Analysis of Exchange Rate Pass-Through to Domestic Prices in Pakistan

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CERTIFICATE

This is to certify that this thesis entitled: **"Analysis of Exchange Rate Pass-Through to Domestic Prices in Pakistan"** submitted by Mr. Talal Ahmad Kundi is accepted in its present form by the Department of Economics & Econometrics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of **Master of Philosophy in Economics**.

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DEDICATION

This research work is dedicated to

My Beloved Parents

For their prayers, moral support and encouragement that enlightened my way and made it possible for me to reach at this stage.

Acknowledgement

Acronyms	
ERPT	Exchange rate Pass-Through
PPP	Purchasing Power Parity
ARDL	Auto-regressive Distributed Lagged Model
ADF	Augmented dickey-Fuller
VAR	Vector Auto-regressive
ECM	Error correction Model
ER	Exchange rate
CPI	Consumer Price Index
LSM	Large Scale Manufacturing
PSB	Public Sector Borrowing
WPI	Wholesale Price Index

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Abstract

Exchange rate pass-through to domestic price level is the phenomena which states that how much fluctuations in the exchange rate are translated into domestic price level. In past 30 years a huge depreciation of exchange rate is recorded in Pakistan. So this objectifies us to find out the long run and short run pass-through in Pakistan and other factors affecting domestic price level as well. Using monthly data from January 1991 to November 2019 and Auto-regressive distributed lagged model as an estimation technique to estimate the long run and short run results. The ERPT to consumer price index in the long run is 15.7 and 50.7% to Wholesale Prices while in the short run ERPT to CPI is 11.2% and these results are in line with the literature. It implies that in the long run the 1% depreciation in the exchange rate the consumer prices will increase by 0.157% and 0.112% in the short run. Overall the ERPT is significant but incomplete which suggests that the exchange rate depreciation is not the main factor of the rise in the inflation in Pakistan.

Chapter 1

Introduction

After abolishment of Bretton Woods agreement and system in 1973, and adoption of floating exchange rate system, the exchange rate pass – through (ERPT) has been under the focus and search of researchers and policy makers. According to Goldberg & Knetter (1997), when there is percentage change in import price in terms of local currency due to one percent fluctuation in exchange rate between two trading countries that phenomena is called exchange rate pass - through. In open economies, domestic and external factors (comprising world prices and exchange rate) plays a vital role in defining the inflation and its dynamics.

Explicitly, through exchange rate depreciation the domestic prices can be affected through two channels, one is direct channel and the other is indirect channel. When exchange rate is depreciated, it influences the imports, directly. Consequently, the imported goods and raw material are accounted to be expensive for consumers and producers. The consumers have to pay higher prices for imported good and goods embedded with imported raw material. In the backdrop, raw material embedded domestically produced goods add on higher cost of production. Through exchange rate depreciation, the imports are being halted and exports are being promoted. This leads towards higher demands of exported goods as well as domestic factor of production. So, the payments for factor of production as well as domestic prices are

raised. Hence, the depreciated exchange rate resulted in higher domestic price level, indirectly (Hyder & Shah, 2004).

The subject of exchange rate pass-through (ERPT) has been addressed by many researchers over the last three decades; since the work of Dornbusch (1987). There is plenty of work on the subject of pass – through of exchange rate for developed economies. This theme is getting attention with reference of developing countries via researcher and policy makers since last decade. The findings for developed economies showed ERPT nexus with domestic inflation, but, this nexus is not one – to – one between dynamics of change in exchange rate and pass – through to inflation (Menon, 1995).

Earlier, the research was bounded to investigate the pass – through affect of exchange rate to import and export prices. Later, the analysis was extended on the aggregate price level and inflation in the economy. The cross country analysis found either a small impact of exchange rate pass-through or the influence is insignificant (Mccarthy, 2000 and Mihailov, 2009). Contrast to this, Campa & Goldberg (2005) and Cavaliere (2007) found significant and one – on – one pass – through affect of exchange rate to import prices.

Pakistan is small open economy and is suffering from different economic problems. The origin of these economic problems is current account deficit and the persistent exchange rate fluctuations. Pakistan is highly import dependent country to meet the domestic demand. Adding, the CPI basket in Pakistan constitutes imported products largely.

Keeping this scenario in light, the fluctuations of exchange rate influence domestic prices; directly as well as indirectly. Therefore, it is pertinent to explore the nexus that how exchange rate and global price fluctuations transmitted into our domestic inflation. We will also consider the variables and factors which may affect the domestic price level along with the focused subject of concern exchange rate fluctuation like public borrowing. Public borrowing is mostly used to meet the government expenditures like subsidies, salary, infrastructure and many other expenditures which only affect the aggregate demand and it results in the increase of domestic price level when aggregate supply remains same. Other variables like money supply, oil prices and large scale manufacturing are also incorporated as control variable in our study.

In case of Pakistan, there are many studies for determining inflation like Khan et al., (2007), Ahsan et al., (2011) and Zaman et al., (2011). But, there are only few studies that are conducted on the subject of pass – through affect of exchange rate in Pakistan. To the best of my knowledge, Hyder & Shah (2004) initially examined the relationship between pass – through of exchange rate and domestic inflation. They found a modest and low ERPT to domestic inflation. Jaffri (2010) has analyzed pass – through of exchange rate while keeping focus on exchange rate misalignment and foreign inflation. The findings showed significant and high impact of foreign inflation (proximate by foreign exporters' cost) on domestic inflation. Our study will address the problems generated through exchange rate depreciation to consumer prices in Pakistan on which there is very less work done till now.

Moreover, this study is different from the previous research in many ways like a long data set (from Jan 1991 to Nov 2019), methodology and variables. Previous studies used VAR methodology while we are using the co-integration approach and one very important variable is added along with other independent variables which is public sector borrowing that previous studies didn't incorporated.

1.1 Significance of the Study

Pakistan is facing a huge problem of inflation and to tackle this inflationary environment State bank of Pakistan increased the interest rate. At the same time, exchange rate has also witnessed a large depreciation over the last two years so this motivated us that it is very important to examine the pass-through affect of exchange rate on domestic inflation in Pakistan.

As, it is already mentioned that there are very few empirical studies which address the ERPT towards domestic consumer prices in Pakistan. This study will fill up the gap in the literature by aiming to find out the affect of persistent fluctuation in exchange rate. The findings of the research will help the researchers and policy makers to better understand the relationship between exchange rate and inflation in Pakistan. And we are also considering other variables to find out the factors affecting inflation in Pakistan along with the exchange rate fluctuations.

1.2 Objectives of the Study

Particularly the goal of the research is to address the objectives given below:

1. To examine long run and short run relationship between exchange rate and domestic prices in Pakistan.
2. To find out the factors affecting the domestic price level other than exchange rate.

1.3 Research Questions

This study is attempted to address the following research questions:

1. Is there prevail a long run relationship between exchange rate and domestic prices in Pakistan?
2. Is there prevail short run association among domestic price inflation and exchange rate in Pakistan?
3. What are the other factors affecting domestic inflation in Pakistan other than exchange rate?

1.4 Organization of Study

In chapter 1 introduction, significance and objective are discussed. Further, in chapter 2 covers the detailed literature regarding developed, developing and Pakistan. Chapter 3 contains the econometric methodology discusses unit root and different co-integration techniques and in chapter 4 contains the data and variables and descriptive properties of the variables. Chapter 5 is regarding estimations and detailed discussion of results and chapter 6 contains the conclusion and policy implications.

Chapter 2

Review of Literature

There is a large amount of theoretical and empirical literature available on exchange rate pass – through (ERPT) to different price levels i.e. import prices, producer prices and consumer prices. There are many studies on the degree of ERPT to inflation and also on the level of inflation and the exchange rate pass – through. A suitable strand of literature is discussed under in which we tried to cover different aspects and dimensions regarding the affects of ERPT to inflation. In relation to Pakistan there is limited literature which discuss the concerned subject. Further the literature on the concerned subject exchange rate pass-through is discussed in different ways below.

2.1 Theoretical Background

The concept of exchange rate pass-thorough (ERPT) refers to the impact of exchange rate changes on import prices. According to Goldberg & Knetter (1996) the ERPT is the percentage change in the local currency import price due the one percent change in the exchange rate between two trading countries. The ERPT is that, that how much variations in the exchange rate is translated in the imported country currency prices of imported(traded) goods (Menon, 1995). The domestic prices are also affected through the exchange rate appreciation and depreciation not only the import prices.

Purchasing power parity (PPP) and the law of one price are the bases of the concept of the ERPT. When there is no arbitrage the law of

one price (LOP) postulates that the common currency price of the similar products is same in different countries and different locations when there are no trade frictions and the conditions which must apply are the price flexibility and free competition. The law of one price is the base PPP. Further purchasing power parity are of two types one is relative PPP which is exactly the law of one price and the second is absolute PPP. Between two countries when the LOP is held for all the commodities then there will be absolute PPP. There are two assumptions for a sound PPP are must: first immediate costless and frictionless arbitrage and second there are identical goods. These assumptions are very difficult to be held as literature suggests. Therefore, a new type of relative PPP which is modified the version developed as a new research area. The $P = \alpha \varepsilon P^*$ equation represents this new version in which P shows the price level in the domestic home currency percentage of international currency and α represents the real exchange rate (Goldberg & Knetter 1997). According to Anaya (2000) when PPP holds, the exchange rate changes are transmitted into proportionate changes in the domestic prices and he found ERPT is equal to one.

The theory of PPP does not look good enough to explain the ERPT in short run but can explain it in a very long run. Roggoff (1996) argued that real exchange rate leads to the parity in very long run and deviates from the PPP in the short run. According to Darvas (2001) when there is stationary real exchange rate here the issue of the time period may arise and plays its role like in 4 years are the 50% life of a fluctuation then how we can say there will be full pass through. Many researchers come

to common conclusion that the degree of ERPT is not always complete as shown in the literature. A Cournot oligopoly model is used by Dornbush (1987), this study concluded that ERPT is not complete and this deviation from the PPP could because of imperfect competition in the market. According to Heckscher (1916) and Obstfeld and Taylor (1997) concluded that the lack of perfect arbitrage and lack of certainty due to this the PPP does not hold. Frenkel (1978) argued in the favor of PPP by using the data of hyperinflation this is not surprising at all due to prevalent monetary disturbance. But Frenkel (1981) or Krugman (1978) rejected the purchasing power parity for a stable monetary situation. So due to the incompleteness of the and lack of the parity the phenomenon of ERPT is under research from almost last three decades. The researchers are trying to find the degree of pass through and the reason behind the incomplete pass through and they are trying to find out that how much fluctuation of exchange rate are transmitted into domestic inflation.

2.2 Developed Country Case

This type of relationship among the exchange rate and price level have attracted the attention of many researchers and scholars. In the beginning researchers and scholars studied the exchange rate pass-through (ERPT) to inflation in developed economies. There is common understanding that the magnitude of ERPT is different across the countries it is recorded low in developed but higher in developing and the literature discussed will support the argument comprehensively. As we said there is a huge strand of literature available regarding developed

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economies and in 1995, Menon (1995) conducted a study in which the author reviewed more than forty studies comprehensively and more than half of the studies are of developed economies particularly USA. The findings of the study are divided in to five categories. The categorization is based on the degree and dynamics of ERPT. Furthermore, author also took in to consideration the ERPT differences across and within countries and also at the product level over time. It is known fact that each country's economy functions differently, and so are the literature provides the same evidence.

The ERPT is different for different countries. For instance, Krenin (1977) devised a range for ERPT for developed and developing countries. According to his findings pass-through of exchange rate in the united states is 50% while in Italy it is full. In opposition to the mentioned studies Spitaeller (1980) and Khosla & Teranishi (1989) found out that ERPT converges to completion in developing countries while it is incomplete or low ERPT in developed countries. A disaggregated analysis of price confirms the significant difference of ERPT among different products and industries. It is also true if we take in to consideration the price differences within the country. Taking example of USA the spectrum of differences stretches between 48.7 percent to 91 percent. The factor responsible for these differences is the methodology used for price indices calculation. Other studies conducted to analyze the pass-through during the period 1970-1995 concluded that it is quietly stable in the mentioned time period (Menon, 1995).

Another study conducted by Menon 1996 to explore ERPT in which the focused country is Australia and the sample consisted of 40 product categories of consumer products. By using OLS based model the results matched the former Menon, 1995 and 1996 studies. During a period of one year nearly all the categories depicts a ERPT of about 70% and above. This mentioned pass through is an average percentage. A further deep analysis at each product level it varies. The variations are due to substitutability of imported products for domestic as it entwines with ERPT. Furthermore, foreign intervention, product differentiation, quotas and imported goods share in the domestic market. The mentioned factors negatively impact the degree of pass-through (Menon, 1996).

By comparing the both developed and developing economies Golfajn & Werlang (2000) investigated the connection between domestic price level and exchange rate. Sample of the study consisted of 71 economies, both developed and emerging and the time period ranges from 1980 to 1988. They found out that the degree of ERPT is dependent time period under consideration. The degree of ERPT in the short time period is about 17 percent and in long run it approaches 73.2 percent during a period of one year. Their results indicate that the ERPT for developing countries is high whereas for OECD countries it is low. In the considered countries they identified factors which affects the magnitude of ERPT such as, inflation level, difference between current GDP and the forecasted GDP, trade openness, and business cycles.

Regarding different industrialized countries McCarthy (2000) investigated the ERPT and import price pass-through (IPPT) in to

domestic producer and consumer prices. His study focused economies are industrialized countries which includes USA, UK, Germany, Belgium, Switzerland, Sweden, Japan, Netherlands and France. Distribution chain is analyzed in this study and for that purpose a VAR methodology is used. Its results illustrate that ERPT and IPPT modestly impacts the consumer and producer prices. In another study by McCarthy (2007) in which author further extended his previous work and concluded that the low inflation environment shows a significant role in curtaining the ERPT and IPPT. In case of UK France, and Japan the impact lessened by almost 50 percent. The factor behind the modest impact is difference in the use of methodology. Deviating from the previous studies this study treated exchange rate and import prices as endogenous. The author also incorporated central bank reaction function in his study to analyze the impact of monetary policy on domestic consumer and producer prices.

European countries have more stable economic conditions, there are 28 countries in the euro zone so every country have different economic condition, some are economically strong while some are weaker so due to this ERPT degrees will be different across the countries. Focusing on the European economies Hufner & Scroder (2002) investigated the ERPT during the period 1987-2007 by using VECM. The rationale behind using VECM is its property to overcome the stationarity problem and gives accurate short term and long term estimates. ERPT impact varies among the economies in short and long term. Though in short term the magnitude of pass through is faster in Netherlands compared to other countries. In the long run a faster pass through degree

is estimated in Italy and France. They also calculated Harmonized Index of Consumer Prices for measuring average ERPT for the euro zone. Results based on HICP shows that during one-year period a 10 percent depreciation of euro causes the inflation rate to rise by 0.4 percent. Similarly, Campa et al., (2005) have also enquired the long and short run ERPT for the European economies, however the deviating factor from the previous literature is disaggregation of prices. The pass through is comparatively high in the short term but not the complete, however in the long term it is high and approximately complete pass through. The magnitude and pace also varies across industries and the economies. Although insignificant, the result depicts that magnitude of pass through for more than half of the manufacturing sector decreases. The results are parallel with the Taylor (2000) argument, as in the industrialized economies the magnitude of pass through decreasing over the longer time period.

A developed economy like Switzerland with stable economic condition and low inflation rate over the years Stulz (2007) explored more thoroughly the ERPT in to inflation in Switzerland and the data used in analysis is monthly started from 1976-2004 while the econometric methodology adopted for the analyses is VAR. Author sums up his study as the magnitude of ERPT to consumer inflation is modest but for import prices its magnitude is high. During a three months' time period the ERPT for import prices is 35 percent while 9 percent recorded for consumer prices. Stulz (2007) considers low inflation in Switzerland for the low pass through, which is also Taylor (2000) conclusion.

Furthermore, Bhattacharya et al., (2008) investigated the same case in United states of America, United Kingdom and Japan and concluded that the ERPT ranges from 30% to 50 % for US based industries, while for UK's metal industries mainly iron and steel, the relationship is insignificant. By the same token the pass through for Japan centered foodstuff, metallic and textile industries is nearly not significant.

Przystupa & Wróbel (2011) arrived at the conclusion of incomplete ERPT not only in short but also in long run in case of Poland. Results of the study deny the evidence of non-uniformity of ERPT with currency appreciation and depreciation however asymmetric behavior of consumer prices do react to abrupt variations in the exchange rate. In contrast hints that pass through varies differently following that how much fluctuation occurs in the exchange rate. A deep analysis of ERPT at quarter level during the period 1980-2010 by Cheikh & Louhichi (2014) for 12 European economies found out that magnitude of pass through varies across countries like the previous studies. The sample countries in their study are Portugal, Greece, Finland, France and Germany. For Portugal when exchange rate depreciated by 1 % there is 0.84% pass through to domestic inflation while in Case of Greece it is 5.8 percent. Furthermore, for Finland, France and Germany it passes to domestic inflation by 2 percent.

Reddan & Rice (2017) examined the ERPT to domestic inflation of Ireland. Previously Fitzgerald and Haller (2008) reported that the Irish consumer prices are determined by some external inflation and also the exchange rate fluctuations. Bradley (1977) and Geary (1976) found

that the consumer prices of UK and Ireland are interlinked. The pass-through of the UK's consumer prices to Irish is faster than the exchange rate (Fitzgerald & Shortall, 1998). They indicate that the consumer prices inflation if Ireland is now interlinked with the exchange rate of EURO and Pound Sterling. Recently Ha et al., (2019) conducted a study on 29 developed and 26 emerging countries. They concluded that domestic that the domestic economic disturbance causes the exchange rate to fluctuate in different countries and the magnitude of ERPT varies across the countries.

2.3 Developing Country Case

The exchange rate pass-through (ERPT) phenomenon is in the neonatal stage in the case of developing economies. Aron et al. (2014) explored the pass-through of exchange rate in the developing economies very recently. The studies (Mihaljek & Klau, 2001, Rowland, 2004, Nogueira, 2007, Bussière & Peltonen, 2008, Karoro et al., 2009, Omisakin, 2009, Parsley, 2010, Ocran, 2010, Aron et al., 2012, Masha & Park, 2012, Aron et al., 2014, Ellyne & Hearn, 2014) sheds light on different aspects related to ERPT. Furthermore, literature related to ERPT to import and domestic Whole price index and consumer price index at aggregated and disaggregated level has also been developed.

Economic conditions in the developing countries are not as good as in developed countries, there is high inflation, low growth rates, lack of industrial sector and high dependence on the imports, so the exchange rate fluctuations affect the domestic price level more than the developed

economies. For that purpose, Mihaljek & Klau, (2001) focused 13 developing economies for the study of ERPT. Through the use of OLS model for ERPT estimation in to domestic inflation and import prices by concluding that the ERPT correlation with the domestic inflation is strong while weak with that of import prices. Analyzing the phenomenon in exactly the same time period for Mexico, Turkey and SA the results portrays that domestic prices are more sensitive towards import prices volatility. In contrast to the above results in case of Poland and Hungary the domestic inflation is responsive to the lagged import price variations. In case of Chile, Malaysia, Turkey and South Africa import prices and exchange rate volatility has even impact on domestic inflation.

