0.3411 (0.8866)	0.1316 (2.6640)**	0.0314 (0.8634)			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
3.3400*	0.8612	-0.8574***	1.3611	S	US	0.63	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	-0.9740 (-1.2701)	0.1266 (0.1708)	-0.6068 (-2.1752)*	-1.9304 (-2.5934)**			
ΔER-	-0.4034 (-3.0240)**	0.0457 (0.0390)	0.8377 (0.6921)	-0.2869 (-0.2522)	0.0839 (2.5355)**		
ΔGDP	-0.0310 (-1.4581)	-0.0810 (-1.6719)	-0.9010 (-1.7815)	0.3110 (3.4725)***	0.3110 (2.2954)**		
ΔMS	-0.0709 (-0.5877)	0.4437 (2.7983)**	0.3355 (2.8363)**				
ΔOP	-0.0046 (-0.2214)						
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
13.9602 (3.0372)***	-0.1815 (-4.6309)***	0.3662 (2.6668)**	0.3229 (5.4403)***	0.0188 (4.3972)***	0.00237 (0.2252)		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
5.8043***	3.5811	-0.8237***	2.2475	S	US	0.83	3.4368**

Table 4.10 shows linear and non-linear ARDL results for Morocco. A one unit appreciation of domestic currency leads to 18% decrease in consumer inflation in the long-run. However, the magnitude of exchange rate depreciation pass-through is relatively greater, as a one unit depreciation of local currency is associated with 36% increase in the consumer inflation. The asymmetry in coefficients is found to be statistically significant by Wald's test. Besides, money supply is also found to significantly contribute to consumer inflation in the long-run. Bound's test show that long-run relationship exists among the variables in both linear and non-linear specification.

LM test shows that both of the models don't suffer from serial correlation. The speed of adjustment is 85% in the linear specification and 82% in the non-linear model. Ramsey RESET test shows both of the models are correctly specified. CUSUM and CUSUM-Square show the both of the models are stable at large. The value of R-Square show the both of the models are good fit.

Table:4.11 Empirical Results for Nepal

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	0.8099 (4.2028)***	-0.1900 (-5.1202)***					
ΔGDP	0.3309 (3.3071)***						
ΔMS	0.5122 (2.9233)***	-0.1076 (-0.6052)	-0.1795 (-0.9608)	-0.1706 (-0.8548)	-0.1896 (-1.0646)		
ΔOP	-0.0440 (-0.9491)	0.2040 (2.9320)***	0.1307 (2.3772)**	0.1735 (2.7960)**			
Panel B: Long run results							
Constant	ER NEP	GDP NEP	MS NEP	OP			
10.1927 (16.8177)***	-0.1819 (-4.7578)***	0.0309 (3.6379)***	0.5551 (3.4222)***	0.0268 (1.3789)			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
7.5532***	0.1856	-0.7891***	2.0888	S	S	0.51	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	0.3583 (1.4130)	0.1570 (0.3357)	0.8609 (1.9546)*	0.1603 (0.4978)	-1.0389 (-3.1443)**		
ΔER-	-0.2166 (-0.4563)	0.5793 (3.8815)***	-2.1985 (-1.6161)	-1.3872 (-1.3172)			
ΔGDP	-0.3509 (-1.5946)	-1.0908 (-1.8136)	0.2609 (1.0254)	0.9909 (2.0984)*			
ΔMS	0.3818 (2.2221)*	0.0486 (0.1927)	-0.1121 (-0. 2250)	-0.0703 (-0.2489)	-0.2934 (-1.4100)		
ΔOP	-0.1544 (-1.6954)	-0.1411 (-1.2698)	-0.0512 (-0.4626)	-0.2362 (-1.6527)	0.2876 (2.4498)**		
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
30.8802 (5.4014)***	-0.1288 (-1.9392)*	0.3112 (5.0499)***	-0.5609 (-1.3849)	0.2294 (2.3988)*	0.2054 (4.4996)***		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
5.4531***	2.6650	-0.8623***	3.0470	S	S	0.82	7.5202**

Table 4.11 outlines the linear and non-linear ARDL results for Nepal. A one unit appreciation of local currency is associated with 12% decrease in consumer inflation for Nepal in the long-run. As expected, an equal magnitude of depreciation however leads to 31% increase in consumer inflation over the long-run. The disparity in pass-through is found to be statistically significant. Money supply and oil price also contribute positively to consumer inflation in the long-run. Bound's test shows that significant long-run relationship exists among the variables.

LM test shows that none of the model suffers from serial correlation. The speed of adjustment to long-run equilibrium is 78% for the linear specification, while it is 86% in the non-linear model. RESET test shows that both of the models are correctly specified. The models are also found to be stable by CUSUM and CUSUM-Square test. Adjusted R-Square shows that both of the models are good fit.

Table:4.12 Empirical Results for Nigeria

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	-0.4234 (-2.9472)***	0.2197 (1.2003)	0.2731 (1.9540)*				
ΔGDP	-0.7410 (-2.5554)**	0.5910 (1.3344)	0.8391 (0.3928)	0.4339 (2.0957)**	-0.0509 (-3.9476)***		
ΔMS	-0.4430 (-0.4490)	0.2142 (3.2325)***					
ΔOP	-0.3840 (-2.1827)**						
Panel B: Long run results							
Constant	ERNIG	GDP NIG	MS NIG	OP			
24.5332 (2.4482)**	0.0985 (0.8816)	-0.0312 (-1.4881)	0.2979 (2.0998)**	0.5443 (2.0248)*			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
6.2661***	2.0766	-0.70***	3.9092	S	US	0.70	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	-0.4486 (-3.2120)***						
ΔER-	-0.4066 (-0.1142)	0.2472 (0.2667)	0.2686 (0.4292)	-0.9811 (-0.1902)	0.5366 (1.4006)		
ΔGDP	-0.2210 (-0.4950)	0.0110 (0.3141)	0.3011 (0.1566)	0.3209 (2.0167)*	-0.6610 (-2.5672)**		
ΔMS	0.0877 (0.0635)	0.1380 (2.8074)	0.3159 (0.1606)	0.4418 (2.0229)*			
ΔOP	-0.3102 (-0.9906)	-0.0635 (-0.1511)	-0.2800 (-0.7183)	-0.4866 (-1.7007)			
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
-66.6522 (-2.4037)**	-0.1517 (-3.8764)***	0.2256 (2.1550)*	0.3510 (2.1863)**	0.2596 (3.7292)***	0.8942 (2.5700)**		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
5.7405***	2.6902	-1.2754***	0.9715	S	S	0.68	2.6652**

Table 4.12 presents linear and non-linear ARDL results of Nigeria. Estimation results show moderate and asymmetric exchange rate fluctuations effect on consumer prices. A one unit appreciation of local currency leads to 15% decrease in the consumer inflation over long-run. However, a one unit depreciation of domestic currency is associated with 22% increase in consumer inflation over long-run in Nigeria. The asymmetry in pass-through is found to be statistically significant by Wald's test. The country also appears to be prone to oil price shocks as oil price contribute significantly to the long-run inflation. Money supply has significant positive effect on consumer inflation but relatively smaller in magnitude. Bound's test confirms the existence of significant long-run relationship (co-integration) among the variables.

LM test rules out the problem of serial correlation in both of the models. The non-linear models follow an oscillatory path of adjustment and both models are found to be correctly specified according to RESET test. CUSUM and CUSUM-Square show both of the models are stable at large. Adjusted R-Square show that both of the models are good fit the data.