Using data of Columbia for the period started from January 1983 to January2002 and Unrestricted VAR model Rowland (2004) reached a conclusion of speedy ERPT into prices of imports. In a period of one year the ERPT to prices of imports is 80 percent while to the domestic wholesale and consumer inflation is 28 and 20 percent. The results of this study are also parallel with the results of Choudhri & Hakura (2006). According to them the magnitude of pass through varies among developing and developed economies as it is high for developing economies as compared to developed economies. This difference is because of the higher level of inflation in the concerned developing economies. Bussière & Peltonen (2008) shaded light on the inflation level role while exploring and comparing the ERPT of 28 developing economies and 13 developed economies. They conclude that by controlling the exchange rate crisis and providing a suitable inflation

level the ERPT is almost similar for both the developing and developed economies.

Ito and Sato (2007) focused region is East Asia for ERPT in to import prices and domestic inflation. They conclude their work by arguing that ERPT and import prices are highly correlated while the relationship is weak in case of domestic prices. The results for Indonesia are in contrast with the above findings as the exchange rate volatility is high translated into domestic inflation. Nogueira (2007) conducted a study on the investigation of the relationship among inflation targeting framework and ERPT in a cross-country analysis by using ARDL model. This study arrived at the conclusion of low ERPT into domestic inflation. When comparing the low ERPT among producer and consumer prices this study concluded that it is higher for producer and low for consumer. Wimalasuriya (2009) focused on Sri-Lankan economy and used two models to investigate the magnitude of ERPT. The model in his study are log-linear regression model used to investigate the ERPT into import prices and VAR model producer and consumer inflation. The regression model results show 50 percent pass through while VAR model results show complete pass through into producer prices while 30 percent into consumer prices.

For estimating the degree of ERPT into inflation level and output in Nigeria, Omisakin (2009) followed the econometric methodology of McCarthy 2000 i.e. variance decomposition and SVAR. This research concludes that the affect of depreciation of exchange rate on consumer inflation is insignificant, however the main reason behind the domestic

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price sensitivity are monetary shocks. Using VAR model a similar study is conducted by Mwase (2006) for a time period 1990-2005 in Tanzania. His conclusion is similar to that of the above as domestic inflation is not much responsive to exchange rate fluctuation during 1990's. The factors responsible for the unorthodox results are economic reforms in Tanzania during 1990's i.e. high competitiveness, discretionary monetary policy and high output.

For sub-Saharan African economies a study conducted by Razafimahefa (2012) concludes that on average the magnitude of exchange rate fluctuation passing into domestic inflation is recorded 40 percent. However, economies adopting the floating exchange rates the degree of ERPT is low. These results are confirmed by different studies (Taylor, 2000, Choudhri & Hakura, 2012 and McCarthy, 2000 and McCarthy, 2006) supported above results as the ERPT during the 1990's and 2000's declined. The amount by which the pass through decreased is 50 percent during 1990's. The factors behind the above estimate are economic conditions and political reforms in sub-Saharan Africa. Similarly, Masha & Park (2012) like McCarthy (2000) used VAR model, making the case for Maldives of the ERPT into consumer prices. The magnitude of pass through in Maldives is high i.e. 79 percent within a span of one year. The explanation for the high ERPT is Maldives's small and open economy and its high dependency on imports. This paper results are in contrast with another study of Sweiden (2013) which took the case of Jordan's small economy. Study arrived with the conclusion that ERPT is moderate in Jordan despite her economy responsiveness to

exchange rate and oil prices. A short run analysis of the fore mentioned variables reveals that oil prices volatility has greater impact on import prices i.e. 29 percent, while that of exchange rate volatility is 13 percent respectively. In a long run, the combine affect of oil prices and exchange rate on import prices is similar i.e. 13 percent.

Using monthly data of the period 1999- 2000 Beckmann & Fidrmuc (2013) focused on CIS region's ERPT phenomenon. They arrived at the conclusion that small open economies have high magnitude of pass through because of their dependence on imports and on dollar. Within one year span the pass through in to domestic inflation ranges between 50 to 70 percent in case of Kyrgyzstan, Ukraine and Moldova. Furthermore, they argue that the focused countries domestic inflation is more responsive towards Us dollar fluctuations as compared to fluctuations in euro. A 60 percent ERPT is estimated for the region in the long run.

Phiakeo (2017) investigated the ERPT to domestic consumer price level in Dollarized economies of south Asian countries and comes with the conclusion that there exists an indirect affect which means that increase in dollarization increases the amount of pass-through to domestic consumer price inflation. Earlier Carranza *et al.,* (2009) found the higher magnitude of pass through to domestic price level in Dollarized economies. Countries with high level of dollarization faces the high rate of pass-through to inflation. Other studies like Sadeghi *et al.,* (2015) found that in dollarized economies the degree of exchange rate pass-through to inflation is high. Helmy *et al.,* (2018) investigated

the connection between domestic prices and the ERPT in Egypt which was not expressed before. Before this Belaisch (2003) found that the ups and downs in the exchange rate had a small affect on the domestic inflation of Brazil. Bwire *et al.,* (2013) expressed that there is incomplete ERPT to inflation in Uganda. While Helmy *et al.,* (2018) found that the ERPT to different prices is considerably slow and incomplete in Egypt and tis affect is more important in consumer prices.

In middle east and north African developing countries Smaili & aissa (2018) studied the level of exchange rate pass-through to domestic price level. They found that found that the affect of pass-through of nominal affective exchange rate is higher on the prices of import then to the producer prices and the smallest on the CPI in these countries. Some other work like Jebali *et al.,* (2006) showed that in Tunisia the magnitude of nominal affective ERPT to CPI was less for the time between 1999 and 2006. Abida & Sghaier (2012) found no role of NEER as a shock transmitter channel.

Adekunle & Tiamiyu (2018) examined the irregularities of ERPT to inflation in Nigeria. They found that the inflation in Nigeria in the period under research is because of the many imported products in the basket and they found the asymmetries in the response of inflation to depreciation and appreciation of exchange rate in Nigeria. Besides Ghosh and Rajan (2007) argued that the asymmetries in the affect of exchange rate ups and downs to domestic consumer inflation is depends on the asymmetric behavior of the exporter towards depreciation and appreciation. Aron *et al.,* (2012) found that the import prices increases

when the exchange rate is depreciated but not much decrease when the exchange rate appreciated.

Recent evidence regarded Ghana which is a developing country so keeping in view Asafo (2019) investigated the ERPT when bank of Ghana adopted the inflation targeting policy using quarterly data from 2003 to 2017. study concluded that the domestic price inflation is very responsive to shocks in exchange rate but not complete. The impulse response suggests that the monetary measures taken by the bank of Ghana are positively related to the domestic inflation as it 12 percent to 18 percent while exchange rate depreciation affects the domestic price by 9 percent to 12 percent Maduku & kaseeram (2018) investigated the affects of exchange rate changes on inflation in South Africa using monthly data from 2002 to 2015. SVAR results shows that the magnitude ERPT to imports and producer prices are more than other price indices and the amount of pass through to producer price inflation is recorded 22 percent and suggested the monetary authorities to change the exchange rate policy to managed float to decrease the ERPT to lower down the domestic price level.

In case of Indian Economy Joy (2019) examined the affect exerted by the depreciation in the exchange rate on the domestic inflation using monthly data from April 2003 to December 2015 by applying the VECM model. Study found that the local prices in India are very responsive to exchange rate and oil price shocks. This study also concluded that the foreign reserves are also responsive to these fluctuations along with the inflation. A panel data study on 28 emerging economies by Caselli &

Roitman (2016), concluded that there is an asymmetric behavior of pass through magnitude in large and small of depreciation of the exchange rate. When the depreciation in the rate of exchange is higher than 40% it gives the pass through degree of 70 percent while a small depreciation causes less than 20 percent. In Iran Farajollahi et al., (2018) examined the affects of exchange rate on domestic producer prices using annual data from 1981 to 2014. They concluded that the pass through to producer prices is incomplete while they argued that when there is more exchange rate depreciation the inflation will also increase.

2.4 Country-Specific Empirical Studies

In this section studies on specific countries are discussed. Comparing the aggregate level analysis and country specific analysis, the later has more significance when we take in to consideration factors that has an impact on the economy of a specific country as each country economic dynamics varies. In this study the spotlight variable is ERPT. Generalized econometric methodologies adopted for aggregate level study usually arrive at more generalized conclusions.

Nogueira & León-Ledesmab (2009) used monthly data of the period 1995-2007 and focused on the changes in the magnitude of ERPT in Brazilian economy. The have taken inflation targeting in 1999. According to them, IT plays important role in curbing the pass ERPT as it is evident from the Brazil's case where the magnitude of pass through decreased from 0.87 to 0.08. Taking the case of inflation Nogueria (2007) further extended his study and arrived at conclusion that ERPT is

endogenous to domestic inflation. This result is supported by Taylor's (2000) argument. Furthermore, by fixing threshold level of inflation and if the domestic consumer price level increases in the long run crosses that threshold then the pass through is approximately 0.39 percent and if the price level is lower than the threshold price level then pass through is almost zero.

Correa & Minella (2010) explored the ERPT with the help of non-linear methodology in the Brazilian context. The methodology takes in to consideration the exchange rate fluctuations, volatility in exchange rate, and business cycles. The conclusions they drawn from their study are (a) the magnitude of pass through is zero if economy lies below threshold, while higher than the threshold economic activity translates in to 9 percent pass through; (b) a high volatility in the exchange rate translates in to 80 percent pass through, while for low volatility in exchange rate the pass through is zero; (c) high amount depreciation leads to 11 percent pass through while small depreciation results in zero pass through.

Focusing on Chilean economy using monthly data for the period January 1987 to December 2013 Justel & Sansone (2015) estimated the magnitude of ERPT making use of VAR model, they arrived at the conclusion that the ERPT the shows declining trend i.e. the estimated aggregate pass through is 0.20, while the sub sample (2002-2013) pass through recorded as 0.14 percent. Another study conducted by Morande & Tapia (2002) explored ERPT utilizing rolling window VAR model

estimated pass through i.e. 0.40 during the first few years of 90's which declined to 0.10 during the period 1996-2001.

While focusing on Mexican economy Espada (2013) studied ERPT utilizing monthly data of the period June 2001 to August 2012 and running VAR model concluded that the magnitude of pass through during the focused period is low and insignificant as after 12-month period the pass through to domestic inflation is only 0.03 percent. Extending the same study Peóna & Brindisb (2014) argued that imports prices are more responsive to ERPT with coefficient of 0.91 while producer and consumer prices are less responsive towards ERPT with coefficients of 0.17 and 0.02 during a 6 months' period. The reason behind low ERPT is low inflation because of tight monetary policy adopted by Mexico during the focused time period. In contrast to the mentioned studies Aleem & Lahiani (2014) took threshold inflation as endogenous while studying the ERPT and inflation nexus. They concluded that prices above the threshold, ERPT and inflation relationship is significant and if the prices are below threshold the ERPT is not translated in to domestic price inflation.

Odria et. al. (2012) investigated the targeted inflation regime and it relationship with ERPT in Peru. Their main emphasis was the comparison of the period before and after the adoption of inflation targeting policy regime. In the long run they estimated 86 percent decrease in the ERPT. This result is also supported by Winkelried (2014) utilizing rolling window. The ERPT estimated in his paper is 0.10 i.e. after the targeted inflation while before the adopted policy it was 0.60.

Forero & Vega (2015) found asymmetric relationship between the domestic inflation and currency appreciation and depreciation. In the long run when currency is depreciated the pass through is estimated as 0.20 while appreciation of the currency translates by 0.10 in to the domestic inflation.

Taking the case of Columbian economy Rowland (2003) took monthly data for the period January 1983 to October 2002 while using VAR model concludes that in the long run the magnitude of ERPT declines while considering distribution chains as in the focused period it was 0.15. Rincón and Rodríguez (2016) argues that there also exist other factors which strengthens or weaken the pass through and inflation nexus. The factors include; high and volatile CPI inflation, overvalued currency, surplus output, less open economy, and low policy rate. They also argue that the ERPT impacts the state of the economy asymmetrically i.e. high local prices leads to high rate of pass through as compared to low inflation period. The magnitude of ERPT increases if the currency appreciates or depreciates and if the exchange rate is more fluctuating the magnitude of pass through will high.

Considering monthly data of the period July 1991 to March 2005 Khundrakpam (2007) investigated the pass through in to domestic inflation in case of India by utilizing ECM. According him the ERPT into domestic price inflation in the long term is very low i.e. 0.09 and there are signs of decreasing trend of the pass through. Study conducted by Bhattacharya (2008) also found that the ERPT spectrum ranges between 0.03 to 0.17 during the period September 1997 to October 2007.

Study conducted by Kapur & Behera (2012) by applying vector auto-regressive model and quarterly data of the period 1996 to 2011, confirms the above study's findings of low magnitude of ERPT in to domestic prices i.e. 0.10 in case of Indian economy.

Literature of ERPT in case of Chinese economy is also available after the government initiatives of deserting the policy of yuan pegging with US dollar and opening up its economy. Shu & Su (2009) investigated the exchange rate pass through in to domestic inflation in short run and long run for the period 1998 to 2007. They conclude that in short run the ERPT is low but in the long run it touches 0.20. Furthermore, they also conclude that during most of the focused time period the pass through remained stable while distribution chain suggests that the magnitude of ERPT declined over time. Study of Wang & Li (2010) also supports the results of the above study. By extending the study time period the ups and downs in the exchange rate and its translation in to domestic inflation increases i.e. 0.60 as found out by Jiang & Kim (2013). By comparing the pass through of exchange rate in two different exchange rates i.e. fixed and flexible exchange rate Jin (2012) estimated a pass through of 0.14 during fixed regime while low pass through i.e. 0.03 during flexible exchange rate regime.

Limited literature is available on ERPT in the case of southeast Asian countries i.e. Thailand, Indonesia, Malaysia and Philippines. In the country case of Thailand Jitpokkasame (2007) using quarterly data started from 1995 to 2005 investigated the ERPT in to domestic inflation and estimated it as 0.18 while another study by Chai-anant et al., (2008)

considering monthly data estimated the ERPT to be 0.13. Supporting the above study, a long term analysis of the pass through by Wattanakoon (2013) using data of the period January 2000 to August 2011 estimated the pass through to be 0.14. To arrive at more accurate results Arintoko (2011) suggests introduction of structural breaks while shifting from fixed exchange rate regime towards flexible exchange rate regime. The pass through estimated by this study is to be 0.11 while considering the time period of 1997 to 2009. Kuncoro (2015) found out that consumer prices are not responsive to exchange rate fluctuation while it does have an impact on the import and producer prices. However, considering the estimates of SSMX model used by Bank of Indonesia, one percent depreciation of the currency translates in to 0.16 rise in consumer prices (Edwards & Sahminan, 2008). The pass through in case of Malaysian economy is in the range of 0.05 to 0.15, estimated by Bank Negara (2012) using VAR model while considering the time period of 1980 to 2006. Ahmad (2009) arrives at a conclusion that considering Malaysian economy the ERPT is low and incomplete. The estimated long run pass through by this study is 0.18. Guinigundo (2008) focused on Philippian economy and concluded that one percent decrease in the value of peso translates into 0.14 percent rise in the domestic prices. By adopting threshold inflation policy during 2002 to 2015, an annual report of the year 2015 by Central Bank of Philippines reveals zero pass through.

Literature on the topic of exchange rate pass through in the case of European economies is also available as after being part of the euro zone all the member states came under the umbrella of Maastrich criteria,

a criterion which fulfill macroeconomic objectives of the euro members. The basic reason behind this criterion was that all the members will adopt same exchange rate for the period of two years and the members were provided with the flexibility of deviating from the central parity only by 15 percent. Because of this reasons exploring pass through tended to be of paramount importance to the European economies.

Considering a monthly data of the period January 1998 to March 2011 of Czech Republic while utilizing VAR model Kucharčuková et. al. (2013) concluded his paper with the result that 1 percent of change exchange rate is translated into 0.11 percent rise in the consumer prices. Contrary to the above paper a study conducted by Hajeka & Horvath (2016) estimated ERPT to be 0.50 into consumer prices which is an indication of strong relationship between the main variables of their study. They also explored the ERPT in to consumer goods prices, specifically food items and tradable goods prices and concluded that food item prices are highly responsive to pass through i.e. it complete while for tradable goods it was low. Babecka-Kucharcukova (2009) utilizing data of the time period Jan 1996 to Dec 2006 concluded that the level of ERPT in to domestic consumer inflation is 0.25 and within a half year span it reaches completion. Furthermore, study found a decreasing trend of the pass through in case of Czech Republic.

Arratibel & Michaelis (2014) focus of analysis is Poland. They utilized the quarterly of the period 1996 to 2012 and argued that dynamic VAR model best fits the Polish data. They concluded that during six quarters time period the consumer prices were less responsive towards

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ERPT i.e. 0.10. Hajnal et. al. (2015) utilized many models i.e. rolling window OLS, VECM, VAR, and threshold VAR model to capture the relationship between domestic inflation and ERPT taking in to consideration 2001 to 2014-time period. Besides some asymmetries they estimated the range to be 0.10 to 0.15. When the currency appreciates the pass through in to domestic inflation is higher as compared to currency depreciation. The ERPT and domestic inflation are highly correlated during high inflationary period, and also during high growth regimes.

Focusing on the Romanian economy Stoian & Murarașu (2015) took in to consideration different time periods and wide range of econometric techniques, conducted a comprehensive study which concluded that consumer prices response to the pass through is low i.e. 0.07 during the period January 2005 to December 2014. In Russian economy the ERPT in to domestic inflation during the period February 2009 to July 2014 was 0.13 according the monetary policy report of the Central Bank of Russia. For the period 2002 to 2012 Ponomarev et. al. (2016) estimated the ERPT to be 0.48. The magnitude of ERPT is asymmetric when it comes to exchange rate fluctuation.

ERPT in to the domestic inflation in case of Turkey is deeply discussed in the literature. Leigh & Rossi (2002) made use of monthly data of the period 1994 to 2002 concluded that during a span of one year specifically in the start of the year the ERPT in to the domestic inflation was 40 percent. This result is also supported by the study of Alper (2003) in which the data utilized is started from 1987 to 2003. The factors

responsible for this high ERPT includes lagged currency crisis, dollar dominancy in the economy and high domestic prices. Utilizing the same framework, Kara & Ögünc (2008, 2012) and Yüncüler (2011) conclude their papers by arguing that during the post-2001 period the pass through has shown a declining trend and the pass through recorded in this period is 15 percent. Responsible factors for the declining trend identified by the researchers are threshold inflation regime and less responsiveness of domestic prices towards exchange rate.