Table:4.13 Empirical Results for Pakistan

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	-0.0986 (-0.8202)	0.0118 (0.0552)	-0.5740 (-2.7933)**	0.3971 (2.2349)**	-0.2874 (-1.8495)*		
ΔGDP	-0.6010 (-2.5419)**	0.1630 (4.2193)***					
ΔMS	-0.3211 (-2.4980)**	-0.0761 (-0.5098)	0.1549 (0.9974)	0.5115 (3.8550)***			
ΔOP	0.0983 (4.0885)***	-0.0684 (-1.9003)*	0.0353 (1.0442)	0.0352 (1.0732)			
Panel B: Long run results							
Constant	ERPAK	GDP PAK	MS PAK	OP			
33.7554 (2.5558)**	-0.1862 (-4.7199)***	-0.7210 (-2.7017)**	0.2123 (2.8599)**	0.1616 (3.1631)***			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
7.6981***	0.6510	-0.6218***	0.5981	S	S	0.83	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	-0.1470 (-0.8520)	-0.0246 (-0.0958)	-0.6341 (-2.2348)*	0.5102 (2.1716)*	-0.6999 (-2.8116)**		
ΔER-	0.2944 (0.7845)	-0.4324 (-0.9008)	0.7675 (1.4876)	-0.8391 (-0.4823)	0.5718 (3.5991)***		
ΔGDP	-0.8110 (-0.7200)	0.2310 (2.2728)**	-0.2211 (-0.0598)	0.6110 (2.2045)*	-0.4810 (-2.1788)*		
ΔMS	0.0477 (0.2326)						
ΔOP	0.2997 (4.2482)***	0.0063 (0.0987)	0.1728 (2.9095)**	0.0406 (0.8104)	0.0884 (2.1370)*		
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
-30.2900 (-4.3888)***	-0.18942 (-2.8641)**	0.2135 (3.3928)***	-0.0121 (-3.8104)**	0.0332 (0.2496)*	0.4240 (3.5749)***		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
5.0612***	1.6350	-1.4339***	0.7730	S	S	0.86	4.2917**

Table 4.13 presents the linear and non-linear ARDL results for Pakistan. The exchange rate pass-through to consumer prices in Pakistan is quite small as compared to other developing countries, however the estimates using non-linear specification are greater than previous estimates for the country (Ahmed et. al (2018), Hyder and Shah (2004), Minhaj and Nishat (2018)). In the non-linear specification, a one unit appreciation of Pakistani rupee is associated with 18% decrease in consumer prices, while in linear model it causes only 15% decrease in consumer prices over the long-run. The degree of depreciation pass-through is however higher, as a one unit deprecation of local currency leads to 21% increase in consumer inflation in the long-run. The asymmetry in exchange rate pass-through is found to be significant by Wald's test. Besides, money supply and oil price also contribute positively to consumer inflation over the long-run in both linear and non-linear models. Increase in overall output is however negatively related to consumer inflation in the country. Strong and significant long-run relation exists among the variable according to Bound's test.

LM test accepts the alternative hypothesis that there is serial correlation in both of the models. The non-linear specification follows an oscillatory path of adjustment to the long-run equilibrium. RESET test indicates both of the models are correctly specified. Both of the models are found to be stable by CUSUM and CUSUM-Square.

Table:4.14 Empirical Results for Sri Lanka

Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER	-0.0795 (-0.2717)	-0.5102 (-1.2429)	-0.2960 (-0.9109)	0.9282 (2.6973)**	-0.4184 (-1.3086)		
ΔGDP	-0.0909 (-1.5654)	0.5309 (0.9110)	-0.7910 (-0.5160)	0.5810 (0.0896)	0.6409 (1.7225)		
ΔMS	-0.4509 (-2.7373)**	0.9571 (4.1186)***	-0.8953 (-1.9527)*				
ΔOP	0.2078 (1.6621)	0.1469 (1.0756)	-0.2967 (-2.9879)***	0.3951 (3.4198)***	-0.5666 (-4.078)***		
Panel B: Long run results							
Constant	ERSRK	GDP SRK	MS SRK	OP			
20.5499 (2.1474)**	-0.3611 (-2.0855)*	0.3909 (2.5920)**	0.3738 (1.0130)	-0.1089 (-0.8530)			
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	
3.7714**	1.7971	-0.7410***	2.1843	S	S	0.55	
Non-Linear ARDL model estimates							
Panel A: Short run results							
Lags	0	1	2	3	4	5	6
ΔER+	0.0820 (0.5100)	-0.2736 (-1.2119)	-0.2263 (-0.8444)	0.1956 (0.7121)	-0.1625 (-0.9093)		
ΔER-	-0.5373 (-3.7693)**	0.2720 (2.8161)**	0.1762 (0.0611)	0.8868 (3.7475)**	-0.3704 (-6.0977)***		
ΔGDP	-0.4709 (-2.6155)*	0.9009 (2.7014)*	-0.2710 (-0.7253)	-0.0801 (-1.2995)	0.7009 (2.8494)**		
ΔMS	-0.7939 (-3.8704)**	0.6872 (2.4201)*	-0.6451 (-2.3667)*	0.1211 (0.5459)	-0.1344 (-4.8757)***		
ΔOP	0.2053 (2.6802)*	0.3083 (2.6749)*	-0.3073 (-4.8848)***	0.3480 (5.7839)***	-0.6553 (-7.454)***		
Panel B: Long run results							
Constant	ER+	ER-	GDP	MS	OP		
29.9569 (6.6882)***	-0.1886 (-2.2456)*	0.2808 (2.3245)**	0.0612 (2.7786)**	0.8654 (6.7834)***	0.0494 (1.1192)		
Panel C: Diagnostic results							
F	LM	ECM	RESET	CSM	CSM2	Adj R2	L-Wald
29.4654***	1.0134	-0.7893***	0.7377	S	S	0.95	22.98***

Table 4.14 reveals linear and non-linear ARDL results for Sri Lanka. A one unit appreciation of domestic currency is associated with 18% decrease in consumer inflation. While a one unit depreciation of local currency leads to 28% increase in consumer inflation in the long-run. The asymmetry in coefficients is found to be statistically significant by Wald's test. Besides, money supply also significantly contributes to consumer inflation in the long-run. Bound's test show strong significant long-run relationship.

LM test indicates both of the models are free from problem of serial correlation. Ramsey RESET test indicates that both of the models are correctly specified as well. The speed of adjustment is 74% for the linear model for 78% in the non-linear specification. CUSUM and CUSUM-Square show that models are stable. Adjusted R-Square show that model are good fit.

Chapter 5

Conclusion

The first section briefly concludes the study. Policy implications are outlined the second section. The third section outlines limitations of the study and future research prospects in the area.

5.1 Conclusion of the Study

Price level stability is of paramount importance in the paradigm of economic policy making. It is the main objective of monetary policy in many countries. Its importance further increases in the context of developing countries where a besides economic repercussions a huge social cost is associated with it. In those countries a rise in inflation poses threat of pushing millions of people deep into poverty.

Survey of literature on the determinants of inflation reveals that exchange rate fluctuation is one of the important determinants of inflation. The Exchange rate depreciation imports the global inflation thus raising the domestic prices level. While exchange rate appreciations are expected to lower domestic inflation. The impact of exchange rate fluctuations to consumer prices can be partial or complete depending on country specific features. Asymmetric effects of exchange rate fluctuations exist when exchange rate effect inflation differently based on the direction of changes in exchange rate.

This study uses linear ARDL model to check the impact of exchange rate fluctuations to consumer prices in developing countries. Short-run and long-run impact of exchange rate fluctuations to consumer prices exists in all of the sample countries. The magnitude of pass-through tends to be higher in the long-run probably because of the second-stage pass-through effect. The study found strong evidence of asymmetric impact of exchange rate fluctuations

into consumer prices for all of the selected developing countries. Besides, money supply and oil prices give mixed results for the selected sample.

5.2 Policy Implications

The study has profound implications for the formulation of monetary policy in developing countries. As it has now been established that domestic inflation in selected developing countries is partly explained by the exchange rate depreciation, monetary authorities should be careful in the conduct of monetary policy. As the study has tested pass-through to consumer price, large and persistent exchange rate depreciation can have strong welfare consequences for developing countries. Such devaluation can increase uncertainty, lessen the purchasing power and affect household and businesses budget planning. The utmost priority of central banks in the developing countries should exchange rate stability through careful and measured interventions whenever needed.

The higher impact of exchange rate fluctuations on consumer prices observed also highlights the vulnerability of developing economies in face of flexible exchange rate and free trade policy. Given the volatile exchange rate of selected developing countries a liberal trade policy can be disastrous for welfare. Exchange rate appreciation have modest role in the disinflation in most of countries. This highlights the downward rigidity of prices in such countries. Such countries are ought to embark on market liberalization journey, minimizing restrictive interventions like minimum wage laws, while having good regard for the social welfare.