Arbatli (2003) made use of threshold VAR models to explore more extensively the ERPT and inflation relationship. During the course of his analysis study found some asymmetries impacting the concerned relationship. In another study by Kara et al. (2007) investigated different exchange rate and monetary policy regimes utilizing dynamic parameter approaches concluded that the mentioned regimes can be the possible antecedents of the ERPT in to domestic inflation. Arslaner et al. (2015) computed the ERPT to be 0.15 in case of Turkish economy. In another recent paper by Kılınç & Tunç (2017) utilizing recursive VAR and SVAR models estimated the ERPT to be 8 percent in case of RVAR. The reason identified by them behind the low pass through is high oil prices due to which the currency lost its value. Their results of VAR reveal the pass through of 18 percent including the impact of other variables.

Another study in South African context is done by Aron et al., (2014) utilizing monthly data of the period 1980 to 2009. During this period South African economy shifted from fixed ER regime to floating

ER regime. Within a period of 12 months the ERPT is recorded as incomplete i.e. 0.50 percent. By taking in to consideration a sub-sample the magnitude of ERPT decreased to 0.40 percent. Researchers have also taken in to consideration ERPT in to aggregate CPI by utilizing a especial data set of micro-consumer price data at product level of the period 2002 to 2007. Further sub branching the CPI the researchers have found that ERPT fluctuates noticeably across the branches. Aggregating the components to calculate an index, the ERPT is recorded as 0.30 percent for the period of two years. Helmy *et al.,* (2018) examined the unexpressed relationship between domestic prices and the pass-through affect of the exchange rate in Egypt. They found that the pass-through of the exchange rate to different prices is considerably slow and incomplete in Egypt and tis affect is more important in consumer prices. Before this Belaisch (2003) found that the ups and downs in the exchange rate had a small impact on the domestic inflation of Brazil. Bwire *et al.,* (2013) expressed that there is incomplete pass-through of exchange rate to inflation in Uganda.

2.5 Pass-Through in Pakistan

As already discussed in first section that literature related to Pakistan is limited on the topic of exchange rate pass – through to domestic prices. The pioneer study of Hyder & Shah (2004) has contributed to the literature. They found a low exchange rate pass-through and a modest impact of exchange rate fluctuations on the domestic prices and exchange rate pass-through is more pronounced in wholesale prices than consumer prices in Pakistan. Jaffri (2010)

investigated the ERPT in Pakistan using monthly data from 1995 to 2009 and concluded that there is very low pass through to domestic prices due to appreciation of the exchange rate and suggested to adopt the inflation targeting policies and floating exchange rates to monetary authorities.

Shaikh & Hussain (2015) worked on the phenomena of exchange rate pass-through to domestic prices in Pakistan. They found that the ERPT is more translated in whole sale prices and exchange rate pass-through is less in consumer prices. Choudhri & Khan (2002) found no evidence of inflationary affect of rupee devaluation in Pakistan and they argued that the inflation is because of exchange rate fluctuations. In contrast, according to Siddiqui & Akhtar (1999) there is no significant relationship between exchange rate fluctuations and domestic inflation and argued that money supply is the factor that affect the domestic prices in Pakistan. Shaheen (2013) conducted study on the affects of exchange rate changes on the economic performance of the Pakistan using yearly data from 2000 to 2010. The author concluded that the exchange rate depreciation affects both the inflation and exports to increase but the boost in the exports due to the depreciation is mitigated due to increase in inflation in Pakistan.

Further, in 2018 using monthly data from 2005 to 2015 by applying VAR model Ahmed et al., (2018) investigated the ERPT affect in case of Pakistan. They come to a conclusion that fluctuations in the exchange rate has less affect on the consumer price index. Minhaj & Nishat (2018) investigated the pass through of exchange rate to domestic prices in Pakistan. They concluded that due to high level of inflation in

the country the magnitude of pass through is high. Along with exchange rate, imports and policy rate have also the significant affect on the domestic consumer prices in Pakistan. Asad et al., (2012) investigated the affect of exchange rate pass through to domestic prices by using real exchange rates. They concluded that the REER have a very low pass through tom domestic prices.

2.6 Concluding Remarks

Exchange rate pass through shows the response of the domestic inflation to the exchange rate fluctuations. Such fluctuations can be recorded as complete or incomplete and a varying degree of pass through can also be recorded. By the same token currency appreciation and currency depreciation has also varying impact on domestic prices even if both are of the same magnitude. As evident from the discussed literature exchange rate is one of the factor responsible for domestic inflation, so it is of utmost importance that policy makers take into consideration ERPT while devising monetary policy.

Complications may occur while devising monetary policy as high magnitude of pass through can weaken the demand management policies. Impediments may also arise while forecasting the inflation as domestic inflation stability is of utmost importance for countries like Pakistan where threshold inflation is adopted as a policy tool to have stable domestic prices. Therefore, exploring and understanding the exchange rate pass through phenomenon is important for policy decisions and

evaluating the pressure on macro level economic indicators as a results of such policies.

While reviewing the literature, two mechanisms of how exchange rate passes through into domestic inflation are identified. In one channel, exchange rate fluctuations directly affect import prices which in turn impacts producer prices and in return it targets the consumer prices and the second channel through which ER affects the domestic price is though demand and exports. The speed with which the ER passes in to domestic inflation and its degree of pass through is affected by many factors some of which are exchange rate fluctuations, firms pricing decisions, substitutability property of products, inflation environment and market structure.

It is evident from the review of the empirical literature of ERPT that it is incomplete either developed or in developing economy. Though it is recorded higher in emerging economies than the developed economies. Across the countries the magnitude of the Exchange rate pass through different and over the years it is decreasing in most of the economies. There is 85 percent ERPT in some countries means 10% depreciation causes an 8.5 percent increase in the domestic inflation whereas in some countries it is 20 percent.

Chapter 3

Econometric Specification and Estimation Techniques

This chapter is about the econometric specification and estimation techniques that will be used in the study. It discusses the theoretical framework that how exchange rate depreciation affect is passes through to domestic price level in Pakistan. Moreover, different econometric techniques including unit root tests and co-integration techniques are discussed in detail below.

3.1 Theoretical Framework

Explicitly, through exchange rate depreciation the domestic prices can be affected through two channels, one is the direct and the second is the indirect channel. The direct affect of the exchange rate takes place through the increase in price of imported finished goods and imported raw material. Usually in the price taker countries like Pakistan when the exchange rate depreciated the import price will rise and when it appreciates the price of the imports will decrease. As the exchange rate depreciates the high price of the imported finished goods and the high price of raw material associated with this depreciation. It will increase the cost of production and marginal cost of the producer and the end result of this depreciation will be increase price of the domestically produced good and the domestic price level.

Second channel is the indirect channel is that the depreciations in the exchange rate affects will affect the exports and the aggregate demand will increase which in turn the domestic price level will be

increased. Moreover, to keep the profit margins maintained, the firms which are import competing will increase the prices to respond the high price of the importing competitor. Though there are some other factors (i.e. market structure, pricing policies, mixing up the tradeable with non-tradeable, inflation in the economy and import share in the consumer baskets) which affects the magnitude and the velocity of pass through to domestic inflation. (see figure-1)

ER ↑ → Import Prices ↑ → Price of Imported Finished Goods ↑→ Domestic Price ↑   (Direct Affect)

When the exchange rate depreciated, the first direct affect of this depreciation is that the price of the imported finished goods becomes expensive in Pakistani rupee and the domestic price increases.

ER ↑ → Price of imported raw material ↑ → Production Cost ↑ → Domestic Price ↑   (Direct Affect)

The second direct affect of the exchange rate depreciation is that the imported raw material becomes expensive in Pakistani rupee due to this the production cost increases. In the end, the depreciation put pressure on the domestic price level and the domestic inflation increases.

ER ↑ → Export and substitute goods Demand ↑ → Labor Demand ↑ → Price of Factor of Production ↑ → Production Cost ↑ →domestic price ↑
                                              (Indirect affect)

Due to exchange rate depreciation, the demand for exports and substitute goods rises. Because of the rise in demand the price of factors of production increases this will increase production cost and hence domestic prices level increases.

Figure 1 Pass-through channel

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                        ┌─────────────────┐
                        │   Pak Rupee     │
                        │   Depreciates   │
                        └─────────────────┘
                        /                  \
                       /                    \
          ┌──────────────────┐          ┌──────────────────┐
          │  Direct impact   │          │  Indirect impact │
          └──────────────────┘          └──────────────────┘
            │          \                          │
            │           \                         ▼
            │      ┌──────────────┐      ┌──────────────────┐
            │      │   Imported   │      │   Demand for     │
            │      │    inputs    │      │   Pakistani      │
            │      │   become     │      │    exports       │
            │      │  expensiv    │      └──────────────────┘
            │      │  e in PKR    │               │
            │      └──────────────┘               │
            │             │                       │
            ▼             ▼                       ▼
   ┌──────────────┐  ┌──────────────┐      ┌──────────────────┐
   │  Finished    │  │  Production  │──────│   Substitutes    │
   │  imported    │  │  cost rises  │      │      and         │
   │   goods      │  └──────────────┘      │    exports       │
   │  become      │         │              │   become         │
   │ expensive    │         ▼              │  expensive       │
   │  in PKR      │  ┌──────────────┐      └──────────────────┘
   └──────────────┘─▶│  Domestic    │◀────────────┘
                     │   prices     │
                     │  Increases   │
                     └──────────────┘
                            ▲
                            ┃
          ┌──────────────────────────────────┐
          │ -Market Structure                │
          │ -Pricing policies                │
          │ -Product substitutability        │
          │ -Involvement of various non-     │
          │ tradables in the distribution    │
          │ of tradables                     │
          │ -Slow adjustment of non-         │
          │ tradable                         │
          │  prices and wages                │
          │ -Prevailing exchange rate        │
          │ policy                           │
          │ -Inflationary environment        │
          └──────────────────────────────────┘
```

Model

We are using Consumer Price Index and Wholesale Price Index on the dependent side and P is used as the dependent variable in the equations below on the independent side and exchange rate is the focused independent variable along with other control variables which are oil prices, Large scale manufacturing, money growth, and public sector borrowing are taken and given below:

P= f (ER, OIL, M2, LSM, PSB)   (3.1)

3.2 Econometrics Technique

Time series data will be used in this study so it is very important to check the stationarity of the data in order to check the co-integration among the variables. Without checking the stationarity, we cannot proceed to the next step of the estimation because if there are non-stationary series this will give the wrong results. The non-stationarity problem occurs due the shocks and due to this series not revolves around its mean, while in stationary series these affects are for the short time period. so before proceeding further it is important to test the stationarity of the data for that purpose, we will apply the unit root test.

3.3 Unit Root Testing for Time Series

For the stationarity of the time series data different tests are used, which were recommended by Hamilton (1994), Stock (1994), Hatanaka (1995), Fuller and Phillips (1996), Maddala and Kim (1998) and Phillips

and Xiao (1998). The augmented Dicky Fuller will be used in this study to check the stationarity. Augmented Dicky Fuller test presented by Dicky and Fuller (1979) is an auto-regressive unit root test in which order is unknown. Augmented Dicky Fuller test uses the correct lag length selection and these lags can be selected through information criterion i.e. Akaike Information Criterion (AIC) and Schwarz information criterion (SIC). The probability of the rejection of the null hypothesis is increased by including many lags while using ADF. AIC and SIC select almost the same lag length.

All the variables of the time series data cannot be represented by AR(I)

$$\Delta P_t = \alpha_0 + \gamma P_{t-1} + \alpha_2 t + \varepsilon_t \tag{3.2}$$

Where ΔP_t (Δ is the I(1) operator) shows the dependent variable which are consumer price index and Wholesale Price Index, t is time trend, P_{t-1} is 1$^{\text{st}}$ lag of P_t, and ε_t error term.

Dicky-Fuller test can be used in equation 3.2

$$P_t = \alpha_0 + \alpha_1 P_{t-1} + \cdots \ldots \ldots \ldots + \alpha_{p-1} P_{t-p+1} + \alpha_p P_{t-p} + \omega_t \tag{3.3}$$

To obtain the ADF test equation add and subtract $\alpha_p y_{t-p+1}$

$$P_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_1 P_{t-2} + \cdots + \alpha_{p-2} P_{t-p+2} + (\alpha_{p-1} + \alpha_p) P_{t-p+1} -$$
$$\alpha_p \Delta P_{t-p+1} + \omega_t \tag{3.4}$$

Now, add and subtract $(\alpha_{p-1} + \alpha_p) CPI_{t-p+2}$ in (3.4) we get:

$$P_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_1 P_{t-2} + \cdots - (\alpha_{p-1} + \alpha_p) P_{t*p+2} - \alpha_p \Delta P_{t-p+1} + \varepsilon_t \tag{3.5}$$

Continuing this process, we have:

$$\Delta P_t = \alpha_0 + \gamma P_{t-1} + \sum_{i=2}^{p} \beta i \, \Delta P_{t-i+1} + \varepsilon_t \qquad (3.6)$$

Where $\gamma = 1 - \sum_{i=1}^{p} \alpha_i$ and $\beta_i = -\sum_{j=1}^{p} \alpha_j$ \qquad (3.7)

γ is very important coefficient in the equation (3.6), when $\gamma = 0$ it means that the equation has the unit root and is I(1). when $\sum \alpha_i = 1$ which means the sum of the coefficient of the differenced equation is 1 and $\gamma = 0$ so the unit root exists.

The assumption we take in the ADF test is that the residuals are independent with the variance constant. The two important attributes arise due to this process; one is that the coefficient γ can't be estimated correctly and the standard errors of the term γ which are included in the equation without any AR term. So obviously $\Delta P_t = \alpha_0 + \gamma P_{t-1} + \varepsilon_t$ a simple regression is inadequate for this motive when the data generating process of equation (3.6) is true. Thus there exist the problem of suitable lag length selection criteria and the correct order of AR is not known. The second feature is that the trend and intercept might be unknown to the equation (3.6).

3.4 Lag length selection criteria

When the stationarity requirements are satisfied then next the appropriate lag length will be chosen. For this purpose, the process normally used is restricted VAR which tells us that how much lags will be good for the model. Lag length is selected where the Akaike information criterion and Bayesian information criterion values are minimum.

3.5 Co-integration Approach

After checking the stationarity of the data and the integrated order of all the variables, the next step is to check the co-integration among the variables. There are different types of tests for co-integration, each test is different from the other and chosen on the bases of the integrated order of the variables. These test includes Engle-Granger (EG) test, Error Correction Model (ECM), The Johansen Juselius (J.J) technique and auto-regressive distributed lag model (ARDL). When there are two variables and the order of integration is same EG test will be used to find out the long run relation. But there are two disadvantages of EG one is if the integrating order is not same then the results will be wrong and second is that it can only be used when there are two variables. An error correction model is another technique used to find out the long run relation in which if two variables out all are I(1) and the error term is I(0) then there exist long run relationship otherwise not. The next approach is J.J co-integration, it is basically a multi-variate VAR based methodology and applied when the integration order of all variables is I(0) or I(1) to check the co-integration among the variables. The last approach discussed below to find out the co-integration among the variables is ARDL model which is the best among other techniques.

3.6 Auto-regressive distributed lag (ARDL) model

An auto-regressive distributed lag (ARDL) technique is widely used technique to extract the long-run and short run results. Peasran et al. (2001) established the ARDL model to examine the co-integration between the variables. There are two benefits of the ARDL technique,

first, it gives the estimates of the long and short time period while testing for co-integration. Second, the stationarity properties for using the ARDL model includes when the variables are integrated at I(0) or at I(1) or a mixture of I(0) and I(1), so when these will be stationarity properties ARDL will be used. But, ARDL technique is not valid if the variables are on first difference so for the stationarity of the variables unit root test will be applied which is compulsory before applying the ARDL technique. We are apprised to the best prior stationary properties of time series that's why we are employing ARDL technique.

Consider following model of ARDL

$$P_t = \gamma + \alpha_i P_{t-i} + \cdots + \alpha_n P_{t-n} + \beta_0 X_t + \beta_1 X_{t-1} + \cdots + \beta_y X_{t-n} + \delta_0 ER_t +$$

$$\delta_1 ER_{t-1} + \delta_2 ER_{t-n} + v_t \qquad (3.9)$$

$$P_t = \gamma + \sum_{i=1}^{n} \alpha_1 P_{t-i} + \sum_{i=0}^{n} \beta_1 X_{t-i} + \sum_{i=0}^{n} \delta_1 ER_{t-i} + v_t \qquad (3.10)$$

P_t shows the dependent variables consumer price index and Wholesale Price Index and ER is an independent side variable stands for exchange rate ,X_t is a vector of control variables (oil prices, money supply, Large scale manufacturing and Public sector borrowing) and v_t is error term.

There are some advantages of using ARDL described as;

It gives the most robust results and when the data sample is small it performs well. Both the short and long run estimates of the ARDL test are more consistent and vigorous. The ARDL approach does not involve pre-testing of the variables, which means that the test for the existence of relationship between variables in levels is applicable irrespective of

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whether the underlying regressors are purely I(0), purely I(1) or mixture of both. There are some other limitations of the ARDL model that there will be no auto-correlation and no heteroscedasticity.

Chapter 4

Data and Variable Construction

In the previous studies of exchange rate pass-through many variables are used in the estimation process. In this chapter the theoretical specification of the variables that how these variables are constructed which will be used to find out the ERPT in Pakistan. This chapter also includes data properties like **time period and the source of data collection are discussed below.**

4.1 Variable construction

Exchange Rate

By taking into account unique properties of each type has, this study will make the best employment of one's availability and feasibility. We will use nominal exchange rate only as it depends on market forces of demand and supply while real affective rate is adjusted for inflation and normally based on specific year. In case of Pakistan, characterize by high uncertainty, it is untenable to use real affective exchange rate. Jaffri (2010) and Helmy et al., (2018) and Campa et al., (2005) used NEER in their studies. The monthly data exchange rate is taken from state bank of Pakistan for the period ranges from January 1991 to November 2019.

Consumer Price Index

The consumer price index is a commonly used index for domestic inflation, the basket of CPI comprises 487 imported and domestic items in Pakistan will be used in the study. Earlier Hyder & Shah (2004) and Shaikh and Hussain (2015) used CPI in their study related to Pakistan. The monthly data of consumer price index is taken from state bank of Pakistan for the period ranges from January 1991 to November 2019.

Wholesale Price Index

For producers price the Wholesale price index(WPI) or it is also known as producer price index(PPI), the index is composed by the basket of 463 items, it will be used in the study. Besides Papell (1994) and Shaikh and Hussain (2015) used WPI in their study. The monthly data of consumer price index is taken from state bank of Pakistan for the period ranges from January 1991 to November 2019.

Oil prices

Brent crude oil price is used as a proxy for fluctuations in the world price of crude oil and the data is taken from Federal Reserve Economic Data. In the model, movements in crude oil price capture aggregate supply side shocks. Earlier Sek & Kapsalyamova (2008) used this in their study.

Money Supply

Broad money M2 will be used as the money supply variable in the study which is composed by including all parts of the M1 and others elements like mutual funds, securities, and time and saving deposits. Previously Mirdala (2014), Stulz (2007) and Hyder & Shah (2004) used broad money as a variable for the monetary policy in their study. The monthly data for money supply is taken from state bank of Pakistan for the period ranges from January 1991 to November 2019.

Quantum Index of Manufacturing (LSM)

The quantum index is used as an index of output growth for demand-side shocks. The quantum index is composed of the number of goods and services produced in the country. Besides in Pakistan Haider & Shah (2004) used QIM as a demand-side shock. There also is the same problem of base year in QIM, so we have compiled the data on the 2005-2006=100 base year to use in this study.

Public Sector Borrowing

Public sector borrowing (PSB) includes the loan which government borrowed from the domestic commercial banks and many other sources like by issuing securities and bonds. In the studies of exchange rate pass-through the PSB is not used before but used an indicator in the literature of inflation determinants so it is added for the first time in case of Pakistan. Previously PSB is used as an independent variable in the studies of the determinants of the inflation like Islam &

Kabir (2012), Adnan et al., (2008), Khan et al., (2007) and Akçay et al., (2001). These studies concluded that PSB do affect the inflation.

4.2 Data and its Sources

Data used in this study are monthly from January 1991 to November 2019, thus giving us a total of 340 observations. The source of data for consumer price index, exchange rate, money supply and Quantum Index of Manufacturing, public sector borrowing and data of the international oil prices will be taken from the State bank of Pakistan (SBP) Statistical Bulletin.

Chapter 5

Results and Discussion

In the previous chapter's methodology and the data specifications are discussed in detail. This chapter includes the descriptive statistics of all the variables and secondly the stationarity properties of all the variables. Lastly the results extracted from the proposed methodology which gives the long run and short run estimates of the model are discussed.

5.1 Descriptive statistics

Descriptive statistics includes the mean, median, maximum and minimum values, skewness and kurtosis listed in the table 1 below. Mean represents the average value of every variable and median is middle value and minimum and maximum value shows the lowest and highest values in the data. There are two test for the normality of data which are skewness and kurtosis. Further kurtosis of three types, when the value is 3 it is mesokurtic, when the value is positive and greater than 3 it is leptokurtic and when this value is less than 3 or negative it is called Platykurtic. Skewness has three types normal, positive and negative skewness, when the value is zero it is normal skewness, when it is greater than zero and positive it is positive skewness and when the value is negative it is called negative skewness. Then the Jarque-bera test also used to show the normality of data and the null hypothesis for J-Q test is that the distribution is normal and if p-value is less than 5% the null will be rejected.

The mean, median, maximum and minimum values of the CPI are 105.46, 77.77, 244.03 and 26.98 respectively and the standard deviation value of 64.80 shows there is 64.80% deviated from its mean. The skewness value of CPI is positive so it is positively skewed and the kurtosis value is 0.636 and it is less than 3 so it is platykurtic with flattered curve. The probability value of the jarque-bera test is clearly less than 5% so we can reject the null hypothesis of normal distribution. The mean, median, maximum and minimum values of the exchange rate are 68.54, 60.11, 141.16 and 22.13 respectively. Exchange rate is positively skewed with the value of 0.346 and kurtosis value of 2.202 tells us that it is platykurtic with flattered curve. The jarque-bera test probability value is 0.000371 less than 0.05 which tells us that the series is not normally distributed. However, broad money and public sector borrowing are positively skewed but have the kurtosis values greater than 3 so these are leptokurtic (peaked curves) and are not normally distributed because the probability values are less than 5%.

Variables	Mean	Median	Maxi.	Mini.	Std.Dev	Skew	Kurt	J-B Prob
Consumer Price Index	105.46	77.77	244.03	26.98	64.80	0.636	1.94	0
Exchange rate	66.54	60.11	141.16	22.13	28.88	0.346	2.20	0.0003
Oil prices	47.89	36.53	133	10.05	33.509	0.753	2.30	0
Broad money	14.81	14.83	16.63	12.75	1.11	-0.05	1.81	0
Public sector Borrowing	13.94	13.31	16.16	12.1	1.17	0.557	1.87	0
Large scale Manufacturing Index	4.385	4.520	5.209	3.550	0.444	-0.20	1.64	0
Wholesale Price Index	107.6	74.30	259.5	24.7	71.25	0.600	1.79	0

Table 1 Descriptive Statistics

5.2 Unit root Results

Before checking the co-integration among the variables used in the model, first it is important to check the stationarity of time series data as we are using time series data in the study. To check the stationarity of the data Augmented Dickey-Fuller test (ADF) of unit root is used. The null hypothesis is unit root versus the alternative hypothesis of stationarity.

The variables don't have the same integrating order it can be seen from the results of the ADF test mentioned below. Respectively this conclusion is confirmed from the results in the table 2 below. The variable which are stationary on level are large scale manufacturing and broad money supply. While the variable which are stationary on first difference includes exchange rate, consumer price index, wholesale price index, public sector borrowing and Oil prices. The results of the ADF test stated that, the resulted values are greater than the critical values. So we accept the alternative hypothesis that series are stationary against the null hypothesis of unit root (Andrews, 1991 and Newey-West, 1994).

Table 2 Unit root results						
Null Hypothesis # Series has a unit root						
Variables	Level I(0)		First Difference I(1)		Criteria	Decision
	t-stat	p-value	t-stat	p-value		
CPI	-1.2150	0.6690	-8.15	0.000	AIC	I(1)
ER	-0.8904	0.7907	-11.84	0.000	AIC	I(1)
LSM	-6.1681	0.0000	-12.12	0.000	AIC	I(1)
OIL	-1.6330	0.4646	-14.60	0.000	AIC	I(1)
M2	-1.3163	0.557	-5.963	0.000	AIC	I(1)
PSB	0.8941	0.9954	-5.745	0.000	AIC	I(1)
WPI	-0.733	0.9691	-12.29	0.000	AIC	I(1)

5.3 Test for Lag Length Selection

For the lag length selection, we used the Akaike information criterion and Schwarz Bayesian Criterion of VAR model. So for that purpose we have estimated the six VAR models *p=0, 1, 2, 3, 4, 5, 6* over the data started from 1991 to 2019. AIC selected the order of lag is 6 while SBC selected 2 order. Table 3 below shows the results for the different lag length selection criteria.

Table 3 Lag Length Selection Criteria		
Lag	**AIC**	**SBC**
0	-2.295	-2.22
1	-26.44	-25.97*
2	-26.73	-25.85
3	-26.87	-25.58
4	-26.95	-25.26
5	-26.92	-24.83
6	-26.99*	-24.49
* indicates lag order selected by the criterion		
AIC: Akaike information criterion		
SBC: Schwarz Bayesian Criterion		

5.4 Test for Co-integration

By the application of unit root test, it is evident that all the variables are stationary either on level or first difference. We used the Auto regressive distributed lagged (ARDL) model of Pesaran & Shinn (1995) and Pesaran et al., (1996) to check the impact of Exchange rate

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on Consumer Price Index by using secondary time series data of Pakistan from January 1991 to November 2019. After finding out the integration order, before using ARDL the next step is to check the co-integration by using Bound F-statistics in which the null hypothesis is $H_0 : \beta_1 = 0$,it means there is no co-integration. In bound testing the F- statistics calculated is compared with the lower and upper bound values, if value is less than the lower bound then we will accept the null hypothesis and if the value is greater than the upper bound we will reject the null hypothesis and accept the alternative hypothesis which is $H_1 : \beta_1 \neq 0$.

The bound test results of co-integration are listed in the table below. The calculated F- statistics (5.183631) value is greater than the upper bound value at all significance levels so the null hypothesis of no co-integration is rejected and we can implicitly accept the alternative hypothesis ($H_1 : \beta_1 \neq 0$). It implies that the variables are co-integrated and there exists a long run relationship. (See Table 4 below)

Table 4 ARDL Bounds Test		
Null Hypothesis: No long-run relationships exist		
Test Statistic	**Value**	**K**
F-statistic	5.183631	6
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

The F values of bound test shows the existence of the long run relationship and allow us to estimate the long run and short run results using ARDL model. The results of ARDL are listed below.

5.5 Long Run estimates of ARDL

After the application of bound test the next step is to run the ARDL model to find out the long run results. Equation 3.9 is the long run auto regressive distributed lagged model equation. The long run coefficients are estimated by keeping different criterions under consideration like (AIC), (SBC), (HQ) and Adjusted R-Square Criterion. All the models gave almost the same results so SBC criterion results are chosen because it gives the most penurious estimates because it minimized the loss of degree of freedom and selects the smallest lag length selection as much as possible.

The long run results of the ARDL model are listed in the table 5 below. Consumer price index is the dependent variable and the exchange rate is the main focused variable. The coefficient of the ER is 0.1575 and the results shows that it is significant with the t-stat value of 2.0789, it infers that one percent increase in exchange rate the consumer price will increase by 0.1575%. It shows that the fluctuations in the exchange rate are passes through to domestic price level but not the complete pass-through. The findings of our study resembles other studies such as Hyder & Shah (2004), Goldberg & Knetter (1997) and Menon (1995) and exchange rate positively affects the consumer prices is consistent with the empirical literature for example Choudhri & Hakura (2006),

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Devereux & Yetman (2010), Shintani et al., (2013), Mohammed et al., (2015), Cheikh & Louhichi (2016).

Then we also use some very important control variables like Money supply, oil prices, Large scale manufacturing and public sector borrowing. The coefficient and the sign of all the control variables are according to the theory and shows significant impact on CPI. The coefficient of money supply is 0.3658 and significant with the t-stat value of 3.1576 which means that 1% increase in money supply there will be a 0.3658% increase in consumer price index of Pakistan. The results are in line with McCandless & Weber (1995), Hyder & Shah (2004), Rolnick & Weber (1994) and Lucus (1980), they concluded that an increase in money supply causes the increase in the inflation. Our results are also in line with Qayyum, A. (2006) who investigated the relationship among broad money supply and price level in Pakistan and comes with the conclusion that growth in money supply will cause the increase in domestic inflation.

Pakistan is an oil importing country and oil is the second main source of the energy production and used in production processes so the domestic price level follows the fluctuations in the oil price as well. We also found the positive and significant relationship between oil prices and domestic inflation, the coefficient of oil price is 0.0727 with the t-stat value of 3.1261, it implies that 1% increase in oil prices it increases the consumer price index by 0.0727%. According to Kiptui (2009), and Kargi (2014) the increase in oil price have long run and significant impact on CPI inflation that the increase in oil price will be translated

into consumer price index. More over our results are also consistent with other studies like Hooker (2002) and Castillo et al. (2010) who found that oil prices significantly impact the inflation and increase in oil price will increase the domestic price level.

Large scale manufacturing (LSM) has the negative and significant impact on the dependent variable which is consumer price index with coefficient value of -0.2140 along with t-stat value of 2.1122. It implies that 1% decrease in the LSM the CPI will increase by 0.2140%. these results are consistent with previous studies confirms the tradeoff between inflation and large scale manufacturing which includes Bans-Akutey et al., (2016), Siyakiya (2014) and Chaudhry (2013) reported this relationship in case of Pakistan.