5.3 Limitations of the Study and Future Research Prospects

This study is conducted on a sample of selected developing countries regardless of exchange rate regime followed. Future research can analyze the impact of exchange rate fluctuations on consumer prices separately under pegged and floating rate regimes. Such a division can further

increase the understanding of pass-through to consumer prices under various exchange rate regimes.

The study observes impact of exchange rate fluctuations to consumer price inflation only. Future result should explore the impact of exchange rate fluctuations to other price indices like producer price index (PPI) and wholesale price index (WPI). A comparison of pass-through to different price inflation shall reveal which price index is more vulnerable to fluctuations in exchange rate.

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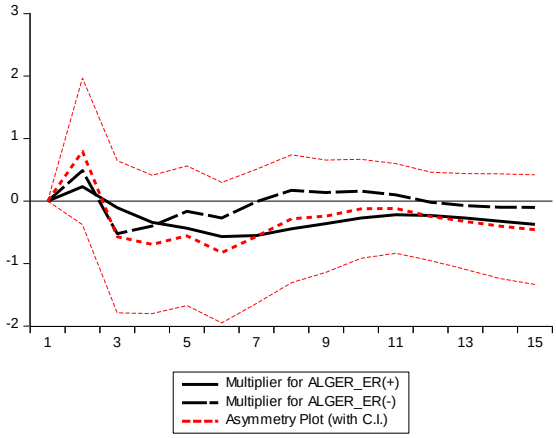
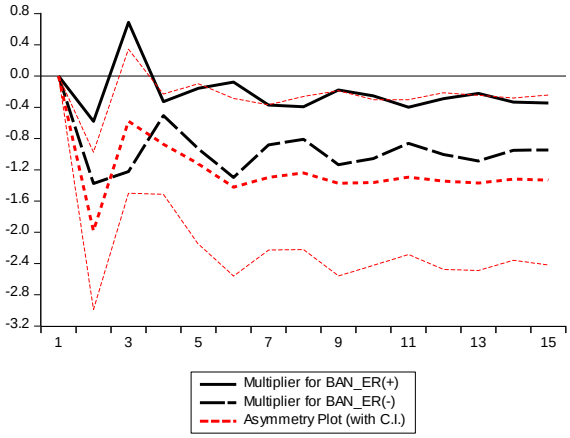
Appendix

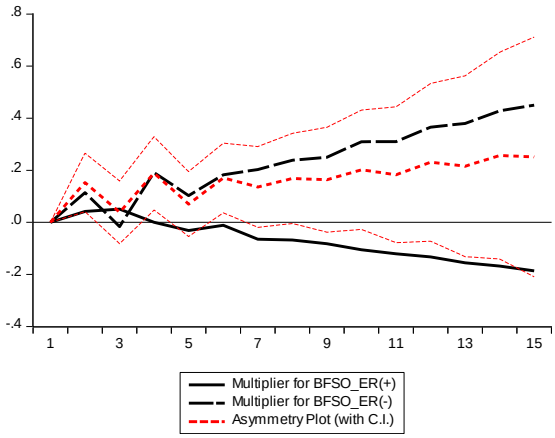
Table 1-A: List of Countries

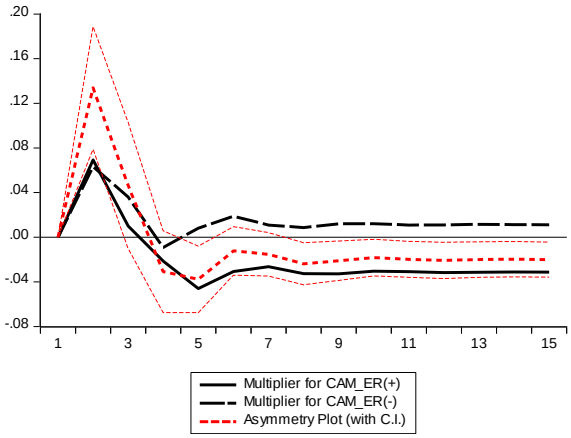
Country Name		
1. Algeria	2. Bangladesh	3. Burkina Faso
4. Cameroon	5. Egypt	6. India
7. Indonesia	8. Kenya	9. Morocco
10. Nepal	11. Nigeria	12. Pakistan
13. Sri Lanka		