Public sector borrowing is another control variable we have used in our study. The estimated coefficient is positive and have significant relationship with consumer prices. The coefficient of the public sector borrowing is 0.1264 with the t-stat value of 6.1605 which implies that 1% increase in PSB the consumer prices will increase by 0.1264% in Pakistan. Our results are consistent with Islam & Kabir (2012), Adnan et al., (2008), Khan et al., (2007) and Akçay et al., (2001) who found the positive and significant impact of public sector borrowing on the domestic inflation.

Table 5 Long Run Coefficients			
Dependent variable is natural log of CPI			
Independent Variables	Coefficient	t-Statistic	Standard Error
Exchange Rate	0.1575	2.0789	0.0757
Public Sector Borrowing	0.1264	6.1605	0.0205
Oil Prices	0.0727	3.1261	0.0232
Money Supply (M2)	0.3658	3.1576	0.1158
Large Scale Manufacturing Index	-0.2140	-2.1122	-0.1013
Intercept	-4.6264	-3.0234	1.5302
Diagnostic			
Normality	0.794131		
Serial Correlation	0.593206		
Heteroscedasticity	0.111078		
Functional Form	0.502904		

5.6 Short Run Estimates

The short run results are listed in table 6 which contains the coefficients of all the regressors along with the ecm value. The prior expectations about all the coefficients and the signs in the short run are fulfilled as exchange rate and other control variables shows exactly the same behavior as discussed in the literature. Though the short run coefficients of all the variables are less than the long run estimates so these findings indicate that in the long run the independent variables has

the stronger affect on the dependent variable which is consumer price inflation.

The thing which is more important in the short run results is the coefficient of the error correction (ECM) which shows the speed of adjustment towards equilibrium. The coefficient of ECM is mentioned in the table 6 which is statistically significant and with the correct sign which confirms the long run co-integration among the variables established earlier. The ECM value is -0.0853 which implies that 8% of the disequilibrium occurs in the short run is adjusted in the long run. The pass-through of exchange rate in the short run is 11% and significant against the 15.7% pass-through in the long run while both are incomplete as reported in the literature. All other independent variables are showing the significant and correct results with lower coefficient than the long run. (table 6).

Table 6 Short Run Coefficients			
Dependent variable is natural log of CPI			
Independent Variables	Coefficient	t-Statistic	Standard Error
Δ *Exchange Rate*	0.1120	2.4786	0.0452
Δ *Public Sector Borrowing*	0.0856	4.1744	0.0205
Δ *Oil Prices*	0.0654	2.8135	0.0233
Δ *Money Supply (M2)*	0.3016	2.6036	0.1158
Δ *Large Scale Manufacturing Index*	-0.2090	-2.0629	-0.1013
Error correction Term	-0.0853	3.9987	0.0213
Diagnostic			
R-Square	0.6825		
F-Stats	7.1519		
Durbin Watson	1.7326		
CUSUM	Stable		
CUSUMSQ	Stable		

5.7 Diagnostic Test

For the robustness of the results the model is passed through different diagnostic and stability tests. These tests include test for serial correlation, heteroscedasticity, functional form, normality and the CUSUM and CUSUMSQR test for the stability of the model. The 0.59 p-

value in the table 5 confirms that there is no serial correlation and p-value of 0.11 rejected the existence of Heteroscedasticity likewise p-values of normality and functional form satisfied the assumptions of the model. In the table 6 the 0.68 value of R-square tells us that the estimated model is explained well and again D-W test statistics also confirms that there is no serial correlation. At the end the CUSUM and CUSUMSQR approves that the estimated model is stable.

5.8 Long Run ERPT to Wholesale prices

Table 7 shows the results for the second regression in which the dependent variable is wholesale price index and the independent variable are same as in the first regression. Exchange rate has a positive and highly significant affect on wholesale price index. The coefficient of exchange rate is 0.509 along with t-stat value of 2.582, it means that if exchange rate depreciated by 1% the wholesale price index will increase by 0.509%. So the exchange rate pass-through to wholesale price index is 0.509% which means that any change occurs in exchange rate 0.61% of that change will be transmitted into wholesale price index.

The results clearly depicted that exchange rate fluctuations do affect the wholesale price index of Pakistan though it is not complete pass-through of exchange rate but a significant affect on wholesale price index. It is evident from the literature that exchange rate fluctuations are pronounced in wholesale prices. An and Wang (2011), Sek and Kapsalyamova (2008) and Draca (2009) concluded that exchange rate

fluctuations affect the wholesale price index but the exchange rate pass-through is not complete.

Money supply, oil prices and public sector borrowing all are positive and have significant impact on wholesale price index 3.014 value of t-stat. The coefficient of money supply is 0.934 which means that 1% increase in money supply there will be a 0.934% increase in wholesale price index of Pakistan. The results are in line with McCandless and Weber (1995), Rolnick and Weber (1994) and Lucus (1980), they concluded that an increase in money supply causes the increase in the inflation. The coefficient of oil price is 0.201 which is significant with t value of 3.640, it implies that 1% increase in oil prices it increases the wholesale price index by 0.201%. The wholesale price index of Pakistan contains the commodities which are more responsive to oil price changes and imported goods like machinery.

The estimated coefficient of public sector borrowing is positive and have significant relationship with wholesale prices. The coefficient of the public sector borrowing is 0.285 with the t-stat value of 4.721 which implies that 1% increase in PSB wholesale prices will increase by 0.285% in Pakistan. Our results are consistent with Islam & Kabir (2012), Adnan et al., (2008), Khan et al., (2007) and Akçay et al., (2001) who found the positive and significant impact of public sector borrowing on the domestic inflation. The coefficient of the large scale manufacturing index is positive and insignificant with the coefficient value of 0.245 along with t value of 1.118.

Table 7 Long Run Coefficients			
Dependent variable is natural log of WPI			
Independent Variables	Coefficient	t-Statistic	Standard Error
Exchange Rate	0.509	2.582	0.197
Public Sector Borrowing	0.285	4.721	0.060
Oil Prices	0.201	3.640	0.055
Money Supply (M2)	0.934	3.014	0.310
Large Scale Manufacturing Index	0.245	1.118	0.219
Intercept	-15.22	-3.579	4.251
Diagnostic			
Normality	0.6711		
Serial Correlation	0.1476		
Heteroscedasticity	0.2348		
Functional Form	0.7253		

5.8 Diagnostic Test

For the robustness of the results the model is passed through different diagnostic and stability tests. These tests include test for serial correlation, heteroscedasticity, functional form and normality test. The 0.1476 p-value in the table 7 confirms that there is no serial correlation and p-value of 0.2348 rejected the existence of Heteroscedasticity

likewise p-values of normality and functional form satisfied the assumptions of the model.

Chapter 6

Conclusion

A size able strand of literature confirms that the exchange rate depreciations are passes through to domestic price level with different magnitudes across the countries (developed and developing). If we look at exchange rate depreciation history of Pakistan, over the last 30 year's exchange rate started depreciating from 22.13 rupees per dollar to 155.25. While in the last 2 years it depreciated approximately 30% from 104 to 155 along with increase in the consumer price inflation. There is a school of thought who argued that the increase in inflation is due to the depreciation of exchange rate so this motivated us to examine the exchange rate pass-through to consumer prices in Pakistan which was missing in the literature related to Pakistan.

To empirically analyze the ERPT in Pakistan monthly data have been used from January 1991 to November 2019. The bound testing approach of ARDL is used to find out the co-integration among the variables which confirms the existence of the long run relationship between exchange rate and consumer price inflation. The pass-through of exchange rate to consumer price inflation is 15.7% in the long run which is statistically significant implies that the depreciation of exchange rate exerts 15.7% pressure on consumer prices in the long run but 50.9% in wholesale prices as suggested by the extensive empirical literature. Likewise, for the short run the results of the ECM also shows the existence of short run relation between the exchange rate and consumer inflation. The pass-through of the exchange rate is 11.2% in

the short run. While oil prices contribute 7%, public sector borrowing contributes 12.6%, money supply contributes 36% and large scale manufacturing contributes 21% to the domestic price level in the long run and the short run results are lower than the long run but follows the same path.

Policy Implications

We have seen that the ERPT is low and incomplete but significant both in the short run and long run as concluded in the literature. The low magnitude of the ERPT suggest that the depreciation is not directly affecting the consumer prices in Pakistan immediately. Therefore, the argument of policy maker that the abrupt and large depreciation will generate the inflationary pressure on the consumer prices is not valid. Therefore, this low pass-through as in the conclusion have some very important policy recommendations that the exchange rate should be mainly determined by the market instead of central bank interventions.

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DEDICATION

This research work is dedicated to

My Beloved Parents

For their prayers, moral support and encouragement that enlightened my way and made it possible for me to reach at this stage.

Acknowledgement

Acronyms	
ERPT	Exchange rate Pass-Through
PPP	Purchasing Power Parity
ARDL	Auto-regressive Distributed Lagged Model
ADF	Augmented dickey-Fuller
VAR	Vector Auto-regressive
ECM	Error correction Model
ER	Exchange rate
CPI	Consumer Price Index
LSM	Large Scale Manufacturing
PSB	Public Sector Borrowing
WPI	Wholesale Price Index

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Abstract

Exchange rate pass-through to domestic price level is the phenomena which states that how much fluctuations in the exchange rate are translated into domestic price level. In past 30 years a huge depreciation of exchange rate is recorded in Pakistan. So this objectifies us to find out the long run and short run pass-through in Pakistan and other factors affecting domestic price level as well. Using monthly data from January 1991 to November 2019 and Auto-regressive distributed lagged model as an estimation technique to estimate the long run and short run results. The ERPT to consumer price index in the long run is 15.7 and 50.7% to Wholesale Prices while in the short run ERPT to CPI is 11.2% and these results are in line with the literature. It implies that in the long run the 1% depreciation in the exchange rate the consumer prices will increase by 0.157% and 0.112% in the short run. Overall the ERPT is significant but incomplete which suggests that the exchange rate depreciation is not the main factor of the rise in the inflation in Pakistan.

Chapter 1

Introduction

After abolishment of Bretton Woods agreement and system in 1973, and adoption of floating exchange rate system, the exchange rate pass – through (ERPT) has been under the focus and search of researchers and policy makers. According to Goldberg & Knetter (1997), when there is percentage change in import price in terms of local currency due to one percent fluctuation in exchange rate between two trading countries that phenomena is called exchange rate pass - through. In open economies, domestic and external factors (comprising world prices and exchange rate) plays a vital role in defining the inflation and its dynamics.

Explicitly, through exchange rate depreciation the domestic prices can be affected through two channels, one is direct channel and the other is indirect channel. When exchange rate is depreciated, it influences the imports, directly. Consequently, the imported goods and raw material are accounted to be expensive for consumers and producers. The consumers have to pay higher prices for imported good and goods embedded with imported raw material. In the backdrop, raw material embedded domestically produced goods add on higher cost of production. Through exchange rate depreciation, the imports are being halted and exports are being promoted. This leads towards higher demands of exported goods as well as domestic factor of production. So, the payments for factor of production as well as domestic prices are

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raised. Hence, the depreciated exchange rate resulted in higher domestic price level, indirectly (Hyder & Shah, 2004).

The subject of exchange rate pass-through (ERPT) has been addressed by many researchers over the last three decades; since the work of Dornbusch (1987). There is plenty of work on the subject of pass – through of exchange rate for developed economies. This theme is getting attention with reference of developing countries via researcher and policy makers since last decade. The findings for developed economies showed ERPT nexus with domestic inflation, but, this nexus is not one – to – one between dynamics of change in exchange rate and pass – through to inflation (Menon, 1995).

Earlier, the research was bounded to investigate the pass – through affect of exchange rate to import and export prices. Later, the analysis was extended on the aggregate price level and inflation in the economy. The cross country analysis found either a small impact of exchange rate pass-through or the influence is insignificant (Mccarthy, 2000 and Mihailov, 2009). Contrast to this, Campa & Goldberg (2005) and Cavaliere (2007) found significant and one – on – one pass – through affect of exchange rate to import prices.

Pakistan is small open economy and is suffering from different economic problems. The origin of these economic problems is current account deficit and the persistent exchange rate fluctuations. Pakistan is highly import dependent country to meet the domestic demand. Adding, the CPI basket in Pakistan constitutes imported products largely.

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Keeping this scenario in light, the fluctuations of exchange rate influence domestic prices; directly as well as indirectly. Therefore, it is pertinent to explore the nexus that how exchange rate and global price fluctuations transmitted into our domestic inflation. We will also consider the variables and factors which may affect the domestic price level along with the focused subject of concern exchange rate fluctuation like public borrowing. Public borrowing is mostly used to meet the government expenditures like subsidies, salary, infrastructure and many other expenditures which only affect the aggregate demand and it results in the increase of domestic price level when aggregate supply remains same. Other variables like money supply, oil prices and large scale manufacturing are also incorporated as control variable in our study.

In case of Pakistan, there are many studies for determining inflation like Khan et al., (2007), Ahsan et al., (2011) and Zaman et al., (2011). But, there are only few studies that are conducted on the subject of pass – through affect of exchange rate in Pakistan. To the best of my knowledge, Hyder & Shah (2004) initially examined the relationship between pass – through of exchange rate and domestic inflation. They found a modest and low ERPT to domestic inflation. Jaffri (2010) has analyzed pass – through of exchange rate while keeping focus on exchange rate misalignment and foreign inflation. The findings showed significant and high impact of foreign inflation (proximate by foreign exporters' cost) on domestic inflation. Our study will address the problems generated through exchange rate depreciation to consumer prices in Pakistan on which there is very less work done till now.

Moreover, this study is different from the previous research in many ways like a long data set (from Jan 1991 to Nov 2019), methodology and variables. Previous studies used VAR methodology while we are using the co-integration approach and one very important variable is added along with other independent variables which is public sector borrowing that previous studies didn't incorporated.

1.1 Significance of the Study

Pakistan is facing a huge problem of inflation and to tackle this inflationary environment State bank of Pakistan increased the interest rate. At the same time, exchange rate has also witnessed a large depreciation over the last two years so this motivated us that it is very important to examine the pass-through affect of exchange rate on domestic inflation in Pakistan.

As, it is already mentioned that there are very few empirical studies which address the ERPT towards domestic consumer prices in Pakistan. This study will fill up the gap in the literature by aiming to find out the affect of persistent fluctuation in exchange rate. The findings of the research will help the researchers and policy makers to better understand the relationship between exchange rate and inflation in Pakistan. And we are also considering other variables to find out the factors affecting inflation in Pakistan along with the exchange rate fluctuations.

1.2 Objectives of the Study

Particularly the goal of the research is to address the objectives given below:

1. To examine long run and short run relationship between exchange rate and domestic prices in Pakistan.
2. To find out the factors affecting the domestic price level other than exchange rate.

1.3 Research Questions

This study is attempted to address the following research questions:

1. Is there prevail a long run relationship between exchange rate and domestic prices in Pakistan?
2. Is there prevail short run association among domestic price inflation and exchange rate in Pakistan?
3. What are the other factors affecting domestic inflation in Pakistan other than exchange rate?

1.4 Organization of Study

In chapter 1 introduction, significance and objective are discussed. Further, in chapter 2 covers the detailed literature regarding developed, developing and Pakistan. Chapter 3 contains the econometric methodology discusses unit root and different co-integration techniques and in chapter 4 contains the data and variables and descriptive properties of the variables. Chapter 5 is regarding estimations and detailed discussion of results and chapter 6 contains the conclusion and policy implications.

Chapter 2

Review of Literature

There is a large amount of theoretical and empirical literature available on exchange rate pass – through (ERPT) to different price levels i.e. import prices, producer prices and consumer prices. There are many studies on the degree of ERPT to inflation and also on the level of inflation and the exchange rate pass – through. A suitable strand of literature is discussed under in which we tried to cover different aspects and dimensions regarding the affects of ERPT to inflation. In relation to Pakistan there is limited literature which discuss the concerned subject. Further the literature on the concerned subject exchange rate pass-through is discussed in different ways below.

2.1 Theoretical Background

The concept of exchange rate pass-thorough (ERPT) refers to the impact of exchange rate changes on import prices. According to Goldberg & Knetter (1996) the ERPT is the percentage change in the local currency import price due the one percent change in the exchange rate between two trading countries. The ERPT is that, that how much variations in the exchange rate is translated in the imported country currency prices of imported(traded) goods (Menon, 1995). The domestic prices are also affected through the exchange rate appreciation and depreciation not only the import prices.

Purchasing power parity (PPP) and the law of one price are the bases of the concept of the ERPT. When there is no arbitrage the law of

one price (LOP) postulates that the common currency price of the similar products is same in different countries and different locations when there are no trade frictions and the conditions which must apply are the price flexibility and free competition. The law of one price is the base PPP. Further purchasing power parity are of two types one is relative PPP which is exactly the law of one price and the second is absolute PPP. Between two countries when the LOP is held for all the commodities then there will be absolute PPP. There are two assumptions for a sound PPP are must: first immediate costless and frictionless arbitrage and second there are identical goods. These assumptions are very difficult to be held as literature suggests. Therefore, a new type of relative PPP which is modified the version developed as a new research area. The P = αεP* equation represents this new version in which P shows the price level in the domestic home currency percentage of international currency and α represents the real exchange rate (Goldberg & Knetter 1997). According to Anaya (2000) when PPP holds, the exchange rate changes are transmitted into proportionate changes in the domestic prices and he found ERPT is equal to one.

The theory of PPP does not look good enough to explain the ERPT in short run but can explain it in a very long run. Roggoff (1996) argued that real exchange rate leads to the parity in very long run and deviates from the PPP in the short run. According to Darvas (2001) when there is stationary real exchange rate here the issue of the time period may arise and plays its role like in 4 years are the 50% life of a fluctuation then how we can say there will be full pass through. Many researchers come

to common conclusion that the degree of ERPT is not always complete as shown in the literature. A Cournot oligopoly model is used by Dornbush (1987), this study concluded that ERPT is not complete and this deviation from the PPP could because of imperfect competition in the market. According to Heckscher (1916) and Obstfeld and Taylor (1997) concluded that the lack of perfect arbitrage and lack of certainty due to this the PPP does not hold. Frenkel (1978) argued in the favor of PPP by using the data of hyperinflation this is not surprising at all due to prevalent monetary disturbance. But Frenkel (1981) or Krugman (1978) rejected the purchasing power parity for a stable monetary situation. So due to the incompleteness of the and lack of the parity the phenomenon of ERPT is under research from almost last three decades. The researchers are trying to find the degree of pass through and the reason behind the incomplete pass through and they are trying to find out that how much fluctuation of exchange rate are transmitted into domestic inflation.

2.2 Developed Country Case

This type of relationship among the exchange rate and price level have attracted the attention of many researchers and scholars. In the beginning researchers and scholars studied the exchange rate pass-through (ERPT) to inflation in developed economies. There is common understanding that the magnitude of ERPT is different across the countries it is recorded low in developed but higher in developing and the literature discussed will support the argument comprehensively. As we said there is a huge strand of literature available regarding developed

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economies and in 1995, Menon (1995) conducted a study in which the author reviewed more than forty studies comprehensively and more than half of the studies are of developed economies particularly USA. The findings of the study are divided in to five categories. The categorization is based on the degree and dynamics of ERPT. Furthermore, author also took in to consideration the ERPT differences across and within countries and also at the product level over time. It is known fact that each country's economy functions differently, and so are the literature provides the same evidence.

The ERPT is different for different countries. For instance, Krenin (1977) devised a range for ERPT for developed and developing countries. According to his findings pass-through of exchange rate in the united states is 50% while in Italy it is full. In opposition to the mentioned studies Spitaeller (1980) and Khosla & Teranishi (1989) found out that ERPT converges to completion in developing countries while it is incomplete or low ERPT in developed countries. A disaggregated analysis of price confirms the significant difference of ERPT among different products and industries. It is also true if we take in to consideration the price differences within the country. Taking example of USA the spectrum of differences stretches between 48.7 percent to 91 percent. The factor responsible for these differences is the methodology used for price indices calculation. Other studies conducted to analyze the pass-through during the period 1970-1995 concluded that it is quietly stable in the mentioned time period (Menon, 1995).