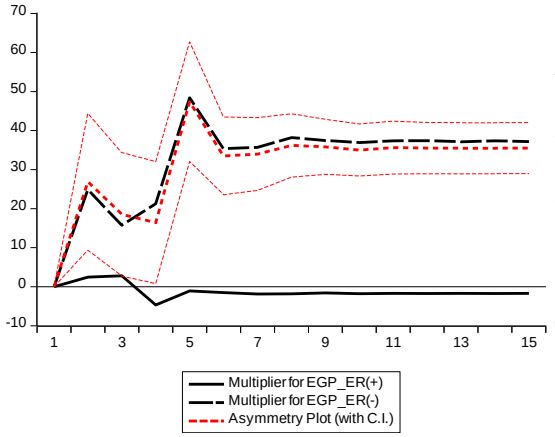
Graphs 1-A: Non-Linear ARDL Multiplier Graphs

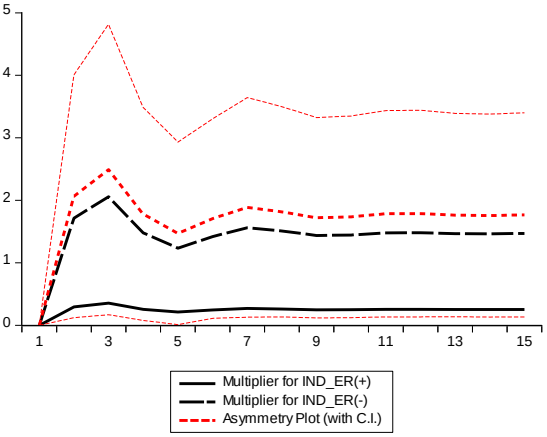


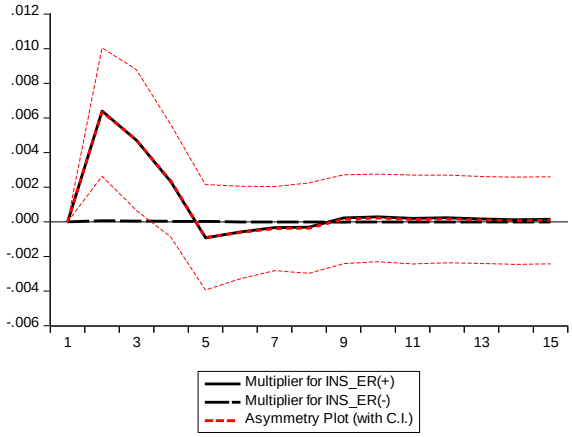








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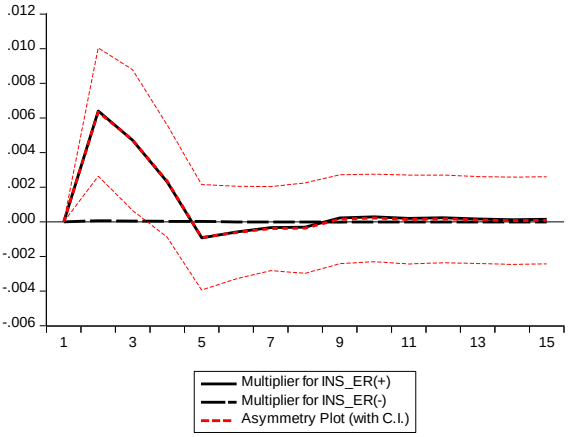
Multiplier for INS_ER(-)
Asymmetry Plot (with C.I.)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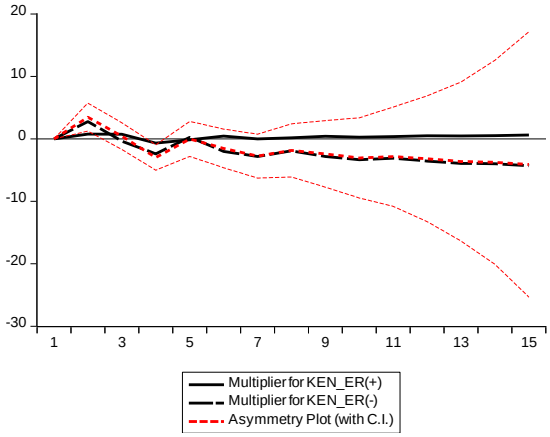
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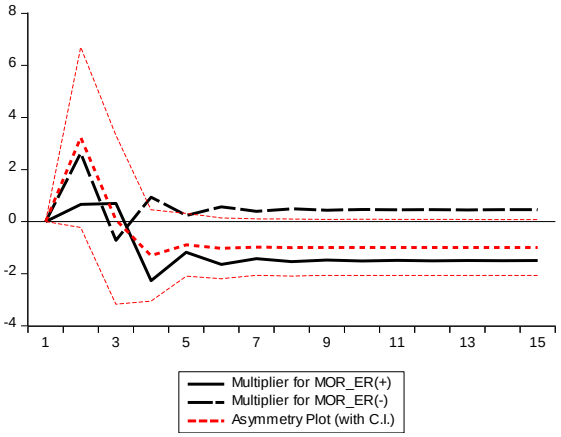
Asymmetry Plot (with C.I.)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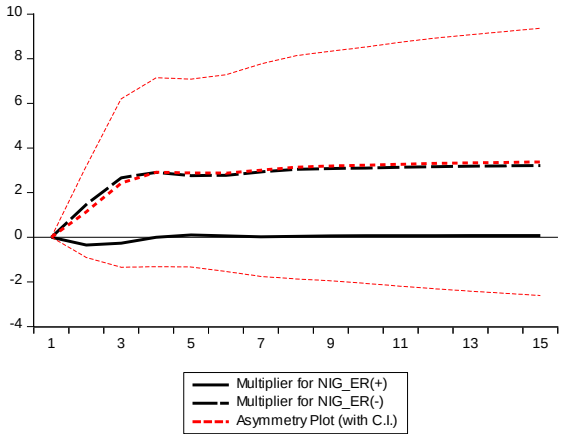
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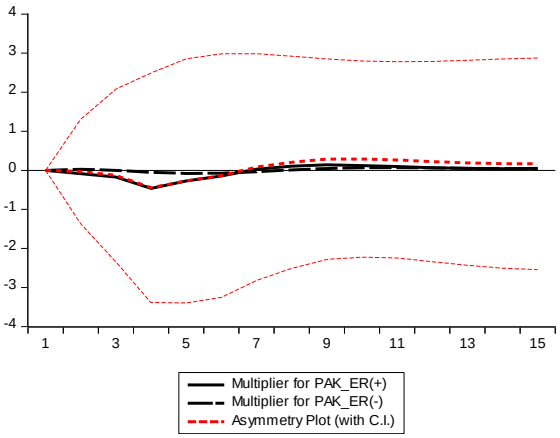
Multiplier for NIG_ER(-)
Asymmetry Plot (with C.I.)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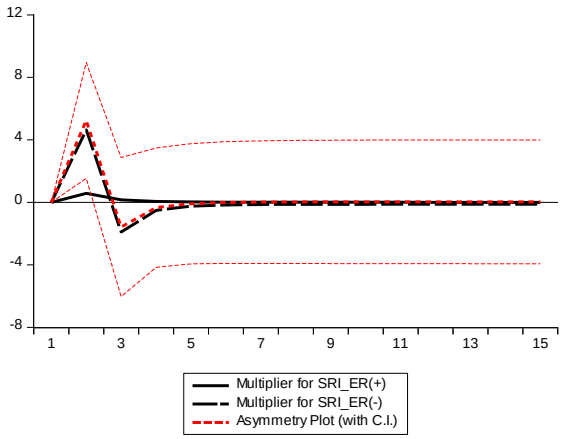
Asymmetry Plot (with C.I.)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Multiplier for SRI_ER(-)
Asymmetry Plot (with C.I.)