Another study conducted by Menon 1996 to explore ERPT in which the focused country is Australia and the sample consisted of 40 product categories of consumer products. By using OLS based model the results matched the former Menon, 1995 and 1996 studies. During a period of one year nearly all the categories depicts a ERPT of about 70% and above. This mentioned pass through is an average percentage. A further deep analysis at each product level it varies. The variations are due to substitutability of imported products for domestic as it entwines with ERPT. Furthermore, foreign intervention, product differentiation, quotas and imported goods share in the domestic market. The mentioned factors negatively impact the degree of pass-through (Menon, 1996).

By comparing the both developed and developing economies Golfajn & Werlang (2000) investigated the connection between domestic price level and exchange rate. Sample of the study consisted of 71 economies, both developed and emerging and the time period ranges from 1980 to 1988. They found out that the degree of ERPT is dependent time period under consideration. The degree of ERPT in the short time period is about 17 percent and in long run it approaches 73.2 percent during a period of one year. Their results indicate that the ERPT for developing countries is high whereas for OECD countries it is low. In the considered countries they identified factors which affects the magnitude of ERPT such as, inflation level, difference between current GDP and the forecasted GDP, trade openness, and business cycles.

Regarding different industrialized countries McCarthy (2000) investigated the ERPT and import price pass-through (IPPT) in to

domestic producer and consumer prices. His study focused economies are industrialized countries which includes USA, UK, Germany, Belgium, Switzerland, Sweden, Japan, Netherlands and France. Distribution chain is analyzed in this study and for that purpose a VAR methodology is used. Its results illustrate that ERPT and IPPT modestly impacts the consumer and producer prices. In another study by McCarthy (2007) in which author further extended his previous work and concluded that the low inflation environment shows a significant role in curtaining the ERPT and IPPT. In case of UK France, and Japan the impact lessened by almost 50 percent. The factor behind the modest impact is difference in the use of methodology. Deviating from the previous studies this study treated exchange rate and import prices as endogenous. The author also incorporated central bank reaction function in his study to analyze the impact of monetary policy on domestic consumer and producer prices.

European countries have more stable economic conditions, there are 28 countries in the euro zone so every country have different economic condition, some are economically strong while some are weaker so due to this ERPT degrees will be different across the countries. Focusing on the European economies Hufner & Scroder (2002) investigated the ERPT during the period 1987-2007 by using VECM. The rationale behind using VECM is its property to overcome the stationarity problem and gives accurate short term and long term estimates. ERPT impact varies among the economies in short and long term. Though in short term the magnitude of pass through is faster in Netherlands compared to other countries. In the long run a faster pass through degree

is estimated in Italy and France. They also calculated Harmonized Index of Consumer Prices for measuring average ERPT for the euro zone. Results based on HICP shows that during one-year period a 10 percent depreciation of euro causes the inflation rate to rise by 0.4 percent. Similarly, Campa et al., (2005) have also enquired the long and short run ERPT for the European economies, however the deviating factor from the previous literature is disaggregation of prices. The pass through is comparatively high in the short term but not the complete, however in the long term it is high and approximately complete pass through. The magnitude and pace also varies across industries and the economies. Although insignificant, the result depicts that magnitude of pass through for more than half of the manufacturing sector decreases. The results are parallel with the Taylor (2000) argument, as in the industrialized economies the magnitude of pass through decreasing over the longer time period.

A developed economy like Switzerland with stable economic condition and low inflation rate over the years Stulz (2007) explored more thoroughly the ERPT in to inflation in Switzerland and the data used in analysis is monthly started from 1976-2004 while the econometric methodology adopted for the analyses is VAR. Author sums up his study as the magnitude of ERPT to consumer inflation is modest but for import prices its magnitude is high. During a three months' time period the ERPT for import prices is 35 percent while 9 percent recorded for consumer prices. Stulz (2007) considers low inflation in Switzerland for the low pass through, which is also Taylor (2000) conclusion.

Furthermore, Bhattacharya et al., (2008) investigated the same case in United states of America, United Kingdom and Japan and concluded that the ERPT ranges from 30% to 50 % for US based industries, while for UK's metal industries mainly iron and steel, the relationship is insignificant. By the same token the pass through for Japan centered foodstuff, metallic and textile industries is nearly not significant.

Przystupa & Wróbel (2011) arrived at the conclusion of incomplete ERPT not only in short but also in long run in case of Poland. Results of the study deny the evidence of non-uniformity of ERPT with currency appreciation and depreciation however asymmetric behavior of consumer prices do react to abrupt variations in the exchange rate. In contrast hints that pass through varies differently following that how much fluctuation occurs in the exchange rate. A deep analysis of ERPT at quarter level during the period 1980-2010 by Cheikh & Louhichi (2014) for 12 European economies found out that magnitude of pass through varies across countries like the previous studies. The sample countries in their study are Portugal, Greece, Finland, France and Germany. For Portugal when exchange rate depreciated by 1 % there is 0.84% pass through to domestic inflation while in Case of Greece it is 5.8 percent. Furthermore, for Finland, France and Germany it passes to domestic inflation by 2 percent.

Reddan & Rice (2017) examined the ERPT to domestic inflation of Ireland. Previously Fitzgerald and Haller (2008) reported that the Irish consumer prices are determined by some external inflation and also the exchange rate fluctuations. Bradley (1977) and Geary (1976) found

that the consumer prices of UK and Ireland are interlinked. The pass-through of the UK's consumer prices to Irish is faster than the exchange rate (Fitzgerald & Shortall, 1998). They indicate that the consumer prices inflation if Ireland is now interlinked with the exchange rate of EURO and Pound Sterling. Recently Ha et al., (2019) conducted a study on 29 developed and 26 emerging countries. They concluded that domestic that the domestic economic disturbance causes the exchange rate to fluctuate in different countries and the magnitude of ERPT varies across the countries.

2.3 Developing Country Case

The exchange rate pass-through (ERPT) phenomenon is in the neonatal stage in the case of developing economies. Aron et al. (2014) explored the pass-through of exchange rate in the developing economies very recently. The studies (Mihaljek & Klau, 2001, Rowland, 2004, Nogueira, 2007, Bussière & Peltonen, 2008, Karoro et al., 2009, Omisakin, 2009, Parsley, 2010, Ocran, 2010, Aron et al., 2012, Masha & Park, 2012, Aron et al., 2014, Ellyne & Hearn, 2014) sheds light on different aspects related to ERPT. Furthermore, literature related to ERPT to import and domestic Whole price index and consumer price index at aggregated and disaggregated level has also been developed.

Economic conditions in the developing countries are not as good as in developed countries, there is high inflation, low growth rates, lack of industrial sector and high dependence on the imports, so the exchange rate fluctuations affect the domestic price level more than the developed

economies. For that purpose, Mihaljek & Klau, (2001) focused 13 developing economies for the study of ERPT. Through the use of OLS model for ERPT estimation in to domestic inflation and import prices by concluding that the ERPT correlation with the domestic inflation is strong while weak with that of import prices. Analyzing the phenomenon in exactly the same time period for Mexico, Turkey and SA the results portrays that domestic prices are more sensitive towards import prices volatility. In contrast to the above results in case of Poland and Hungary the domestic inflation is responsive to the lagged import price variations. In case of Chile, Malaysia, Turkey and South Africa import prices and exchange rate volatility has even impact on domestic inflation.

Using data of Columbia for the period started from January 1983 to January2002 and Unrestricted VAR model Rowland (2004) reached a conclusion of speedy ERPT into prices of imports. In a period of one year the ERPT to prices of imports is 80 percent while to the domestic wholesale and consumer inflation is 28 and 20 percent. The results of this study are also parallel with the results of Choudhri & Hakura (2006). According to them the magnitude of pass through varies among developing and developed economies as it is high for developing economies as compared to developed economies. This difference is because of the higher level of inflation in the concerned developing economies. Bussière & Peltonen (2008) shaded light on the inflation level role while exploring and comparing the ERPT of 28 developing economies and 13 developed economies. They conclude that by controlling the exchange rate crisis and providing a suitable inflation

level the ERPT is almost similar for both the developing and developed economies.

Ito and Sato (2007) focused region is East Asia for ERPT in to import prices and domestic inflation. They conclude their work by arguing that ERPT and import prices are highly correlated while the relationship is weak in case of domestic prices. The results for Indonesia are in contrast with the above findings as the exchange rate volatility is high translated into domestic inflation. Nogueira (2007) conducted a study on the investigation of the relationship among inflation targeting framework and ERPT in a cross-country analysis by using ARDL model. This study arrived at the conclusion of low ERPT into domestic inflation. When comparing the low ERPT among producer and consumer prices this study concluded that it is higher for producer and low for consumer. Wimalasuriya (2009) focused on Sri-Lankan economy and used two models to investigate the magnitude of ERPT. The model in his study are log-linear regression model used to investigate the ERPT into import prices and VAR model producer and consumer inflation. The regression model results show 50 percent pass through while VAR model results show complete pass through into producer prices while 30 percent into consumer prices.

For estimating the degree of ERPT into inflation level and output in Nigeria, Omisakin (2009) followed the econometric methodology of McCarthy 2000 i.e. variance decomposition and SVAR. This research concludes that the affect of depreciation of exchange rate on consumer inflation is insignificant, however the main reason behind the domestic

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price sensitivity are monetary shocks. Using VAR model a similar study is conducted by Mwase (2006) for a time period 1990-2005 in Tanzania. His conclusion is similar to that of the above as domestic inflation is not much responsive to exchange rate fluctuation during 1990's. The factors responsible for the unorthodox results are economic reforms in Tanzania during 1990's i.e. high competitiveness, discretionary monetary policy and high output.

For sub-Saharan African economies a study conducted by Razafimahefa (2012) concludes that on average the magnitude of exchange rate fluctuation passing into domestic inflation is recorded 40 percent. However, economies adopting the floating exchange rates the degree of ERPT is low. These results are confirmed by different studies (Taylor, 2000, Choudhri & Hakura, 2012 and McCarthy, 2000 and McCarthy, 2006) supported above results as the ERPT during the 1990's and 2000's declined. The amount by which the pass through decreased is 50 percent during 1990's. The factors behind the above estimate are economic conditions and political reforms in sub-Saharan Africa. Similarly, Masha & Park (2012) like McCarthy (2000) used VAR model, making the case for Maldives of the ERPT into consumer prices. The magnitude of pass through in Maldives is high i.e. 79 percent within a span of one year. The explanation for the high ERPT is Maldives's small and open economy and its high dependency on imports. This paper results are in contrast with another study of Sweiden (2013) which took the case of Jordan's small economy. Study arrived with the conclusion that ERPT is moderate in Jordan despite her economy responsiveness to

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exchange rate and oil prices. A short run analysis of the fore mentioned variables reveals that oil prices volatility has greater impact on import prices i.e. 29 percent, while that of exchange rate volatility is 13 percent respectively. In a long run, the combine affect of oil prices and exchange rate on import prices is similar i.e. 13 percent.

Using monthly data of the period 1999- 2000 Beckmann & Fidrmuc (2013) focused on CIS region's ERPT phenomenon. They arrived at the conclusion that small open economies have high magnitude of pass through because of their dependence on imports and on dollar. Within one year span the pass through in to domestic inflation ranges between 50 to 70 percent in case of Kyrgyzstan, Ukraine and Moldova. Furthermore, they argue that the focused countries domestic inflation is more responsive towards Us dollar fluctuations as compared to fluctuations in euro. A 60 percent ERPT is estimated for the region in the long run.

Phiakeo (2017) investigated the ERPT to domestic consumer price level in Dollarized economies of south Asian countries and comes with the conclusion that there exists an indirect affect which means that increase in dollarization increases the amount of pass-through to domestic consumer price inflation. Earlier Carranza *et al.,* (2009) found the higher magnitude of pass through to domestic price level in Dollarized economies. Countries with high level of dollarization faces the high rate of pass-through to inflation. Other studies like Sadeghi *et al.,* (2015) found that in dollarized economies the degree of exchange rate pass-through to inflation is high. Helmy *et al.,* (2018) investigated

the connection between domestic prices and the ERPT in Egypt which was not expressed before. Before this Belaisch (2003) found that the ups and downs in the exchange rate had a small affect on the domestic inflation of Brazil. Bwire *et al.,* (2013) expressed that there is incomplete ERPT to inflation in Uganda. While Helmy *et al.,* (2018) found that the ERPT to different prices is considerably slow and incomplete in Egypt and tis affect is more important in consumer prices.

In middle east and north African developing countries Smaili & aissa (2018) studied the level of exchange rate pass-through to domestic price level. They found that found that the affect of pass-through of nominal affective exchange rate is higher on the prices of import then to the producer prices and the smallest on the CPI in these countries. Some other work like Jebali *et al.,* (2006) showed that in Tunisia the magnitude of nominal affective ERPT to CPI was less for the time between 1999 and 2006. Abida & Sghaier (2012) found no role of NEER as a shock transmitter channel.

Adekunle & Tiamiyu (2018) examined the irregularities of ERPT to inflation in Nigeria. They found that the inflation in Nigeria in the period under research is because of the many imported products in the basket and they found the asymmetries in the response of inflation to depreciation and appreciation of exchange rate in Nigeria. Besides Ghosh and Rajan (2007) argued that the asymmetries in the affect of exchange rate ups and downs to domestic consumer inflation is depends on the asymmetric behavior of the exporter towards depreciation and appreciation. Aron *et al.,* (2012) found that the import prices increases

when the exchange rate is depreciated but not much decrease when the exchange rate appreciated.

Recent evidence regarded Ghana which is a developing country so keeping in view Asafo (2019) investigated the ERPT when bank of Ghana adopted the inflation targeting policy using quarterly data from 2003 to 2017. study concluded that the domestic price inflation is very responsive to shocks in exchange rate but not complete. The impulse response suggests that the monetary measures taken by the bank of Ghana are positively related to the domestic inflation as it 12 percent to 18 percent while exchange rate depreciation affects the domestic price by 9 percent to 12 percent Maduku & kaseeram (2018) investigated the affects of exchange rate changes on inflation in South Africa using monthly data from 2002 to 2015. SVAR results shows that the magnitude ERPT to imports and producer prices are more than other price indices and the amount of pass through to producer price inflation is recorded 22 percent and suggested the monetary authorities to change the exchange rate policy to managed float to decrease the ERPT to lower down the domestic price level.

In case of Indian Economy Joy (2019) examined the affect exerted by the depreciation in the exchange rate on the domestic inflation using monthly data from April 2003 to December 2015 by applying the VECM model. Study found that the local prices in India are very responsive to exchange rate and oil price shocks. This study also concluded that the foreign reserves are also responsive to these fluctuations along with the inflation. A panel data study on 28 emerging economies by Caselli &

Roitman (2016), concluded that there is an asymmetric behavior of pass through magnitude in large and small of depreciation of the exchange rate. When the depreciation in the rate of exchange is higher than 40% it gives the pass through degree of 70 percent while a small depreciation causes less than 20 percent. In Iran Farajollahi et al., (2018) examined the affects of exchange rate on domestic producer prices using annual data from 1981 to 2014. They concluded that the pass through to producer prices is incomplete while they argued that when there is more exchange rate depreciation the inflation will also increase.

2.4 Country-Specific Empirical Studies

In this section studies on specific countries are discussed. Comparing the aggregate level analysis and country specific analysis, the later has more significance when we take in to consideration factors that has an impact on the economy of a specific country as each country economic dynamics varies. In this study the spotlight variable is ERPT. Generalized econometric methodologies adopted for aggregate level study usually arrive at more generalized conclusions.

Nogueira & León-Ledesmab (2009) used monthly data of the period 1995-2007 and focused on the changes in the magnitude of ERPT in Brazilian economy. The have taken inflation targeting in 1999. According to them, IT plays important role in curbing the pass ERPT as it is evident from the Brazil's case where the magnitude of pass through decreased from 0.87 to 0.08. Taking the case of inflation Nogueria (2007) further extended his study and arrived at conclusion that ERPT is

endogenous to domestic inflation. This result is supported by Taylor's (2000) argument. Furthermore, by fixing threshold level of inflation and if the domestic consumer price level increases in the long run crosses that threshold then the pass through is approximately 0.39 percent and if the price level is lower than the threshold price level then pass through is almost zero.

Correa & Minella (2010) explored the ERPT with the help of non-linear methodology in the Brazilian context. The methodology takes in to consideration the exchange rate fluctuations, volatility in exchange rate, and business cycles. The conclusions they drawn from their study are (a) the magnitude of pass through is zero if economy lies below threshold, while higher than the threshold economic activity translates in to 9 percent pass through; (b) a high volatility in the exchange rate translates in to 80 percent pass through, while for low volatility in exchange rate the pass through is zero; (c) high amount depreciation leads to 11 percent pass through while small depreciation results in zero pass through.

Focusing on Chilean economy using monthly data for the period January 1987 to December 2013 Justel & Sansone (2015) estimated the magnitude of ERPT making use of VAR model, they arrived at the conclusion that the ERPT the shows declining trend i.e. the estimated aggregate pass through is 0.20, while the sub sample (2002-2013) pass through recorded as 0.14 percent. Another study conducted by Morande & Tapia (2002) explored ERPT utilizing rolling window VAR model

estimated pass through i.e. 0.40 during the first few years of 90's which declined to 0.10 during the period 1996-2001.

While focusing on Mexican economy Espada (2013) studied ERPT utilizing monthly data of the period June 2001 to August 2012 and running VAR model concluded that the magnitude of pass through during the focused period is low and insignificant as after 12-month period the pass through to domestic inflation is only 0.03 percent. Extending the same study Peóna & Brindisb (2014) argued that imports prices are more responsive to ERPT with coefficient of 0.91 while producer and consumer prices are less responsive towards ERPT with coefficients of 0.17 and 0.02 during a 6 months' period. The reason behind low ERPT is low inflation because of tight monetary policy adopted by Mexico during the focused time period. In contrast to the mentioned studies Aleem & Lahiani (2014) took threshold inflation as endogenous while studying the ERPT and inflation nexus. They concluded that prices above the threshold, ERPT and inflation relationship is significant and if the prices are below threshold the ERPT is not translated in to domestic price inflation.

Odria et. al. (2012) investigated the targeted inflation regime and it relationship with ERPT in Peru. Their main emphasis was the comparison of the period before and after the adoption of inflation targeting policy regime. In the long run they estimated 86 percent decrease in the ERPT. This result is also supported by Winkelried (2014) utilizing rolling window. The ERPT estimated in his paper is 0.10 i.e. after the targeted inflation while before the adopted policy it was 0.60.

Forero & Vega (2015) found asymmetric relationship between the domestic inflation and currency appreciation and depreciation. In the long run when currency is depreciated the pass through is estimated as 0.20 while appreciation of the currency translates by 0.10 in to the domestic inflation.

Taking the case of Columbian economy Rowland (2003) took monthly data for the period January 1983 to October 2002 while using VAR model concludes that in the long run the magnitude of ERPT declines while considering distribution chains as in the focused period it was 0.15. Rincón and Rodríguez (2016) argues that there also exist other factors which strengthens or weaken the pass through and inflation nexus. The factors include; high and volatile CPI inflation, overvalued currency, surplus output, less open economy, and low policy rate. They also argue that the ERPT impacts the state of the economy asymmetrically i.e. high local prices leads to high rate of pass through as compared to low inflation period. The magnitude of ERPT increases if the currency appreciates or depreciates and if the exchange rate is more fluctuating the magnitude of pass through will high.

Considering monthly data of the period July 1991 to March 2005 Khundrakpam (2007) investigated the pass through in to domestic inflation in case of India by utilizing ECM. According him the ERPT into domestic price inflation in the long term is very low i.e. 0.09 and there are signs of decreasing trend of the pass through. Study conducted by Bhattacharya (2008) also found that the ERPT spectrum ranges between 0.03 to 0.17 during the period September 1997 to October 2007.

Study conducted by Kapur & Behera (2012) by applying vector auto-regressive model and quarterly data of the period 1996 to 2011, confirms the above study's findings of low magnitude of ERPT in to domestic prices i.e. 0.10 in case of Indian economy.

Literature of ERPT in case of Chinese economy is also available after the government initiatives of deserting the policy of yuan pegging with US dollar and opening up its economy. Shu & Su (2009) investigated the exchange rate pass through in to domestic inflation in short run and long run for the period 1998 to 2007. They conclude that in short run the ERPT is low but in the long run it touches 0.20. Furthermore, they also conclude that during most of the focused time period the pass through remained stable while distribution chain suggests that the magnitude of ERPT declined over time. Study of Wang & Li (2010) also supports the results of the above study. By extending the study time period the ups and downs in the exchange rate and its translation in to domestic inflation increases i.e. 0.60 as found out by Jiang & Kim (2013). By comparing the pass through of exchange rate in two different exchange rates i.e. fixed and flexible exchange rate Jin (2012) estimated a pass through of 0.14 during fixed regime while low pass through i.e. 0.03 during flexible exchange rate regime.

Limited literature is available on ERPT in the case of southeast Asian countries i.e. Thailand, Indonesia, Malaysia and Philippines. In the country case of Thailand Jitpokkasame (2007) using quarterly data started from 1995 to 2005 investigated the ERPT in to domestic inflation and estimated it as 0.18 while another study by Chai-anant et al., (2008)

considering monthly data estimated the ERPT to be 0.13. Supporting the above study, a long term analysis of the pass through by Wattanakoon (2013) using data of the period January 2000 to August 2011 estimated the pass through to be 0.14. To arrive at more accurate results Arintoko (2011) suggests introduction of structural breaks while shifting from fixed exchange rate regime towards flexible exchange rate regime. The pass through estimated by this study is to be 0.11 while considering the time period of 1997 to 2009. Kuncoro (2015) found out that consumer prices are not responsive to exchange rate fluctuation while it does have an impact on the import and producer prices. However, considering the estimates of SSMX model used by Bank of Indonesia, one percent depreciation of the currency translates in to 0.16 rise in consumer prices (Edwards & Sahminan, 2008). The pass through in case of Malaysian economy is in the range of 0.05 to 0.15, estimated by Bank Negara (2012) using VAR model while considering the time period of 1980 to 2006. Ahmad (2009) arrives at a conclusion that considering Malaysian economy the ERPT is low and incomplete. The estimated long run pass through by this study is 0.18. Guinigundo (2008) focused on Philippian economy and concluded that one percent decrease in the value of peso translates into 0.14 percent rise in the domestic prices. By adopting threshold inflation policy during 2002 to 2015, an annual report of the year 2015 by Central Bank of Philippines reveals zero pass through.

Literature on the topic of exchange rate pass through in the case of European economies is also available as after being part of the euro zone all the member states came under the umbrella of Maastrich criteria,

a criterion which fulfill macroeconomic objectives of the euro members. The basic reason behind this criterion was that all the members will adopt same exchange rate for the period of two years and the members were provided with the flexibility of deviating from the central parity only by 15 percent. Because of this reasons exploring pass through tended to be of paramount importance to the European economies.

Considering a monthly data of the period January 1998 to March 2011 of Czech Republic while utilizing VAR model Kucharčuková et. al. (2013) concluded his paper with the result that 1 percent of change exchange rate is translated into 0.11 percent rise in the consumer prices. Contrary to the above paper a study conducted by Hajeka & Horvath (2016) estimated ERPT to be 0.50 into consumer prices which is an indication of strong relationship between the main variables of their study. They also explored the ERPT in to consumer goods prices, specifically food items and tradable goods prices and concluded that food item prices are highly responsive to pass through i.e. it complete while for tradable goods it was low. Babecka-Kucharcukova (2009) utilizing data of the time period Jan 1996 to Dec 2006 concluded that the level of ERPT in to domestic consumer inflation is 0.25 and within a half year span it reaches completion. Furthermore, study found a decreasing trend of the pass through in case of Czech Republic.

Arratibel & Michaelis (2014) focus of analysis is Poland. They utilized the quarterly of the period 1996 to 2012 and argued that dynamic VAR model best fits the Polish data. They concluded that during six quarters time period the consumer prices were less responsive towards

ERPT i.e. 0.10. Hajnal et. al. (2015) utilized many models i.e. rolling window OLS, VECM, VAR, and threshold VAR model to capture the relationship between domestic inflation and ERPT taking in to consideration 2001 to 2014-time period. Besides some asymmetries they estimated the range to be 0.10 to 0.15. When the currency appreciates the pass through in to domestic inflation is higher as compared to currency depreciation. The ERPT and domestic inflation are highly correlated during high inflationary period, and also during high growth regimes.

Focusing on the Romanian economy Stoian & Murarașu (2015) took in to consideration different time periods and wide range of econometric techniques, conducted a comprehensive study which concluded that consumer prices response to the pass through is low i.e. 0.07 during the period January 2005 to December 2014. In Russian economy the ERPT in to domestic inflation during the period February 2009 to July 2014 was 0.13 according the monetary policy report of the Central Bank of Russia. For the period 2002 to 2012 Ponomarev et. al. (2016) estimated the ERPT to be 0.48. The magnitude of ERPT is asymmetric when it comes to exchange rate fluctuation.

ERPT in to the domestic inflation in case of Turkey is deeply discussed in the literature. Leigh & Rossi (2002) made use of monthly data of the period 1994 to 2002 concluded that during a span of one year specifically in the start of the year the ERPT in to the domestic inflation was 40 percent. This result is also supported by the study of Alper (2003) in which the data utilized is started from 1987 to 2003. The factors

responsible for this high ERPT includes lagged currency crisis, dollar dominancy in the economy and high domestic prices. Utilizing the same framework, Kara & Ögünc (2008, 2012) and Yüncüler (2011) conclude their papers by arguing that during the post-2001 period the pass through has shown a declining trend and the pass through recorded in this period is 15 percent. Responsible factors for the declining trend identified by the researchers are threshold inflation regime and less responsiveness of domestic prices towards exchange rate.

Arbatli (2003) made use of threshold VAR models to explore more extensively the ERPT and inflation relationship. During the course of his analysis study found some asymmetries impacting the concerned relationship. In another study by Kara et al. (2007) investigated different exchange rate and monetary policy regimes utilizing dynamic parameter approaches concluded that the mentioned regimes can be the possible antecedents of the ERPT in to domestic inflation. Arslaner et al. (2015) computed the ERPT to be 0.15 in case of Turkish economy. In another recent paper by Kılınç & Tunç (2017) utilizing recursive VAR and SVAR models estimated the ERPT to be 8 percent in case of RVAR. The reason identified by them behind the low pass through is high oil prices due to which the currency lost its value. Their results of VAR reveal the pass through of 18 percent including the impact of other variables.

Another study in South African context is done by Aron et al., (2014) utilizing monthly data of the period 1980 to 2009. During this period South African economy shifted from fixed ER regime to floating

ER regime. Within a period of 12 months the ERPT is recorded as incomplete i.e. 0.50 percent. By taking in to consideration a sub-sample the magnitude of ERPT decreased to 0.40 percent. Researchers have also taken in to consideration ERPT in to aggregate CPI by utilizing a especial data set of micro-consumer price data at product level of the period 2002 to 2007. Further sub branching the CPI the researchers have found that ERPT fluctuates noticeably across the branches. Aggregating the components to calculate an index, the ERPT is recorded as 0.30 percent for the period of two years. Helmy *et al.,* (2018) examined the unexpressed relationship between domestic prices and the pass-through affect of the exchange rate in Egypt. They found that the pass-through of the exchange rate to different prices is considerably slow and incomplete in Egypt and tis affect is more important in consumer prices. Before this Belaisch (2003) found that the ups and downs in the exchange rate had a small impact on the domestic inflation of Brazil. Bwire *et al.,* (2013) expressed that there is incomplete pass-through of exchange rate to inflation in Uganda.

2.5 Pass-Through in Pakistan

As already discussed in first section that literature related to Pakistan is limited on the topic of exchange rate pass – through to domestic prices. The pioneer study of Hyder & Shah (2004) has contributed to the literature. They found a low exchange rate pass-through and a modest impact of exchange rate fluctuations on the domestic prices and exchange rate pass-through is more pronounced in wholesale prices than consumer prices in Pakistan. Jaffri (2010)

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investigated the ERPT in Pakistan using monthly data from 1995 to 2009 and concluded that there is very low pass through to domestic prices due to appreciation of the exchange rate and suggested to adopt the inflation targeting policies and floating exchange rates to monetary authorities.

Shaikh & Hussain (2015) worked on the phenomena of exchange rate pass-through to domestic prices in Pakistan. They found that the ERPT is more translated in whole sale prices and exchange rate pass-through is less in consumer prices. Choudhri & Khan (2002) found no evidence of inflationary affect of rupee devaluation in Pakistan and they argued that the inflation is because of exchange rate fluctuations. In contrast, according to Siddiqui & Akhtar (1999) there is no significant relationship between exchange rate fluctuations and domestic inflation and argued that money supply is the factor that affect the domestic prices in Pakistan. Shaheen (2013) conducted study on the affects of exchange rate changes on the economic performance of the Pakistan using yearly data from 2000 to 2010. The author concluded that the exchange rate depreciation affects both the inflation and exports to increase but the boost in the exports due to the depreciation is mitigated due to increase in inflation in Pakistan.

Further, in 2018 using monthly data from 2005 to 2015 by applying VAR model Ahmed et al., (2018) investigated the ERPT affect in case of Pakistan. They come to a conclusion that fluctuations in the exchange rate has less affect on the consumer price index. Minhaj & Nishat (2018) investigated the pass through of exchange rate to domestic prices in Pakistan. They concluded that due to high level of inflation in

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the country the magnitude of pass through is high. Along with exchange rate, imports and policy rate have also the significant affect on the domestic consumer prices in Pakistan. Asad et al., (2012) investigated the affect of exchange rate pass through to domestic prices by using real exchange rates. They concluded that the REER have a very low pass through tom domestic prices.

2.6 Concluding Remarks

Exchange rate pass through shows the response of the domestic inflation to the exchange rate fluctuations. Such fluctuations can be recorded as complete or incomplete and a varying degree of pass through can also be recorded. By the same token currency appreciation and currency depreciation has also varying impact on domestic prices even if both are of the same magnitude. As evident from the discussed literature exchange rate is one of the factor responsible for domestic inflation, so it is of utmost importance that policy makers take into consideration ERPT while devising monetary policy.

Complications may occur while devising monetary policy as high magnitude of pass through can weaken the demand management policies. Impediments may also arise while forecasting the inflation as domestic inflation stability is of utmost importance for countries like Pakistan where threshold inflation is adopted as a policy tool to have stable domestic prices. Therefore, exploring and understanding the exchange rate pass through phenomenon is important for policy decisions and

evaluating the pressure on macro level economic indicators as a results of such policies.

While reviewing the literature, two mechanisms of how exchange rate passes through into domestic inflation are identified. In one channel, exchange rate fluctuations directly affect import prices which in turn impacts producer prices and in return it targets the consumer prices and the second channel through which ER affects the domestic price is though demand and exports. The speed with which the ER passes in to domestic inflation and its degree of pass through is affected by many factors some of which are exchange rate fluctuations, firms pricing decisions, substitutability property of products, inflation environment and market structure.

It is evident from the review of the empirical literature of ERPT that it is incomplete either developed or in developing economy. Though it is recorded higher in emerging economies than the developed economies. Across the countries the magnitude of the Exchange rate pass through different and over the years it is decreasing in most of the economies. There is 85 percent ERPT in some countries means 10% depreciation causes an 8.5 percent increase in the domestic inflation whereas in some countries it is 20 percent.

Chapter 3

Econometric Specification and Estimation Techniques

This chapter is about the econometric specification and estimation techniques that will be used in the study. It discusses the theoretical framework that how exchange rate depreciation affect is passes through to domestic price level in Pakistan. Moreover, different econometric techniques including unit root tests and co-integration techniques are discussed in detail below.

3.1 Theoretical Framework

Explicitly, through exchange rate depreciation the domestic prices can be affected through two channels, one is the direct and the second is the indirect channel. The direct affect of the exchange rate takes place through the increase in price of imported finished goods and imported raw material. Usually in the price taker countries like Pakistan when the exchange rate depreciated the import price will rise and when it appreciates the price of the imports will decrease. As the exchange rate depreciates the high price of the imported finished goods and the high price of raw material associated with this depreciation. It will increase the cost of production and marginal cost of the producer and the end result of this depreciation will be increase price of the domestically produced good and the domestic price level.

Second channel is the indirect channel is that the depreciations in the exchange rate affects will affect the exports and the aggregate demand will increase which in turn the domestic price level will be

increased. Moreover, to keep the profit margins maintained, the firms which are import competing will increase the prices to respond the high price of the importing competitor. Though there are some other factors (i.e. market structure, pricing policies, mixing up the tradeable with non-tradeable, inflation in the economy and import share in the consumer baskets) which affects the magnitude and the velocity of pass through to domestic inflation. (see figure-1)

ER ↑ →   Import Prices ↑ → Price of Imported Finished Goods ↑→ Domestic Price ↑   (Direct Affect)

When the exchange rate depreciated, the first direct affect of this depreciation is that the price of the imported finished goods becomes expensive in Pakistani rupee and the domestic price increases.

ER ↑ →   Price of imported raw material ↑ → Production Cost ↑ → Domestic Price ↑   (Direct Affect)

The second direct affect of the exchange rate depreciation is that the imported raw material becomes expensive in Pakistani rupee due to this the production cost increases. In the end, the depreciation put pressure on the domestic price level and the domestic inflation increases.

ER ↑ → Export and substitute goods Demand ↑ → Labor Demand ↑ → Price of Factor of Production ↑ → Production Cost ↑ →domestic price ↑
                                      (Indirect affect)

Due to exchange rate depreciation, the demand for exports and substitute goods rises. Because of the rise in demand the price of factors of production increases this will increase production cost and hence domestic prices level increases.

Figure 1 Pass-through channel


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                        ┌─────────────────┐
                        │   Pak Rupee     │
                        │  Depreciates    │
                        └─────────────────┘
                     ╱                        ╲
        ┌─────────────────┐            ┌─────────────────┐
        │  Direct impact  │            │ Indirect impact │
        └─────────────────┘            └─────────────────┘
                                                │
            ┌──────────────┐                    ▼
            │  Imported    │            ┌─────────────────┐
            │   inputs     │            │  Demand for     │
            │   become     │            │  Pakistani      │
            │ expensive    │            │  exports        │
            │  in PKR      │            └─────────────────┘
            └──────────────┘
                  │
  ┌──────────┐  ┌──────────────┐
  │ Finished │  │ Production   │───────────────────────▶
  │ imported │  │ cost rises   │
  │  goods   │  └──────────────┘          ┌─────────────┐
  │ become   │         │                  │ Substitutes │
  │expensive │         ▼    ┌───────────────┐  and      │
  │ in PKR   │────▶    │ Domestic prices │◀─│ exports    │
  └──────────┘         │   Increases     │  │ become     │
                       └───────────────┘  │ expensive  │
                              ▲            └─────────────┘
                              ┃
        ┌──────────────────────────────────┐
        │ -Market Structure                 │
        │ -Pricing policies                 │
        │ -Product substitutability         │
        │ -Involvement of various non-      │
        │ tradables in the distribution     │
        │ of tradables                      │
        │ -Slow adjustment of non-          │
        │ tradable                          │
        │  prices and wages                 │
        │ -Prevailing exchange rate         │
        │ policy                            │
        │ -Inflationary environment         │
        └──────────────────────────────────┘
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Model

We are using Consumer Price Index and Wholesale Price Index on the dependent side and P is used as the dependent variable in the equations below on the independent side and exchange rate is the focused independent variable along with other control variables which are oil prices, Large scale manufacturing, money growth, and public sector borrowing are taken and given below:

P= f (ER, OIL, M2, LSM, PSB)   (3.1)

3.2 Econometrics Technique

Time series data will be used in this study so it is very important to check the stationarity of the data in order to check the co-integration among the variables. Without checking the stationarity, we cannot proceed to the next step of the estimation because if there are non-stationary series this will give the wrong results. The non-stationarity problem occurs due the shocks and due to this series not revolves around its mean, while in stationary series these affects are for the short time period. so before proceeding further it is important to test the stationarity of the data for that purpose, we will apply the unit root test.

3.3 Unit Root Testing for Time Series

For the stationarity of the time series data different tests are used, which were recommended by Hamilton (1994), Stock (1994), Hatanaka (1995), Fuller and Phillips (1996), Maddala and Kim (1998) and Phillips

and Xiao (1998). The augmented Dicky Fuller will be used in this study to check the stationarity. Augmented Dicky Fuller test presented by Dicky and Fuller (1979) is an auto-regressive unit root test in which order is unknown. Augmented Dicky Fuller test uses the correct lag length selection and these lags can be selected through information criterion i.e. Akaike Information Criterion (AIC) and Schwarz information criterion (SIC). The probability of the rejection of the null hypothesis is increased by including many lags while using ADF. AIC and SIC select almost the same lag length.

All the variables of the time series data cannot be represented by AR(I)

$$\Delta P_t = \alpha_0 + \gamma P_{t-1} + \alpha_2 t + \varepsilon_t \qquad (3.2)$$

Where ΔP_t (Δ is the I(1) operator) shows the dependent variable which are consumer price index and Wholesale Price Index, t is time trend, P_{t-1} is 1st lag of P_t, and ε_t error term.

Dicky-Fuller test can be used in equation 3.2

$$P_t = \alpha_0 + \alpha_1 P_{t-1} + \cdots \ldots \ldots \ldots + \alpha_{p-1} P_{t-p+1} + \alpha_p P_{t-p} + \omega_t \qquad (3.3)$$

To obtain the ADF test equation add and subtract $\alpha_p y_{t-p+1}$

$$P_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_1 P_{t-2} + \cdots + \alpha_{p-2} P_{t-p+2} + (\alpha_{p-1} + \alpha_p) P_{t-p+1} - $$

$$\alpha_p \Delta P_{t-p+1} + \omega_t \qquad (3.4)$$

Now, add and subtract $(\alpha_{p-1} + \alpha_p) CPI_{t-p+2}$ in (3.4) we get:

$$P_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_1 P_{t-2} + \cdots - (\alpha_{p-1} + \alpha_p) P_{t*p+2} - \alpha_p \Delta P_{t-p+1} + \varepsilon_t (3.5)$$

Continuing this process, we have:

$$\Delta P_t = \alpha_0 + \gamma P_{t-1} + \sum_{i=2}^{p} \beta i \, \Delta P_{t-i+1} + \varepsilon_t \qquad (3.6)$$

Where $\gamma = 1 - \sum_{i=1}^{p} \alpha_i$ and $\beta_i = - \sum_{j=1}^{p} \alpha_j$ (3.7)

γ is very important coefficient in the equation (3.6), when $\gamma = 0$ it means that the equation has the unit root and is I(1). when $\sum \alpha_i = 1$ which means the sum of the coefficient of the differenced equation is 1 and $\gamma = 0$ so the unit root exists.

The assumption we take in the ADF test is that the residuals are independent with the variance constant. The two important attributes arise due to this process; one is that the coefficient γ can't be estimated correctly and the standard errors of the term γ which are included in the equation without any AR term. So obviously $\Delta P_t = \alpha_0 + \gamma P_{t-1} + \varepsilon_t$ a simple regression is inadequate for this motive when the data generating process of equation (3.6) is true. Thus there exist the problem of suitable lag length selection criteria and the correct order of AR is not known. The second feature is that the trend and intercept might be unknown to the equation (3.6).

3.4 Lag length selection criteria

When the stationarity requirements are satisfied then next the appropriate lag length will be chosen. For this purpose, the process normally used is restricted VAR which tells us that how much lags will be good for the model. Lag length is selected where the Akaike information criterion and Bayesian information criterion values are minimum.

3.5 Co-integration Approach

After checking the stationarity of the data and the integrated order of all the variables, the next step is to check the co-integration among the variables. There are different types of tests for co-integration, each test is different from the other and chosen on the bases of the integrated order of the variables. These test includes Engle-Granger (EG) test, Error Correction Model (ECM), The Johansen Juselius (J.J) technique and auto-regressive distributed lag model (ARDL). When there are two variables and the order of integration is same EG test will be used to find out the long run relation. But there are two disadvantages of EG one is if the integrating order is not same then the results will be wrong and second is that it can only be used when there are two variables. An error correction model is another technique used to find out the long run relation in which if two variables out all are I(1) and the error term is I(0) then there exist long run relationship otherwise not. The next approach is J.J co-integration, it is basically a multi-variate VAR based methodology and applied when the integration order of all variables is I(0) or I(1) to check the co-integration among the variables. The last approach discussed below to find out the co-integration among the variables is ARDL model which is the best among other techniques.

3.6 Auto-regressive distributed lag (ARDL) model

An auto-regressive distributed lag (ARDL) technique is widely used technique to extract the long-run and short run results. Peasran et al. (2001) established the ARDL model to examine the co-integration between the variables. There are two benefits of the ARDL technique,

first, it gives the estimates of the long and short time period while testing for co-integration. Second, the stationarity properties for using the ARDL model includes when the variables are integrated at I(0) or at I(1) or a mixture of I(0) and I(1), so when these will be stationarity properties ARDL will be used. But, ARDL technique is not valid if the variables are on first difference so for the stationarity of the variables unit root test will be applied which is compulsory before applying the ARDL technique. We are apprised to the best prior stationary properties of time series that's why we are employing ARDL technique.

Consider following model of ARDL

$$P_t = \gamma + \alpha_i P_{t-i} + \cdots + \alpha_n P_{t-n} + \beta_0 X_t + \beta_1 X_{t-1} + \cdots + \beta_y X_{t-n} + \delta_0 ER_t +$$

$$\delta_1 ER_{t-1} + \delta_2 ER_{t-n} + v_t \tag{3.9}$$

$$P_t = \gamma + \sum_{i=1}^{n} \alpha_1 P_{t-i} + \sum_{i=0}^{n} \beta_1 X_{t-i} + \sum_{i=0}^{n} \delta_1 ER_{t-i} + v_t \tag{3.10}$$

P_t shows the dependent variables consumer price index and Wholesale Price Index and ER is an independent side variable stands for exchange rate, X_t is a vector of control variables (oil prices, money supply, Large scale manufacturing and Public sector borrowing) and v_t is error term.

There are some advantages of using ARDL described as;

It gives the most robust results and when the data sample is small it performs well. Both the short and long run estimates of the ARDL test are more consistent and vigorous. The ARDL approach does not involve pre-testing of the variables, which means that the test for the existence of relationship between variables in levels is applicable irrespective of

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whether the underlying regressors are purely I(0), purely I(1) or mixture of both. There are some other limitations of the ARDL model that there will be no auto-correlation and no heteroscedasticity.

Chapter 4

Data and Variable Construction

In the previous studies of exchange rate pass-through many variables are used in the estimation process. In this chapter the theoretical specification of the variables that how these variables are constructed which will be used to find out the ERPT in Pakistan. This chapter also includes data properties like **time period and the source of data collection are discussed below.**

4.1 Variable construction

Exchange Rate

By taking into account unique properties of each type has, this study will make the best employment of one's availability and feasibility. We will use nominal exchange rate only as it depends on market forces of demand and supply while real affective rate is adjusted for inflation and normally based on specific year. In case of Pakistan, characterize by high uncertainty, it is untenable to use real affective exchange rate. Jaffri (2010) and Helmy et al., (2018) and Campa et al., (2005) used NEER in their studies. The monthly data exchange rate is taken from state bank of Pakistan for the period ranges from January 1991 to November 2019.

Consumer Price Index

The consumer price index is a commonly used index for domestic inflation, the basket of CPI comprises 487 imported and domestic items in Pakistan will be used in the study. Earlier Hyder & Shah (2004) and Shaikh and Hussain (2015) used CPI in their study related to Pakistan. The monthly data of consumer price index is taken from state bank of Pakistan for the period ranges from January 1991 to November 2019.

Wholesale Price Index

For producers price the Wholesale price index(WPI) or it is also known as producer price index(PPI), the index is composed by the basket of 463 items, it will be used in the study. Besides Papell (1994) and Shaikh and Hussain (2015) used WPI in their study. The monthly data of consumer price index is taken from state bank of Pakistan for the period ranges from January 1991 to November 2019.

Oil prices

Brent crude oil price is used as a proxy for fluctuations in the world price of crude oil and the data is taken from Federal Reserve Economic Data. In the model, movements in crude oil price capture aggregate supply side shocks. Earlier Sek & Kapsalyamova (2008) used this in their study.

Money Supply

Broad money M2 will be used as the money supply variable in the study which is composed by including all parts of the M1 and others elements like mutual funds, securities, and time and saving deposits. Previously Mirdala (2014), Stulz (2007) and Hyder & Shah (2004) used broad money as a variable for the monetary policy in their study. The monthly data for money supply is taken from state bank of Pakistan for the period ranges from January 1991 to November 2019.

Quantum Index of Manufacturing (LSM)

The quantum index is used as an index of output growth for demand-side shocks. The quantum index is composed of the number of goods and services produced in the country. Besides in Pakistan Haider & Shah (2004) used QIM as a demand-side shock. There also is the same problem of base year in QIM, so we have compiled the data on the 2005-2006=100 base year to use in this study.

Public Sector Borrowing

Public sector borrowing (PSB) includes the loan which government borrowed from the domestic commercial banks and many other sources like by issuing securities and bonds. In the studies of exchange rate pass-through the PSB is not used before but used an indicator in the literature of inflation determinants so it is added for the first time in case of Pakistan. Previously PSB is used as an independent variable in the studies of the determinants of the inflation like Islam &

Kabir (2012), Adnan et al., (2008), Khan et al., (2007) and Akçay et al., (2001). These studies concluded that PSB do affect the inflation.

4.2 Data and its Sources

Data used in this study are monthly from January 1991 to November 2019, thus giving us a total of 340 observations. The source of data for consumer price index, exchange rate, money supply and Quantum Index of Manufacturing, public sector borrowing and data of the international oil prices will be taken from the State bank of Pakistan (SBP) Statistical Bulletin.

Chapter 5

Results and Discussion

In the previous chapter's methodology and the data specifications are discussed in detail. This chapter includes the descriptive statistics of all the variables and secondly the stationarity properties of all the variables. Lastly the results extracted from the proposed methodology which gives the long run and short run estimates of the model are discussed.

5.1 Descriptive statistics

Descriptive statistics includes the mean, median, maximum and minimum values, skewness and kurtosis listed in the table 1 below. Mean represents the average value of every variable and median is middle value and minimum and maximum value shows the lowest and highest values in the data. There are two test for the normality of data which are skewness and kurtosis. Further kurtosis of three types, when the value is 3 it is mesokurtic, when the value is positive and greater than 3 it is leptokurtic and when this value is less than 3 or negative it is called Platykurtic. Skewness has three types normal, positive and negative skewness, when the value is zero it is normal skewness, when it is greater than zero and positive it is positive skewness and when the value is negative it is called negative skewness. Then the Jarque-bera test also used to show the normality of data and the null hypothesis for J-Q test is that the distribution is normal and if p-value is less than 5% the null will be rejected.

The mean, median, maximum and minimum values of the CPI are 105.46, 77.77, 244.03 and 26.98 respectively and the standard deviation value of 64.80 shows there is 64.80% deviated from its mean. The skewness value of CPI is positive so it is positively skewed and the kurtosis value is 0.636 and it is less than 3 so it is platykurtic with flattered curve. The probability value of the jarque-bera test is clearly less than 5% so we can reject the null hypothesis of normal distribution. The mean, median, maximum and minimum values of the exchange rate are 68.54, 60.11, 141.16 and 22.13 respectively. Exchange rate is positively skewed with the value of 0.346 and kurtosis value of 2.202 tells us that it is platykurtic with flattered curve. The jarque-bera test probability value is 0.000371 less than 0.05 which tells us that the series is not normally distributed. However, broad money and public sector borrowing are positively skewed but have the kurtosis values greater than 3 so these are leptokurtic (peaked curves) and are not normally distributed because the probability values are less than 5%.

								J-B
Variables	**Mean**	**Median**	**Maxi.**	**Mini.**	**Std.Dev**	**Skew**	**Kurt**	**Prob**
Consumer Price Index	105.46	77.77	244.03	26.98	64.80	0.636	1.94	0
Exchange rate	66.54	60.11	141.16	22.13	28.88	0.346	2.20	0.0003
Oil prices	47.89	36.53	133	10.05	33.509	0.753	2.30	0
Broad money	14.81	14.83	16.63	12.75	1.11	-0.05	1.81	0
Public sector Borrowing	13.94	13.31	16.16	12.1	1.17	0.557	1.87	0
Large scale Manufacturing Index	4.385	4.520	5.209	3.550	0.444	-0.20	1.64	0
Wholesale Price Index	107.6	74.30	259.5	24.7	71.25	0.600	1.79	0

Table 1 Descriptive Statistics

5.2 Unit root Results

Before checking the co-integration among the variables used in the model, first it is important to check the stationarity of time series data as we are using time series data in the study. To check the stationarity of the data Augmented Dickey-Fuller test (ADF) of unit root is used. The null hypothesis is unit root versus the alternative hypothesis of stationarity.

The variables don't have the same integrating order it can be seen from the results of the ADF test mentioned below. Respectively this conclusion is confirmed from the results in the table 2 below. The variable which are stationary on level are large scale manufacturing and broad money supply. While the variable which are stationary on first difference includes exchange rate, consumer price index, wholesale price index, public sector borrowing and Oil prices. The results of the ADF test stated that, the resulted values are greater than the critical values. So we accept the alternative hypothesis that series are stationary against the null hypothesis of unit root (Andrews, 1991 and Newey-West, 1994).

Table 2 Unit root results						
Null Hypothesis # Series has a unit root						
Variables	Level I(0)		First Difference I(1)		Criteria	Decision
	t-stat	p-value	t-stat	p-value		
CPI	-1.2150	0.6690	-8.15	0.000	AIC	I(1)
ER	-0.8904	0.7907	-11.84	0.000	AIC	I(1)
LSM	-6.1681	0.0000	-12.12	0.000	AIC	I(1)
OIL	-1.6330	0.4646	-14.60	0.000	AIC	I(1)
M2	-1.3163	0.557	-5.963	0.000	AIC	I(1)
PSB	0.8941	0.9954	-5.745	0.000	AIC	I(1)
WPI	-0.733	0.9691	-12.29	0.000	AIC	I(1)

5.3 Test for Lag Length Selection

For the lag length selection, we used the Akaike information criterion and Schwarz Bayesian Criterion of VAR model. So for that purpose we have estimated the six VAR models *p=0, 1, 2, 3, 4, 5, 6* over the data started from 1991 to 2019. AIC selected the order of lag is 6 while SBC selected 2 order. Table 3 below shows the results for the different lag length selection criteria.

Table 3 Lag Length Selection Criteria		
Lag	**AIC**	**SBC**
0	-2.295	-2.22
1	-26.44	-25.97*
2	-26.73	-25.85
3	-26.87	-25.58
4	-26.95	-25.26
5	-26.92	-24.83
6	-26.99*	-24.49
* indicates lag order selected by the criterion		
AIC: Akaike information criterion		
SBC: Schwarz Bayesian Criterion		

5.4 Test for Co-integration

By the application of unit root test, it is evident that all the variables are stationary either on level or first difference. We used the Auto regressive distributed lagged (ARDL) model of Pesaran & Shinn (1995) and Pesaran et al., (1996) to check the impact of Exchange rate

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on Consumer Price Index by using secondary time series data of Pakistan from January 1991 to November 2019. After finding out the integration order, before using ARDL the next step is to check the co-integration by using Bound F-statistics in which the null hypothesis is $H_0 : \beta_1 = 0$, it means there is no co-integration. In bound testing the F- statistics calculated is compared with the lower and upper bound values, if value is less than the lower bound then we will accept the null hypothesis and if the value is greater than the upper bound we will reject the null hypothesis and accept the alternative hypothesis which is $H_1 : \beta_1 \neq 0$.

The bound test results of co-integration are listed in the table below. The calculated F- statistics (5.183631) value is greater than the upper bound value at all significance levels so the null hypothesis of no co-integration is rejected and we can implicitly accept the alternative hypothesis ($H_1 : \beta_1 \neq 0$). It implies that the variables are co-integrated and there exists a long run relationship. (See Table 4 below)

Table 4 ARDL Bounds Test		
Null Hypothesis: No long-run relationships exist		
Test Statistic	**Value**	**K**
F-statistic	5.183631	6
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

The F values of bound test shows the existence of the long run relationship and allow us to estimate the long run and short run results using ARDL model. The results of ARDL are listed below.

5.5 Long Run estimates of ARDL

After the application of bound test the next step is to run the ARDL model to find out the long run results. Equation 3.9 is the long run auto regressive distributed lagged model equation. The long run coefficients are estimated by keeping different criterions under consideration like (AIC), (SBC), (HQ) and Adjusted R-Square Criterion. All the models gave almost the same results so SBC criterion results are chosen because it gives the most penurious estimates because it minimized the loss of degree of freedom and selects the smallest lag length selection as much as possible.

The long run results of the ARDL model are listed in the table 5 below. Consumer price index is the dependent variable and the exchange rate is the main focused variable. The coefficient of the ER is 0.1575 and the results shows that it is significant with the t-stat value of 2.0789, it infers that one percent increase in exchange rate the consumer price will increase by 0.1575%. It shows that the fluctuations in the exchange rate are passes through to domestic price level but not the complete pass-through. The findings of our study resembles other studies such as Hyder & Shah (2004), Goldberg & Knetter (1997) and Menon (1995) and exchange rate positively affects the consumer prices is consistent with the empirical literature for example Choudhri & Hakura (2006),

Devereux & Yetman (2010), Shintani et al., (2013), Mohammed et al., (2015), Cheikh & Louhichi (2016).

Then we also use some very important control variables like Money supply, oil prices, Large scale manufacturing and public sector borrowing. The coefficient and the sign of all the control variables are according to the theory and shows significant impact on CPI. The coefficient of money supply is 0.3658 and significant with the t-stat value of 3.1576 which means that 1% increase in money supply there will be a 0.3658% increase in consumer price index of Pakistan. The results are in line with McCandless & Weber (1995), Hyder & Shah (2004), Rolnick & Weber (1994) and Lucus (1980), they concluded that an increase in money supply causes the increase in the inflation. Our results are also in line with Qayyum, A. (2006) who investigated the relationship among broad money supply and price level in Pakistan and comes with the conclusion that growth in money supply will cause the increase in domestic inflation.

Pakistan is an oil importing country and oil is the second main source of the energy production and used in production processes so the domestic price level follows the fluctuations in the oil price as well. We also found the positive and significant relationship between oil prices and domestic inflation, the coefficient of oil price is 0.0727 with the t-stat value of 3.1261, it implies that 1% increase in oil prices it increases the consumer price index by 0.0727%. According to Kiptui (2009), and Kargi (2014) the increase in oil price have long run and significant impact on CPI inflation that the increase in oil price will be translated

into consumer price index. More over our results are also consistent with other studies like Hooker (2002) and Castillo et al. (2010) who found that oil prices significantly impact the inflation and increase in oil price will increase the domestic price level.

Large scale manufacturing (LSM) has the negative and significant impact on the dependent variable which is consumer price index with coefficient value of -0.2140 along with t-stat value of 2.1122. It implies that 1% decrease in the LSM the CPI will increase by 0.2140%. these results are consistent with previous studies confirms the tradeoff between inflation and large scale manufacturing which includes Bans-Akutey et al., (2016), Siyakiya (2014) and Chaudhry (2013) reported this relationship in case of Pakistan.

Public sector borrowing is another control variable we have used in our study. The estimated coefficient is positive and have significant relationship with consumer prices. The coefficient of the public sector borrowing is 0.1264 with the t-stat value of 6.1605 which implies that 1% increase in PSB the consumer prices will increase by 0.1264% in Pakistan. Our results are consistent with Islam & Kabir (2012), Adnan et al., (2008), Khan et al., (2007) and Akçay et al., (2001) who found the positive and significant impact of public sector borrowing on the domestic inflation.

Table 5 Long Run Coefficients			
Dependent variable is natural log of CPI			
Independent Variables	**Coefficient**	**t-Statistic**	**Standard Error**
Exchange Rate	0.1575	2.0789	0.0757
Public Sector Borrowing	0.1264	6.1605	0.0205
Oil Prices	0.0727	3.1261	0.0232
Money Supply (M2)	0.3658	3.1576	0.1158
Large Scale Manufacturing Index	-0.2140	-2.1122	-0.1013
Intercept	-4.6264	-3.0234	1.5302
Diagnostic			
Normality	0.794131		
Serial Correlation	0.593206		
Heteroscedasticity	0.111078		
Functional Form	0.502904		

5.6 Short Run Estimates

The short run results are listed in table 6 which contains the coefficients of all the regressors along with the ecm value. The prior expectations about all the coefficients and the signs in the short run are fulfilled as exchange rate and other control variables shows exactly the same behavior as discussed in the literature. Though the short run coefficients of all the variables are less than the long run estimates so these findings indicate that in the long run the independent variables has

the stronger affect on the dependent variable which is consumer price inflation.

The thing which is more important in the short run results is the coefficient of the error correction (ECM) which shows the speed of adjustment towards equilibrium. The coefficient of ECM is mentioned in the table 6 which is statistically significant and with the correct sign which confirms the long run co-integration among the variables established earlier. The ECM value is -0.0853 which implies that 8% of the disequilibrium occurs in the short run is adjusted in the long run. The pass-through of exchange rate in the short run is 11% and significant against the 15.7% pass-through in the long run while both are incomplete as reported in the literature. All other independent variables are showing the significant and correct results with lower coefficient than the long run. (table 6).

Table 6 Short Run Coefficients			
Dependent variable is natural log of CPI			
Independent Variables	Coefficient	t-Statistic	Standard Error
Δ *Exchange Rate*	0.1120	2.4786	0.0452
Δ *Public Sector Borrowing*	0.0856	4.1744	0.0205
Δ *Oil Prices*	0.0654	2.8135	0.0233
Δ *Money Supply (M2)*	0.3016	2.6036	0.1158
Δ *Large Scale Manufacturing Index*	-0.2090	-2.0629	-0.1013
Error correction Term	-0.0853	3.9987	0.0213
Diagnostic			
R-Square	0.6825		
F-Stats	7.1519		
Durbin Watson	1.7326		
CUSUM	Stable		
CUSUMSQ	Stable		

5.7 Diagnostic Test

For the robustness of the results the model is passed through different diagnostic and stability tests. These tests include test for serial correlation, heteroscedasticity, functional form, normality and the CUSUM and CUSUMSQR test for the stability of the model. The 0.59 p-

value in the table 5 confirms that there is no serial correlation and p-value of 0.11 rejected the existence of Heteroscedasticity likewise p-values of normality and functional form satisfied the assumptions of the model. In the table 6 the 0.68 value of R-square tells us that the estimated model is explained well and again D-W test statistics also confirms that there is no serial correlation. At the end the CUSUM and CUSUMSQR approves that the estimated model is stable.

5.8 Long Run ERPT to Wholesale prices

Table 7 shows the results for the second regression in which the dependent variable is wholesale price index and the independent variable are same as in the first regression. Exchange rate has a positive and highly significant affect on wholesale price index. The coefficient of exchange rate is 0.509 along with t-stat value of 2.582, it means that if exchange rate depreciated by 1% the wholesale price index will increase by 0.509%. So the exchange rate pass-through to wholesale price index is 0.509% which means that any change occurs in exchange rate 0.61% of that change will be transmitted into wholesale price index.

The results clearly depicted that exchange rate fluctuations do affect the wholesale price index of Pakistan though it is not complete pass-through of exchange rate but a significant affect on wholesale price index. It is evident from the literature that exchange rate fluctuations are pronounced in wholesale prices. An and Wang (2011), Sek and Kapsalyamova (2008) and Draca (2009) concluded that exchange rate

fluctuations affect the wholesale price index but the exchange rate pass-through is not complete.

Money supply, oil prices and public sector borrowing all are positive and have significant impact on wholesale price index 3.014 value of t-stat. The coefficient of money supply is 0.934 which means that 1% increase in money supply there will be a 0.934% increase in wholesale price index of Pakistan. The results are in line with McCandless and Weber (1995), Rolnick and Weber (1994) and Lucus (1980), they concluded that an increase in money supply causes the increase in the inflation. The coefficient of oil price is 0.201 which is significant with t value of 3.640, it implies that 1% increase in oil prices it increases the wholesale price index by 0.201%. The wholesale price index of Pakistan contains the commodities which are more responsive to oil price changes and imported goods like machinery.

The estimated coefficient of public sector borrowing is positive and have significant relationship with wholesale prices. The coefficient of the public sector borrowing is 0.285 with the t-stat value of 4.721 which implies that 1% increase in PSB wholesale prices will increase by 0.285% in Pakistan. Our results are consistent with Islam & Kabir (2012), Adnan et al., (2008), Khan et al., (2007) and Akçay et al., (2001) who found the positive and significant impact of public sector borrowing on the domestic inflation. The coefficient of the large scale manufacturing index is positive and insignificant with the coefficient value of 0.245 along with t value of 1.118.

Table 7 Long Run Coefficients			
Dependent variable is natural log of WPI			
Independent Variables	Coefficient	t-Statistic	Standard Error
Exchange Rate	0.509	2.582	0.197
Public Sector Borrowing	0.285	4.721	0.060
Oil Prices	0.201	3.640	0.055
Money Supply (M2)	0.934	3.014	0.310
Large Scale Manufacturing Index	0.245	1.118	0.219
Intercept	-15.22	-3.579	4.251
Diagnostic			
Normality	0.6711		
Serial Correlation	0.1476		
Heteroscedasticity	0.2348		
Functional Form	0.7253		

5.8 Diagnostic Test

For the robustness of the results the model is passed through different diagnostic and stability tests. These tests include test for serial correlation, heteroscedasticity, functional form and normality test. The 0.1476 p-value in the table 7 confirms that there is no serial correlation and p-value of 0.2348 rejected the existence of Heteroscedasticity

likewise p-values of normality and functional form satisfied the assumptions of the model.

Chapter 6

Conclusion

A size able strand of literature confirms that the exchange rate depreciations are passes through to domestic price level with different magnitudes across the countries (developed and developing). If we look at exchange rate depreciation history of Pakistan, over the last 30 year's exchange rate started depreciating from 22.13 rupees per dollar to 155.25. While in the last 2 years it depreciated approximately 30% from 104 to 155 along with increase in the consumer price inflation. There is a school of thought who argued that the increase in inflation is due to the depreciation of exchange rate so this motivated us to examine the exchange rate pass-through to consumer prices in Pakistan which was missing in the literature related to Pakistan.

To empirically analyze the ERPT in Pakistan monthly data have been used from January 1991 to November 2019. The bound testing approach of ARDL is used to find out the co-integration among the variables which confirms the existence of the long run relationship between exchange rate and consumer price inflation. The pass-through of exchange rate to consumer price inflation is 15.7% in the long run which is statistically significant implies that the depreciation of exchange rate exerts 15.7% pressure on consumer prices in the long run but 50.9% in wholesale prices as suggested by the extensive empirical literature. Likewise, for the short run the results of the ECM also shows the existence of short run relation between the exchange rate and consumer inflation. The pass-through of the exchange rate is 11.2% in

the short run. While oil prices contribute 7%, public sector borrowing contributes 12.6%, money supply contributes 36% and large scale manufacturing contributes 21% to the domestic price level in the long run and the short run results are lower than the long run but follows the same path.

Policy Implications

We have seen that the ERPT is low and incomplete but significant both in the short run and long run as concluded in the literature. The low magnitude of the ERPT suggest that the depreciation is not directly affecting the consumer prices in Pakistan immediately. Therefore, the argument of policy maker that the abrupt and large depreciation will generate the inflationary pressure on the consumer prices is not valid. Therefore, this low pass-through as in the conclusion have some very important policy recommendations that the exchange rate should be mainly determined by the market instead of central bank interventions.

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